UNITED NATIONS ENVIRONMENT PROGRAMME

REGIONAL OFFICE FOR ASIA AND THE PACIFIC

CONTRIBUTIONS TO THE MANAGEMENT OF TOXIC CHEMICALS AND HAZARDOUS WASTES IN THE ASIA-PACIFIC REGION and REPORT OF THE FIRST NETTLAP RESOURCES DEVELOPMENT WORKSHOP FOR EDUCATION AND TRAINING AT TERTIARY LEVEL IN TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT

Bangkok, Thailand

September 28 - 30, 1993

NETWORK FOR ENVIRONMENTAL TRAINING
AT TERTIARY LEVEL IN ASIA AND THE PACIFIC
(*NETTLAP*)

NETTLAP PUBLICATION No. 5
1993

Note: This document has been edited by John E. Hay and Norman G. Thom as a contribution to the *Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP),* a project of the United Nations Environment Programme (UNEP). The preparation of this document was carried out under project FP/3101-92-01 (3020).

For bibliographic purposes this document may be cited as:

Hay, J.E. and N.G. Thom: Contributions to the Management of Toxic Chemicals and Hazardous Wastes in the Asia-Pacific Region and Report of the First NETTLAP Resources Development Workshop for Education and Training at Tertiary Level in Toxic Chemicals and Hazardous Waste Management. UNEP/ROAP Network for Environmental Training at Tertiary Level in Asia and the Pacific, Publication No. 5. UNEP, 1993, 342pp.

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John E. Hay
and
Norman G. Thom
(Editors)

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NETTLAP PUBLICATION No. 5
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PREFACE

The *Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP)* is a UNEP initiative designed to enhance the capacity of tertiary institutions in the Asia-Pacific region to meet the education and training demands associated with efforts to achieve sustainable development in the region. The Network comprises key tertiary-level environmental institutions, educators and trainers in the Asia-Pacific region. It is designed to develop and apply both innovative and established methods in environmental training and to prepare and disseminate curriculum and content guidelines, instructional materials and learning systems. NETTLAP also undertakes to transfer the products of programmes and projects implemented by UNEP and other organizations into the tertiary institutions of the region and thence into government, the private sector and the community at large.

One of the key activities in NETTLAP is the Resources Development Workshop where experienced educators and trainers from tertiary institutions in the region join with experts from UN and other organizations to develop a variety of materials and other resources which will assist tertiary institutions to enhance the quality and relevance of their environmental education and training activities. The first Resources Development Workshop for education and training at tertiary level in toxic chemicals and hazardous wastes represents an important initial step for NETTLAP.

Many organizations and individuals came together to ensure the successful implementation of the workshop. Considerable support was provided by the UNEP's Regional Office for Asia and the Pacific and by the Regional Coordination Unit for the East Asian Seas Action Plan. Staff members provided substantial assistance prior to and during the workshop and also contributed to the production of this volume. The cooperation and assistance of UNEP's Environmental Education and Training Unit was also critical to the ultimate success of the workshop.

Awareness of the range of information, tools and methodologies available to educators and trainers addressing topics in toxic chemicals and hazardous waste management was increased by the involvement of the Secretariat for the Basel Convention (UNEP/SBC), the International Register for Potentially Toxic Chemicals (UNEP/IRPTC), the United Nations Institute for Training and Research (UNITAR) and the Industry and Environment Programme Activity Centre (UNEP IE/PAC). The support and participation of these programmes expanded the breadth, relevance and professionalism of the workshop.

SUMMARY

The *Network for Environmental Training at Tertiary Level in Asia and the Pacific* (NETTLAP) held its first Resources Development Workshop for education and training at tertiary level in toxic chemicals and hazardous wastes (TCHW) in Bangkok, Thailand between September 28 and 30, 1993. The workshop participants were asked to elaborate the curriculum objectives and resulting curriculum guidelines and content related to TCHW education and training activities at the tertiary level in the Asia-Pacific region. The participants were also requested to develop practical and focused instructional materials and to identify and demonstrate appropriate learning aids to support implementation of these activities at the tertiary level.

Fifteen participants from East and Southeast Asia and the Pacific and five resource persons were identified and invited to participate in the workshop. A formal evaluation of the workshop indicates that the 15 participants significantly enhanced their understanding of and familiarity with education and training methods related to TCHW. They are now equipped with relevant instructional materials and aids such as the ability to access data bases (e.g. IRPTC, ICPIC) and use computer aided self learning packages. The five resource persons, including the NETTLAP Thematic Network Coordinator for TCHW, now have an increased awareness of the needs and opportunities for training tertiary level staff in methods and materials related to education and training in TCHW.

The present volume is one way in which the diverse experience and views on curriculum objectives, guidelines and content will be disseminated to those involved in education and training activities related to TCHW at the tertiary level in the Asia-Pacific region. Case studies and other instructional materials which can support these activities are also presented.

The volume also contains a number of recommendations prepared by the workshop participants. These focus on the role and future activities of NETTLAP and of its members. Amongst other activities, NETTLAP is encouraged to facilitate the access for staff of tertiary institutions to relevant materials, methodologies and tools developed by UN bodies and specialized agencies.

The results of a formal evaluation of the workshop are included as an Appendix. As an encouragement to participants to apply the information and understanding they gained at the workshop upon returning to their home countries and institutions, they were given an opportunity to obtain a formal Certificate of Completion. This involved producing a teaching package of relevance to teaching and training in TCHW that was of acceptable standard. Official documentation demonstrating that the package had been used when teaching a course related to TCHW at a tertiary institution in their home country was also required before the Certificate was issued. This would likely be achieved by conducting a course in which the curriculum guidelines, instructional materials and learning aids developed or demonstrated at the workshop were applied.

RECOMMENDATIONS

I. On Role/Activities of the NETTLAP

1.1 NETTLAP should facilitate the build up of a capacity in tertiary education that will contribute to a regional responsibility, and a regional identity, in regard to the environmental challenges of toxic chemicals and hazardous wastes (TCHW).

1.2 NETTLAP should promote the preparation/publication/dissemination of teaching materials related to TCHW and tailored to the needs of the region, including translation in different languages in the region.

1.3 NETTLAP should, as a UNEP agent, promote awareness and facilitate dissemination of and access to other relevant materials developed by UN bodies and specialized agencies in order to assist tertiary institutions in the region.

1.4 NETTLAP should facilitate the development and implementation of courses and programs on environmental management (both specialized and generic) which involve links between tertiary institutions in the region, particularly between developing and developed countries.

1.5 NETTLAP should facilitate the development and implementation of courses and programmes on environmental management, as listed in 2.2 (over).

II. On Role/Activities of the Individual and Institutional Members

2.1 The participants endorse the integration of toxic chemicals and hazardous wastes management and prevention in the curricula of tertiary education. Towards this end, the participants agreed to help in promoting cooperation among the participating individuals and institutions in the region, specifically in the following activities:

(a) development of educational tools using learning materials and resources that are suited to the requirements in the countries within the region;

(b) adoption of innovative teaching methods such as the use of Computer Assisted Learning and Simulation Processes;

(c) development of case studies to demonstrate the various management options for TCHW, with due attention given to community-defined needs and capabilities;

(cont.)

(d) dissemination and use of relevant information materials such as the Basel Convention and APELL guidelines.

2.2 A high priority should be given to facilitating and catalyzing courses and programmes which:

(a) promote the training of people at sub-degree levels, such as certification of treatment plant operators and government employees;

(b) promote the training of graduates, particularly through programs in science and engineering which build the capacity to implement solutions;

(c) promote the training of post-graduate specialists in environmental management, particularly in TCHW;

(d) promote continuing education in TCHW;

(e) promote the ongoing professional development of staff in tertiary institutions who are involved in environmental education and training.

2.3 Specifically, students at tertiary institutions in the region should be exposed to the three areas of concern in TCHW namely, problem identification, solution identification and solution implementation. Innovative approaches to teaching and learning should be used which include case studies, project work, seminars, plant visits and field trips.

III. Networks, Institutions and Organizations

3.1 NETTLAP should establish linkages with other networks within the region for the purpose of assisting in the exchange of faculty members and students between developing and developed countries.

3.2 UNEP should assist NETTLAP to establish and maintain linkages with relevant UN bodies and specialized agencies operating in the region.

IV. Evaluation/Monitoring

4.1 NETTLAP should ensure that these recommendations are reviewed and evaluated in subsequent workshops.

TABLE OF CONTENTS

INTRODUCTION

In the Asia-Pacific region there is widespread use and abuse of toxic chemicals, large amounts of hazardous wastes are generated and subsequently poorly managed and there are many hazardous operations in industry and elsewhere. Coupled with this are large populations vulnerable to the potentially toxic and lethal consequences of exposure to these materials and processes and environments which are particularly sensitive to toxic chemicals and wastes. This situation is of great concern and calls for vigorous responses, both preventive and remedial.

Training and education are a fundamental component of these responses. The development of appropriate resources to support such training activities is a matter of high priority. NETTLAP held its first Resources Development Workshop for education and training at tertiary level in toxic chemicals and hazardous wastes (TCHW) in Bangkok, Thailand between September 28 and 30, 1993.

The workshop objectives were as follows:

- to elaborate the curriculum objectives and resulting curriculum guidelines and content relevant to education and training activities related to toxic chemicals and hazardous wastes at the tertiary level in the Asia-Pacific region

- to develop practical and focused instructional materials to support the implementation of the specific education and training activities identified above

- to identify and demonstrate instructional aids used to support the teaching and training activities identified above.

Participants in the workshop were staff members in tertiary institutions with responsibilities for courses on TCHW management or related topics. Participants are expected to incorporate the knowledge and practical expertise they gained at the workshop into their regular teaching, thereby enhancing the TCHW awareness, skills and expertise of graduates. This process is being aided by awarding participants a Postgraduate Certificate of Completion. The Certificate will be awarded only to those participants who achieve an acceptable standard in the production of a package which supports teaching and training activities in TCHW and incorporates information and tools acquired or presented at the workshop. Participants will also be required to submit official documentation demonstrating that they have used the package when teaching a course related to TCHW at a tertiary institution in their home country.

During the workshop participants were also encouraged to offer short courses for senior staff in government and industry who have responsibilities related to TCHW. In addition, university staff are often themselves involved in advising on and assisting with the development and implementation of policies related to toxic and hazardous substances. Thus, despite focussing on a relatively small target group, the information and practical skills acquired at the workshop will be transferred rapidly to a large and influential constituency.

But the Resources Development Workshop is also designed to facilitate the preparation of instructional materials and learning aids which can be packaged for wide distribution to tertiary institutions in the region. This is where the full effectiveness of the Resources Development Workshop is revealed. The present volume contributes to this dissemination process. It contains the views of experienced tertiary level environmental educators and trainers from East and Southeast Asia and the Pacific. A diverse range of topics related to the teaching of courses dealing with toxic chemicals and hazardous waste management are included. These cover the spectrum from curriculum objectives to descriptions of resource materials and learning systems. The volume also includes, as Appendices, the workshop programme, a list of participants and resource persons, the results of the workshop evaluation and a selected bibliography on industrial and hazardous waste management.

At the conclusion of the workshop each participant completed a formal evaluation of the workshop. Detailed information on the evaluation process and results is included in Appendix III. The results show that the majority of the participants viewed the workshop as:

- very good in satisfying the participants' personal needs for professional development;
- very good regarding the printed materials provided;
- excellent with respect to organization and execution;
- very good regarding usefulness of information, methods and instructional tools;
- excellent in terms of the likely usefulness of the printed and other materials for future professional activities;
- very good in terms of an overall evaluation of the workshop;
- very good to excellent regarding usefulness to a tertiary level educator; and
- very good regarding the usefulness of the software and databases demonstrated in the workshop.

Numerous participants stated that the most useful and interesting aspects of the workshop were the increased awareness of, and practical experience with, software packages for education and training and computer data bases on such topics as potentially toxic chemicals and cleaner production.

TOXIC CHEMICALS AND HAZARDOUS WASTES: IDENTIFYING TRAINING OPPORTUNITIES

Norman Thom
Environmental Science
University of Auckland
New Zealand

I. Introduction.

The United Nations Environmental Programme (UNEP) recognizes the need for trained people to address environmental issues of concern in the countries of Asia and the Pacific. It has therefore moved to facilitate communication amongst educators within the region and the Network for Environmental Training at the Tertiary Level in Asia and the Pacific (NETTLAP) has been established for this purpose. Thematic networks are being developed to reflect the significant environmental management problems existing within the region. One of the three thematic networks which have been established acts as a communicating linkage for educational institutions and individuals providing training in the management of toxic chemicals and hazardous waste.

Progress in the prevention and control of environmental effects arising from toxic chemicals and hazardous wastes is contingent on the availability of people with appropriate training in a wide range of disciplines. Opportunities for such training can be identified by reviewing the way in which the control of these materials has evolved over time, the comprehensive management systems that have resulted and the international activities that are in operation to provide support and guidance.

Substances are regarded as hazardous because of characteristics they may possess - for example by being explosive, flammable, poisonous, corrosive, radioactive or because of other direct or indirect adverse effects that they may have on the environment. Toxicity, particularly if it is related solely to humans, is too restrictive when considering potential for environmental hazards. Toxic chemicals and hazardous wastes should therefore be regarded as hazardous substances and their management and control should at least be consistent.

The criteria for determining hazard classes are generally based on results from scientific testing. The introduction of a system for identification and classification thus implies the availability of local people who have been trained in the techniques involved.

Opportunities for training can be identified at three levels.

First there is the need to develop awareness, especially in current and potential future decision makers, of the issues involved and the options available to address these.

Next is the need to train local specialists with the capabilities required for the development and ongoing support of management and control programmes. A wide range of disciplines are involved and these specialists will be required by both public and private organizations.

Finally there is the requirement for ongoing training to provide the linkage between managers and supporting technologists administering current control programmes, and the providers of the research and development which extend the knowledge base on hazardous characteristics and management technologies.

II. Evolution in the Control of Hazardous Substances.

The control of hazardous substances has evolved in a common manner in many countries. In specific cases controls may vary in comprehensiveness and may be still evolving.

Initially there is a focus on the management of those substances which clearly exhibit direct harmfulness to human health. Typically this gives rise to control measures for poisons and explosives, and the coverage extends into food additives, pharmaceuticals and pesticides.

This is followed by the management of substances which are regarded as having the potential to give rise to adverse environmental effects or otherwise indirectly affect public health. Such concerns have given rise to pollution control and occupational health and safety measures. Normally associated with these are emission limits and exposure values.

As communities develop, concerns relating to the potential for emergencies such as chemical incidents and the associated risk of direct and indirect health and environmental effects are often expressed. These concerns may be addressed by restrictions on the location or zoning of facilities associated with hazardous substances, such as in manufacturing, use, storage or disposal. Many communities prepare for such incidents by establishing a coordinating group consisting of emergency services, local authorities and other specialists. Emergency incident response planning thus is facilitated, rehearsed and updated.

A further stage is when consideration is given to the effectiveness of previous control measures and the environmental contamination that may have resulted from hazardous substances previously used. This gives rise to specific chemical product control reviews which may, for example, cover pesticides, food additives and pharmaceuticals, the use of which was previously regarded as acceptable. It also allows for evaluation and management of sites that may have become contaminated by previous activities.

Many countries are recognizing the need for controlling the use of substances that may result in global environmental damage. A prime example would be the use of substances such as chlorofluorocarbons which result in the depletion of stratospheric ozone.

Finally there is the recognition that effective management of hazardous substances requires a life cycle or " cradle to grave" approach in that the environmental implications of that substance during all stages through raw materials, manufacture, use and final disposal are considered. Emphasis is less on the safe use of hazardous substances and processes, and more on questioning the need to use such substances and the use of safe substances in processes which have minimal environmental impact.

Training opportunities exist at all stages during the evolution of control measures.

III. International Initiatives In the Management of Hazardous Substances.

The following examples are given of international activities relating to the management of hazardous substances.

- International Register of Potentially Toxic Chemicals (IRPTC).	UNEP, 1976
- London Guidelines for the Exchange of Information on Chemicals in International Trade (London Guidelines).	UNEP, 1987
- The Prior Informed Consent Principles, an addition to the London Guidelines.	UNEP, 1989
- International Code of Conduct on the Distribution and Use of Pesticides.	FAO, 1985
- The Basel Convention on the Transboundary Movements of Hazardous Wastes and their Control.	UNEP,1989
- International Programme on Chemical Safety (IPCS).	UNEP, WHO, ILO
- International Cleaner Production Programme	UNEP IE/PAC, UNIDO

There are training opportunities in developing awareness of these activities and the provision of support staff at international, regional and local levels.

IV. Comprehensive Management of Hazardous Substances.

A system for the comprehensive management and control of hazardous substances at national or local levels should incorporate all of the following activities:

- The provision of information on hazardous substances and their alternatives.

- Facilities for identification and classification.

- Hazard evaluation and risk assessment capabilities.

- Standards for packaging and labelling, including the requirement for materials safety data sheets.

- The proper management of transportation and storage of these substances, including maintenance of manifests and inventories.

- An effective system for the evaluation of technologies and processes which manufacture or use hazardous substances. This should include the capability to determine whether alternative cleaner products, processes and services are available and viable for specific applications.

- Programmes to ensure the health and safety of all people involved with the handling, production and use of hazardous substances.

- An environmental management programme which ensures that emissions, effluents and other wastes resulting from the manufacture or use of these substances are minimized, residues effectively controlled and disposal methods are appropriate.

- Documentation of emergency procedures aimed at safeguarding health and the environment in the event of incidents involving hazardous substances. These procedures should coordinate the efforts of all emergency services, be regularly rehearsed and be kept up to date.

- Public education on the safe use and handling of hazardous substances in wider use and the availability of alternatives.

- Regular re-evaluation of past management and control practices in light of improved knowledge relating to the environmental effects of hazardous substances, thus allowing for the identification of areas of contamination.

- A continuing review of the health and environmental implications of the continuing use of these substances and whether the benefits accruing outweigh the risks involved, or whether such benefits might be achieved using substances and methods involving less hazard.

- Comprehensive legislation and effective enforcement.

- Effective economic incentives and disincentives.

Substantial training opportunities arise in the development and ongoing support of a comprehensive management programme for hazardous substances incorporating these elements. It will be recognized that such training will involve a wide range of disciplines and will vary from the general to highly specialized levels.

V. Conclusion.

Concerns relating to hazardous substances within countries of the Asia and Pacific region will result in the continuing evolution of management and control measures as is occurring elsewhere. These measures have significant training implications.

Any programme for the management of hazardous substances will require people with the necessary levels of skill and understanding for its development and ongoing support. As decision makers become more aware of the potential for adverse health and environmental effects that may be associated with these materials there will be expectation that appropriately trained specialists will be locally available to develop and maintain the necessary management and control systems.

International agencies are available to assist by providing information and guidelines on good management practices. These agencies also require trained specialists to maintain their programmes and to assist the development of support activities at national levels.

A comprehensive management and control system requires trained specialists from a wide range of disciplines.

Matching these requirements is a challenge to educators, particularly those at the tertiary level, throughout Asia and the Pacific.

The establishment of the Thematic Network for Toxic Chemicals and Hazardous Wastes, as part of UNEP's NETTLAP activities, will provide considerable support towards meeting this challenge.

VI. Bibliography

UN — Recommendations on the Transport of Dangerous Goods: (ST/SG/AC.10/Rev 6), 1989.

UN — United Nations Conference on Environment and Development, Agenda 21, Chapter 19. "Environmentally Sound Management of Toxic Chemicals". June 1992.

UNEP — London Guidelines for the Exchange of Information on Chemicals in International Trade. 1987, and amendments 1989.

UNEP — The Basel Convention on the Transboundary Movements of Hazardous Wastes and their Control. 1989.

UNEP — Guidance on Chemical Management Legislation : Overview, UNEP/PIC/WG,1/3/2. Revised Draft, 1993

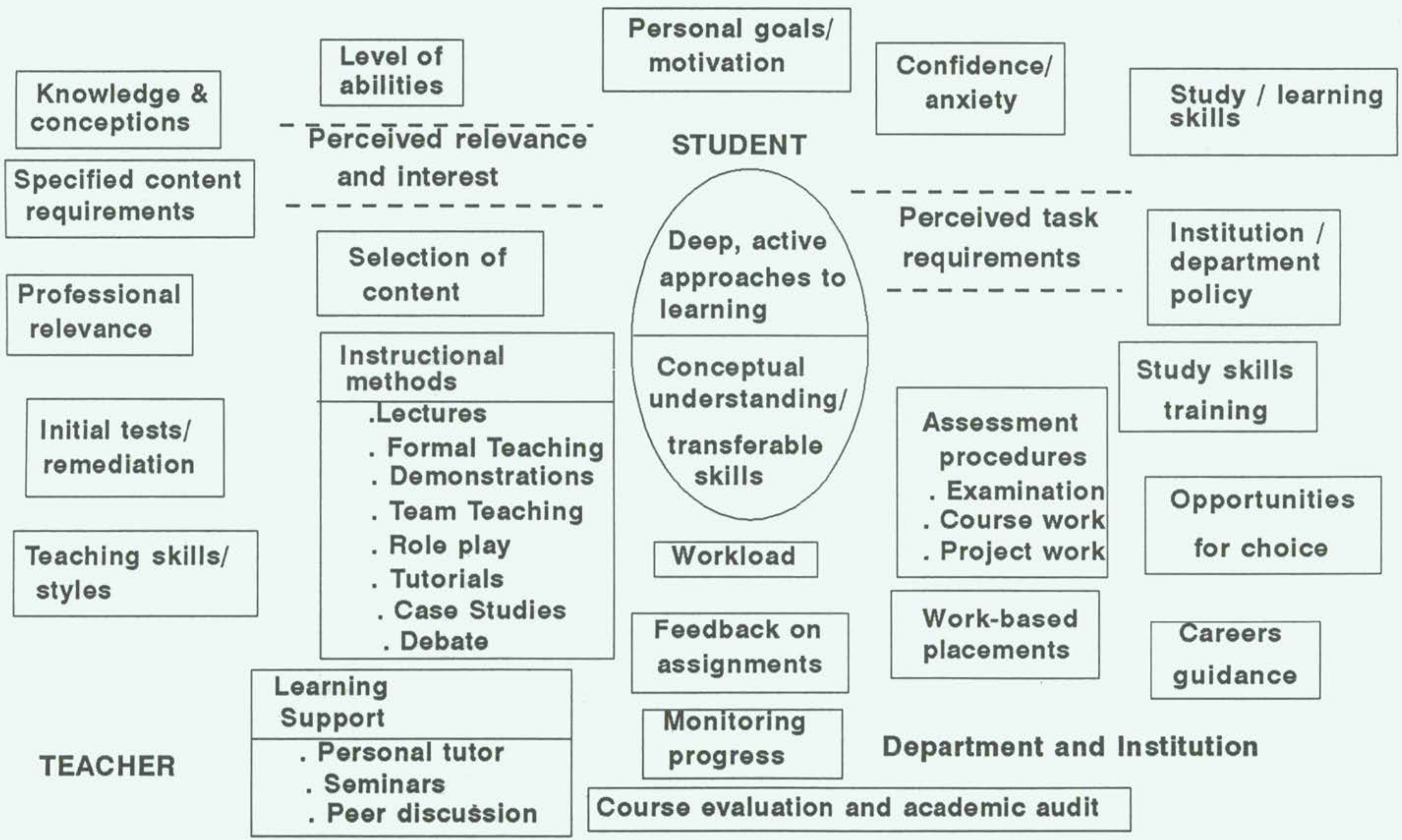
TEACHING AND TRAINING RELATED TO TCHW

C. Visvanathan
Environmental Engineering Programme
School of Environment, Resources and Development
Asian Institute of Technology
Bangkok, Thailand

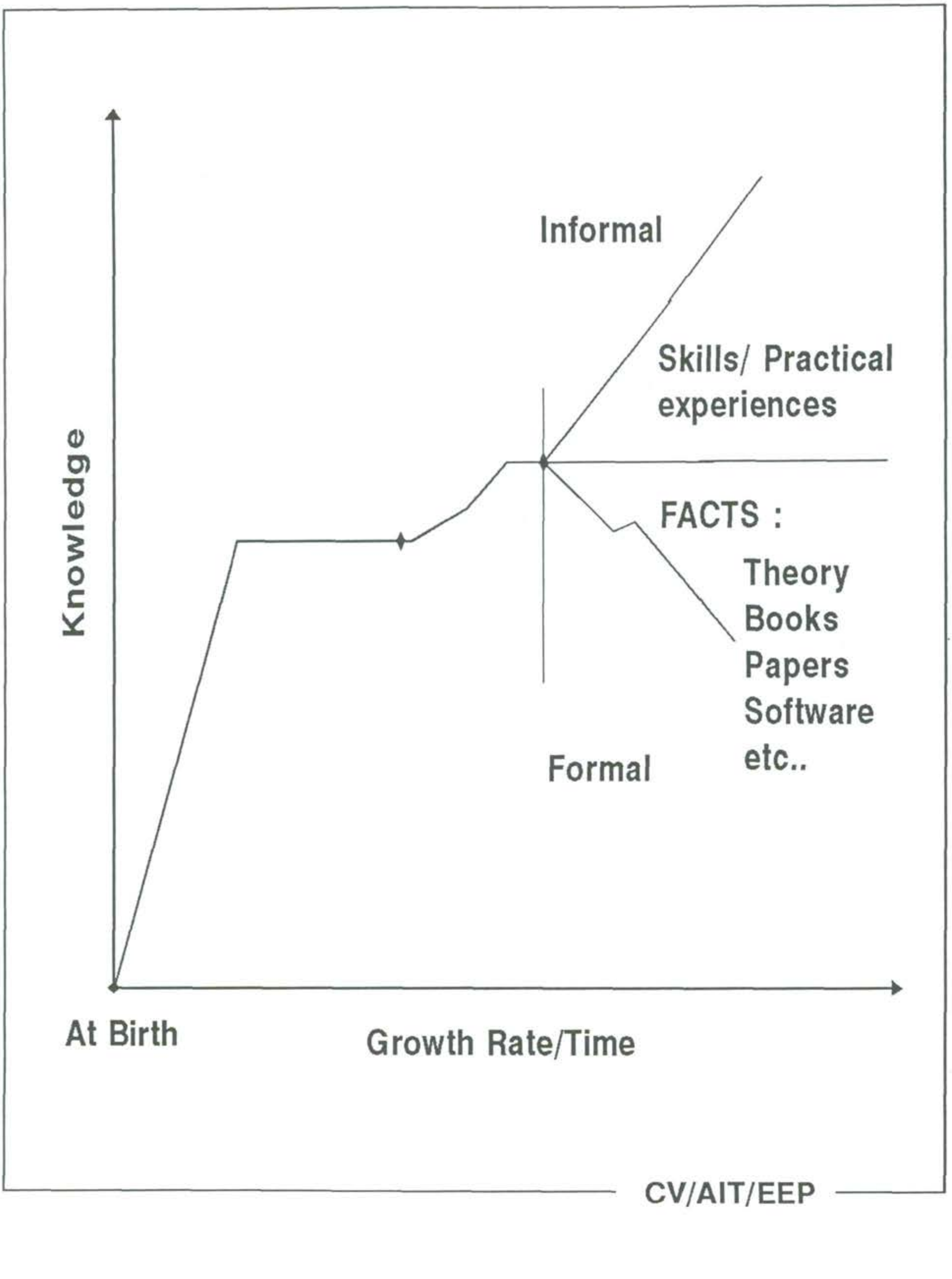
In his presentation, Dr Visvanathan addressed present trends in the teaching of courses related to toxic chemicals and hazardous wastes (TCHW), the teaching tools and methods which are used, and the training programmes which are offered.

His talk was based on a series of overhead transparencies. They are self-explanatory. The transparencies are reproduced on the following pages, for the benefit of the interested reader. The form in which the material is presented means that it is readily reproduced for use in other teaching and training programmes.

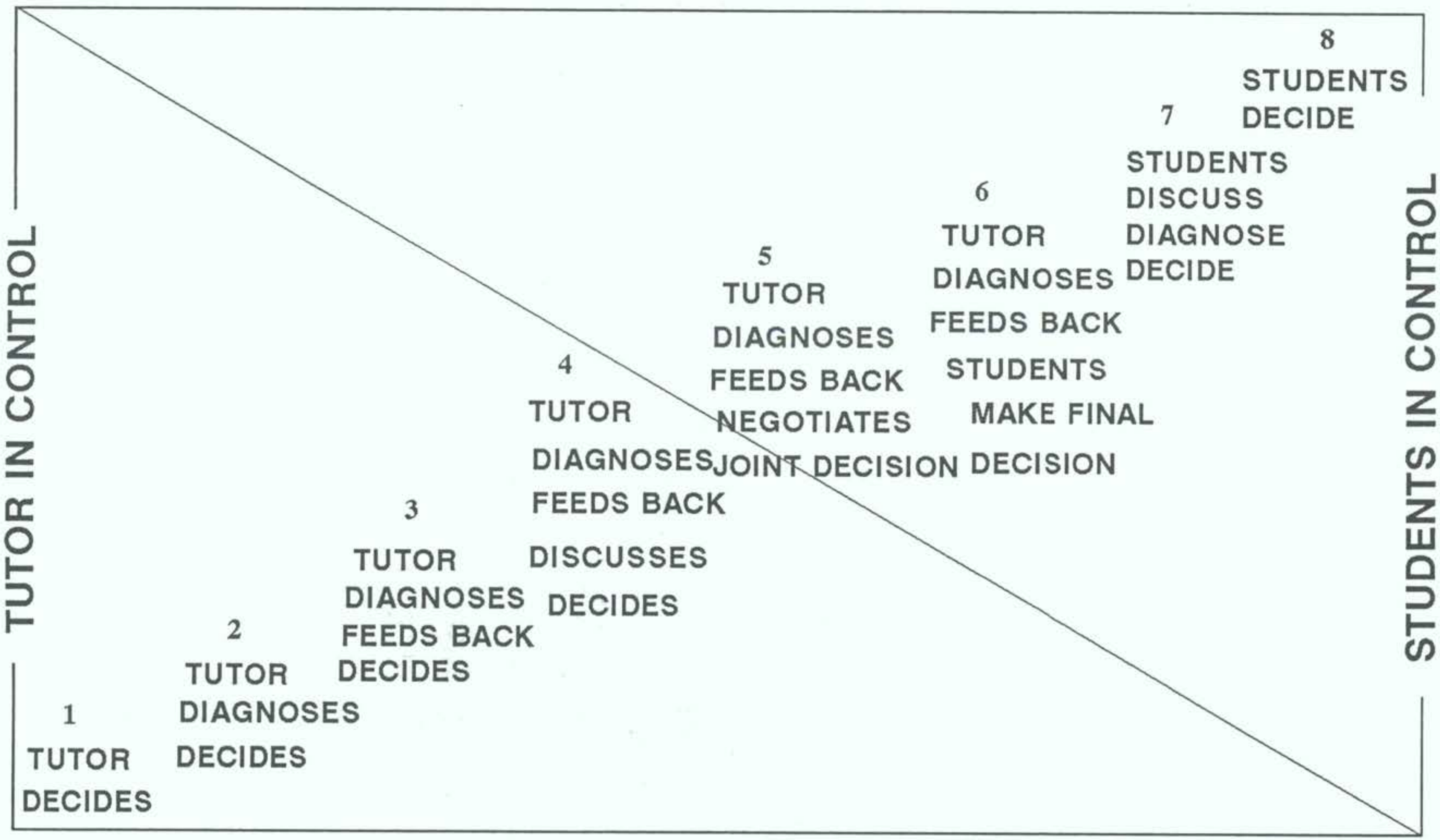
A CONCEPTUAL MAP OF A TEACHING-LEARNING SYSTEM IN EDUCATION



CV/AIT/EEP


Informal
Skills/ Practical
experiences
FACTS :
Theory
Books
Papers
Software
etc..
Formal
Knowledge
At Birth
Growth Rate/Time
CV/AIT/EEP

DECIDING WHAT TO TEACH



NEGOTIATING A SYLLABUS - A Continuum of Possibilities

CV/AIT/EEP

WHAT ARE EMPLOYERS LOOKING FOR ?

★ The ability to communicate, including active listening skills and presentational skills.

★ Planning skills, particularly personal planning and time management.

★ Team work and leadership skills, that is the ability to work with and through others.

★ Specific abilities and aptitudes, particularly computer literacy and the ability to understand how technology can be applied within specific roles.

★ Drive or achievement skills, that is the ability to review issues systematically and make informed judgements.

★ An orientation to change, that is the ability to cope with the demands of a dynamic environment.

★ A willingness to continue learning, involving knowing how to learn and a commitment to life-long development.

WHAT ARE STUDENTS LOOKING FOR ?

★ ENHANCED CAREER OPTIONS

★ INCREASED INDEPENDENCE

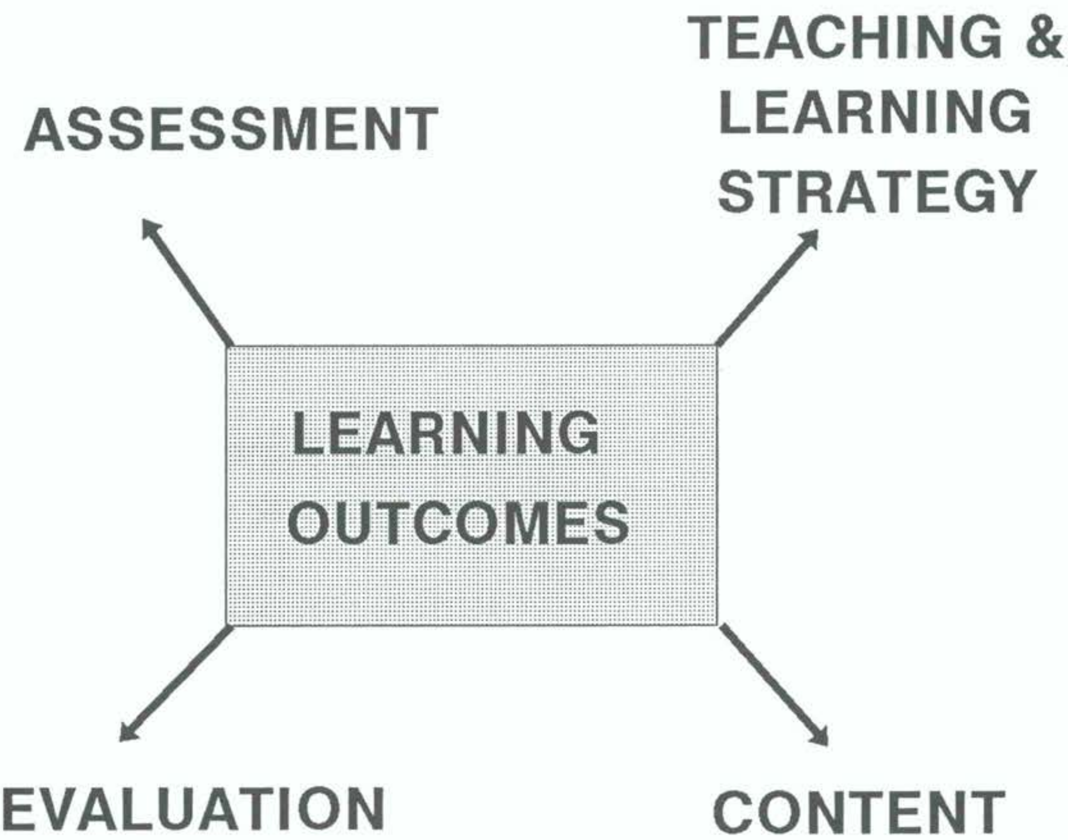
★ INCREASED SELF ESTEEM

★ ACQUIRE A BROAD BASE OF SKILLS/ TECHNIQUES

★ INCREASED KNOWLEDGE

★ CRITICAL THINKING

COURSE PLANNING : A SYSTEMATIC APPROACH

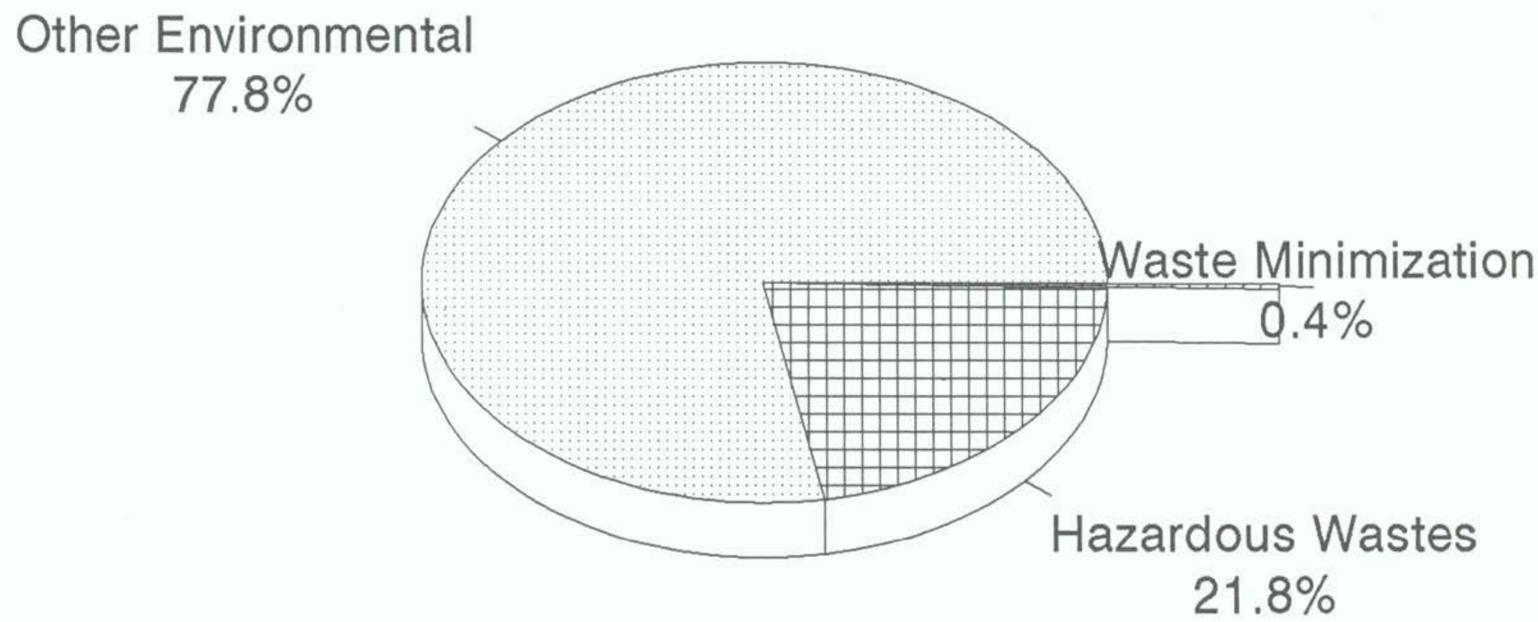


"COURSE PLANNING SHOULD BE MARKED BY COHERENCE AND CONGRUENCE"

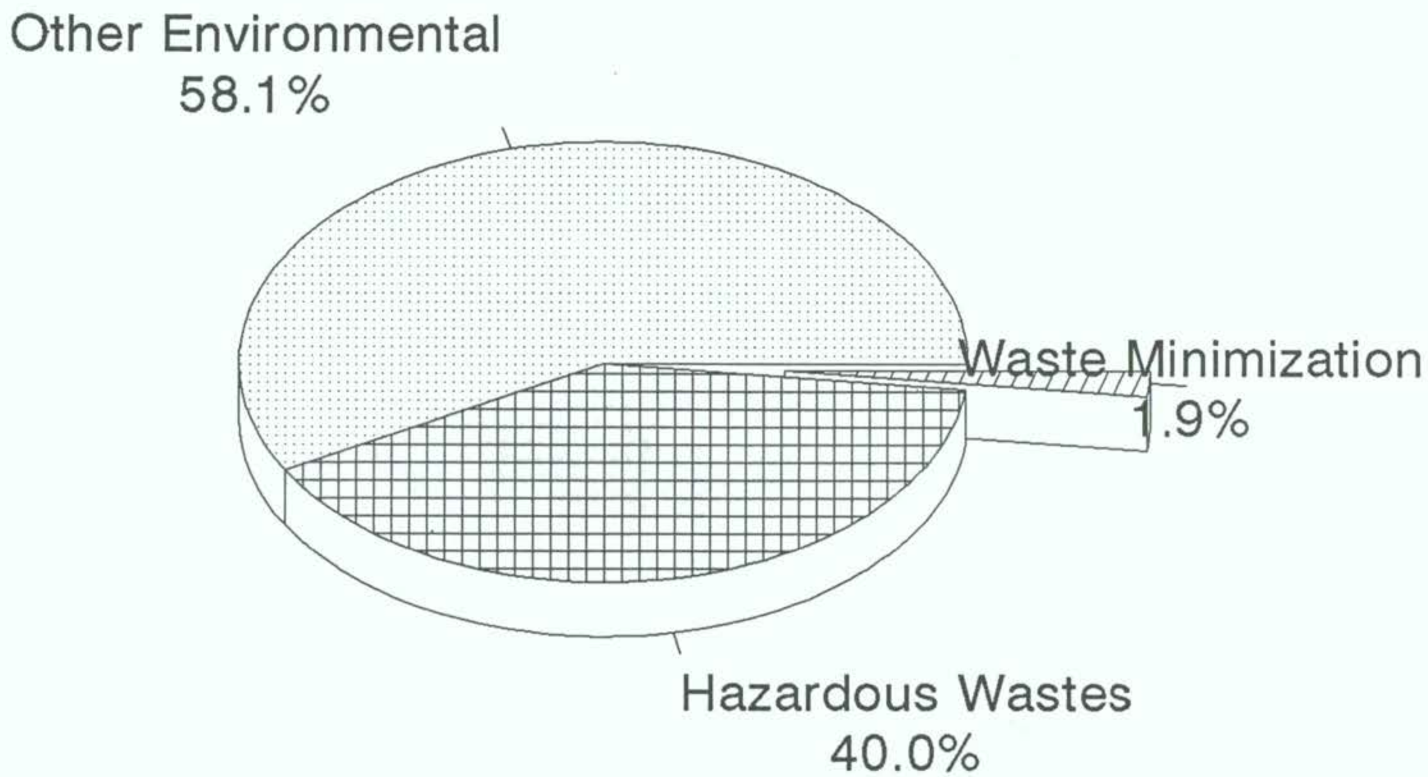
ROLE OF THE LECTURER

TEACHER	→	(Learning theory, methods, skills)
RESEARCHER/ SCHOLAR	→	(Subject and educational research)
MANAGER	→	(People, resources e.g. team leader, year tutor)
ADMINISTRATOR	→	(Procedures e.g. admissions, exams)
COUNSELLOR	→	(Students' needs e.g. academic & pastoral)
ASSESSOR	→	(Judge, evaluator, appraiser)
COURSE DESIGNER	→	(Course planning & review)
ENTREPRENEUR	→	(Marketing, industrial, liaison, external relations)
PERSON	→	(Interpersonal skills, self management)
CONSULTANT	→	
SUBJECT EXPERT	→	

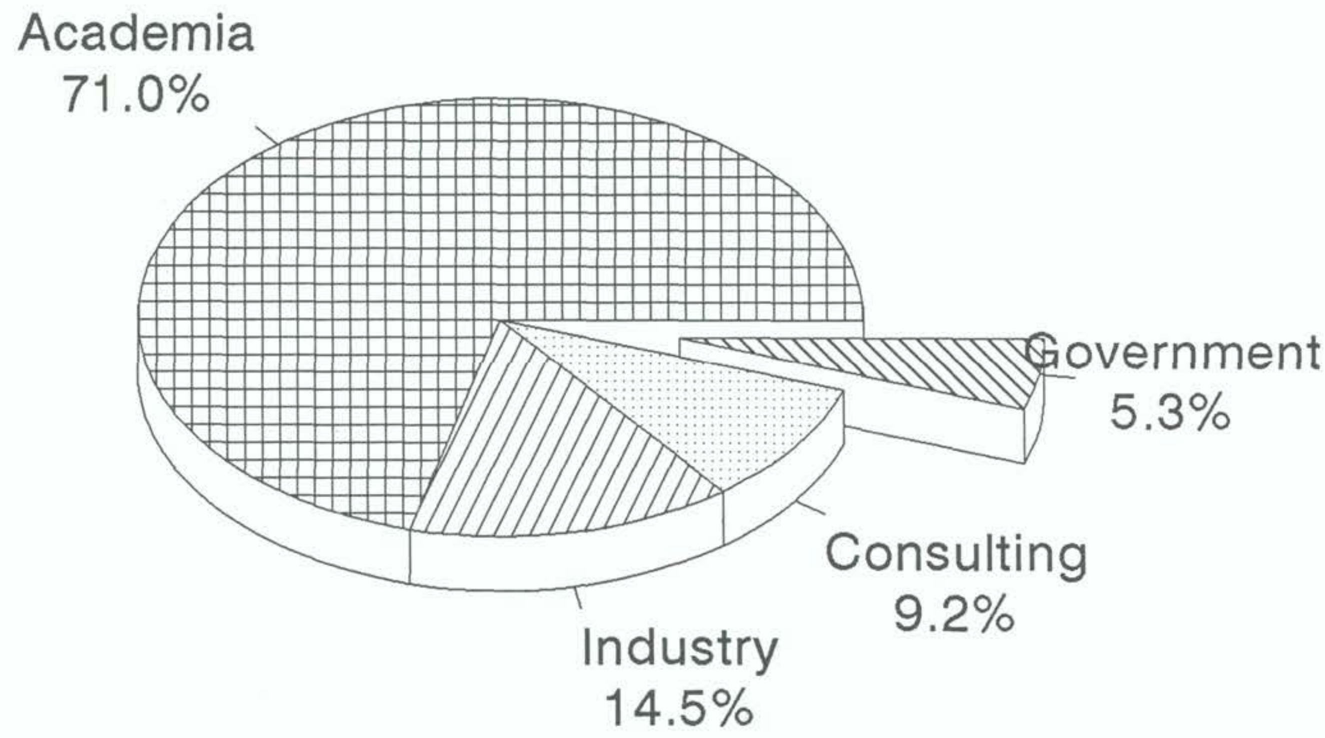
CV/AIT/EEP



Faculty Publications in the Environmental Field
in the US in the year 1986-1988.



Overall Topical Environmental Experience
Of University Faculty in the US.



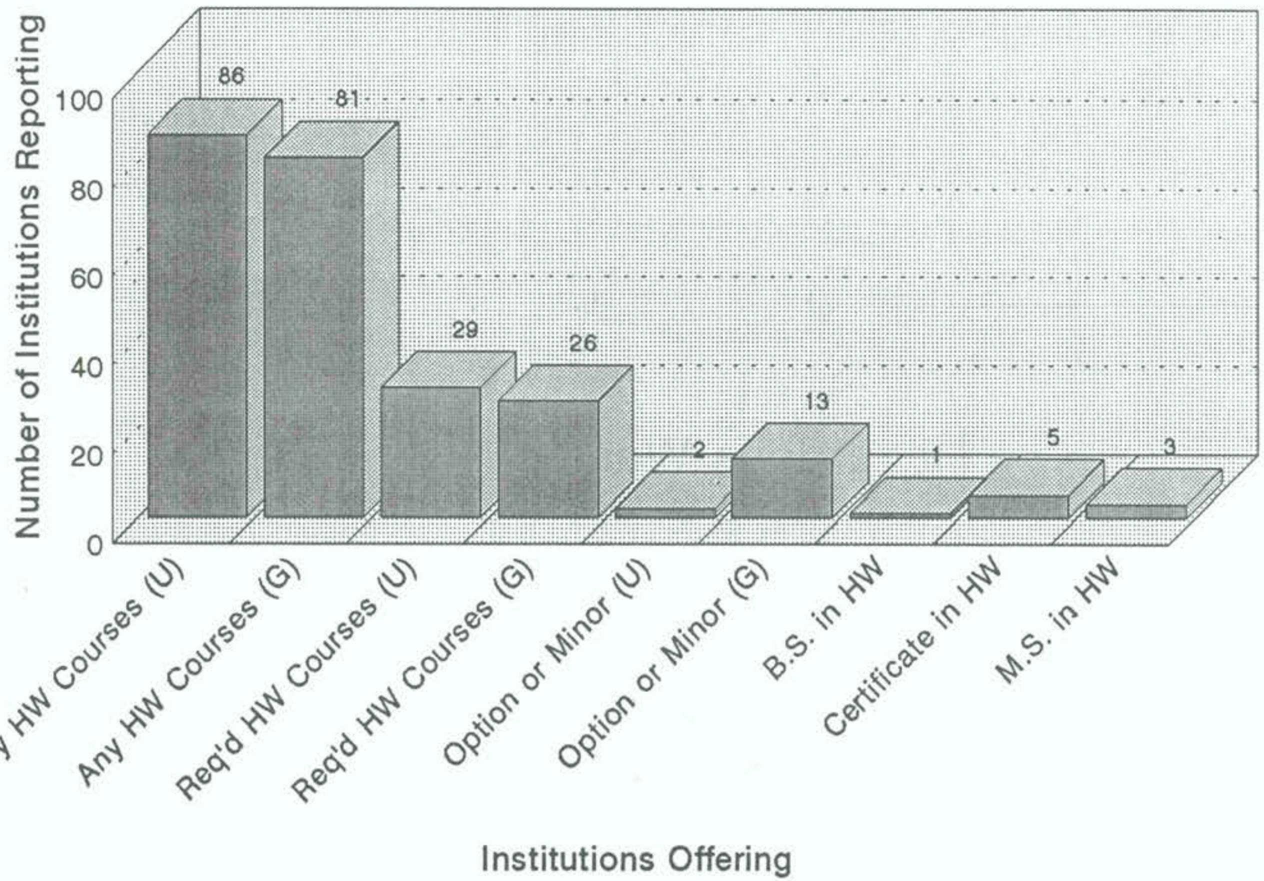
Environmental Experience of University Faculty in the US.

Implications

- University faculty in the Environmental field lack regulatory background.

- Because hazardous wastes management and research is driven by government regulations, Environmental faculty at universities probably have more difficulty meeting regulatory-driven research needs than faculty in more traditional engineering disciplines whose academic demands and researches are driven by the market. . . . .

Profile of Educational Institution Hazardous Waste Instruction Offerings in the US.



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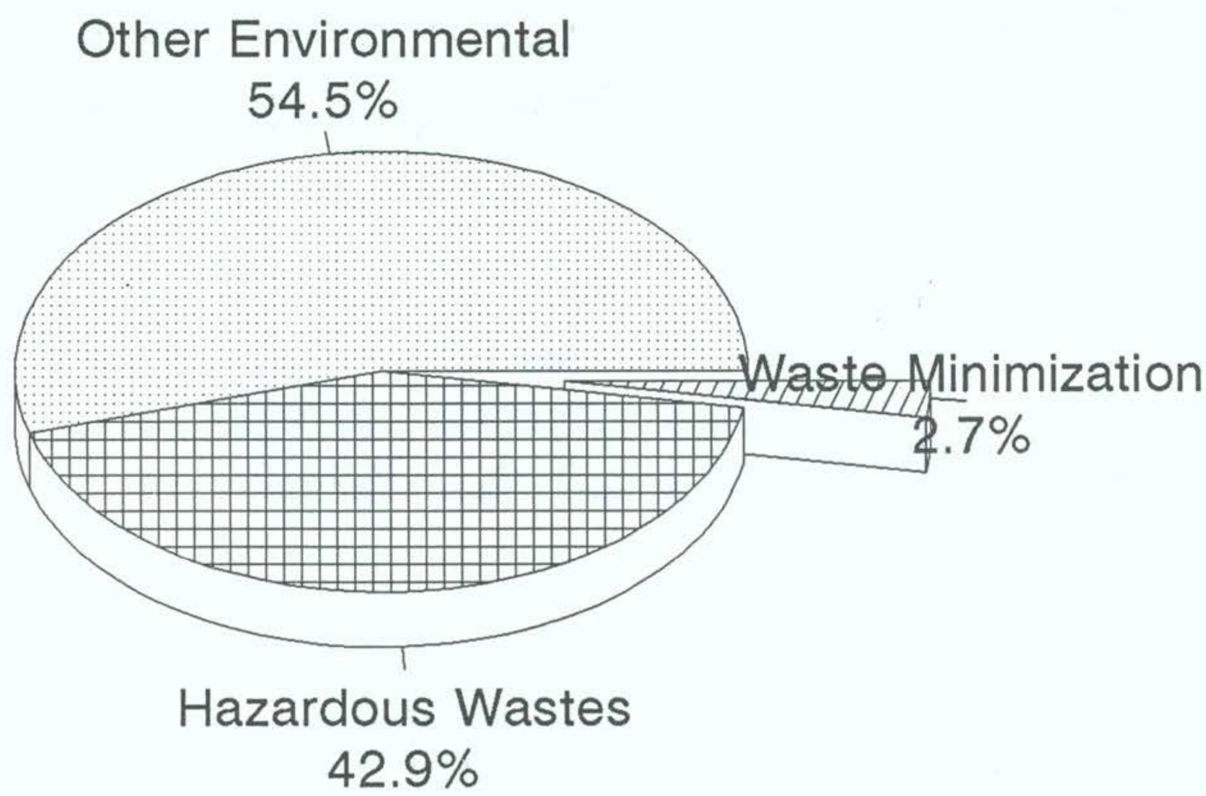


1988 Environmental Research Projects
at 62 US Universities.

WHAT IS HAZARDOUS WASTE ?

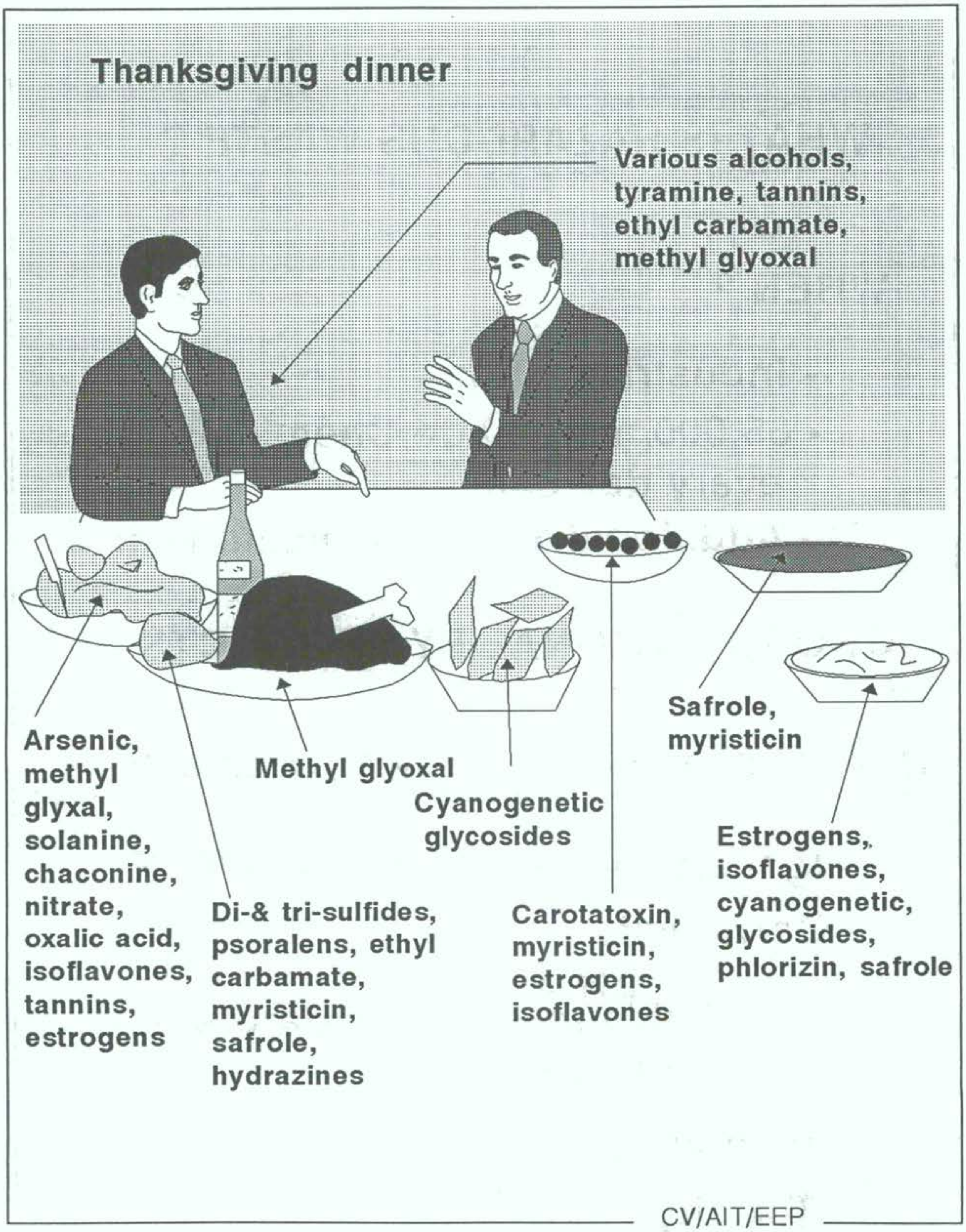
WHEN ?

- Industrialization
- 65,000 man-made Chemicals in every day use
- Additional 1000 chemicals/year

GROSS NATIONAL BY-PRODUCTS

HAZARDOUS WASTE CHARACTERIZATION

- Ignitability - flash point < 140° F
- Corrosivity
  - 2 < pH > 12.5
  - 6.35 mm/year standard steel container
- Reactivity
- Toxicity


Thanksgiving dinner
Various alcohols, tyramine, tannins, ethyl carbamate, methyl glyoxal
Arsenic, methyl glyxal, solanine, chaconine, nitrate, oxalic acid, isoflavones, tannins, estrogens
Methyl glyoxal
Cyanogenetic glycosides
Safrole, myristicin
Di-& tri-sulfides, psoralens, ethyl carbamate, myristicin, safrole, hydrazines
Carotatoxin, myristicin, estrogens, isoflavones
Estrogens, isoflavones, cyanogenetic, glycosides, phlorizin, safrole
CV/AIT/EEP

ENVIRONMENTAL ISSUES

1970 - DECADE OF WATER

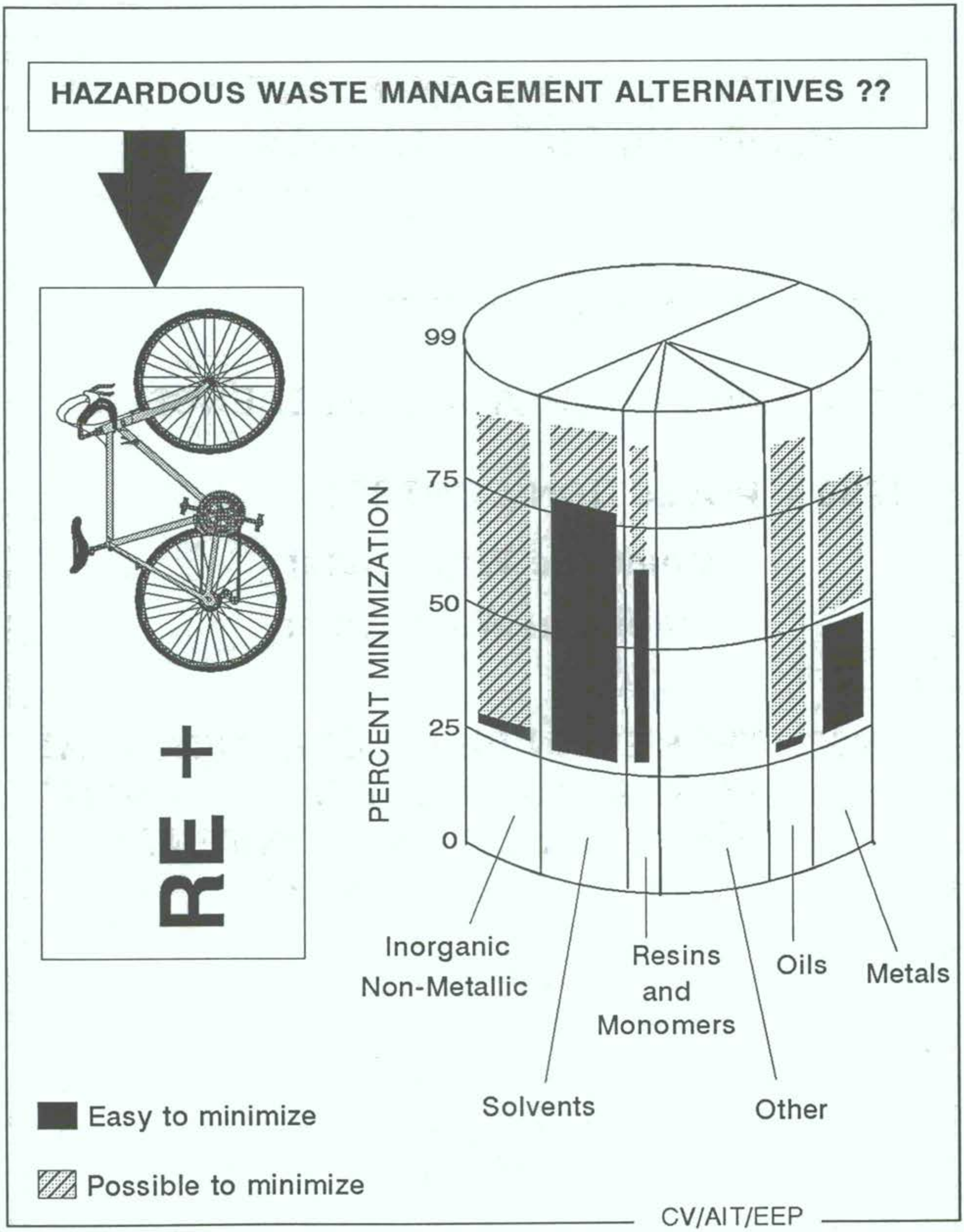
1974 - MER DEL PLATA CONFERENCE

1980 - POLLUTION CONTROL

Domestic Wastewater

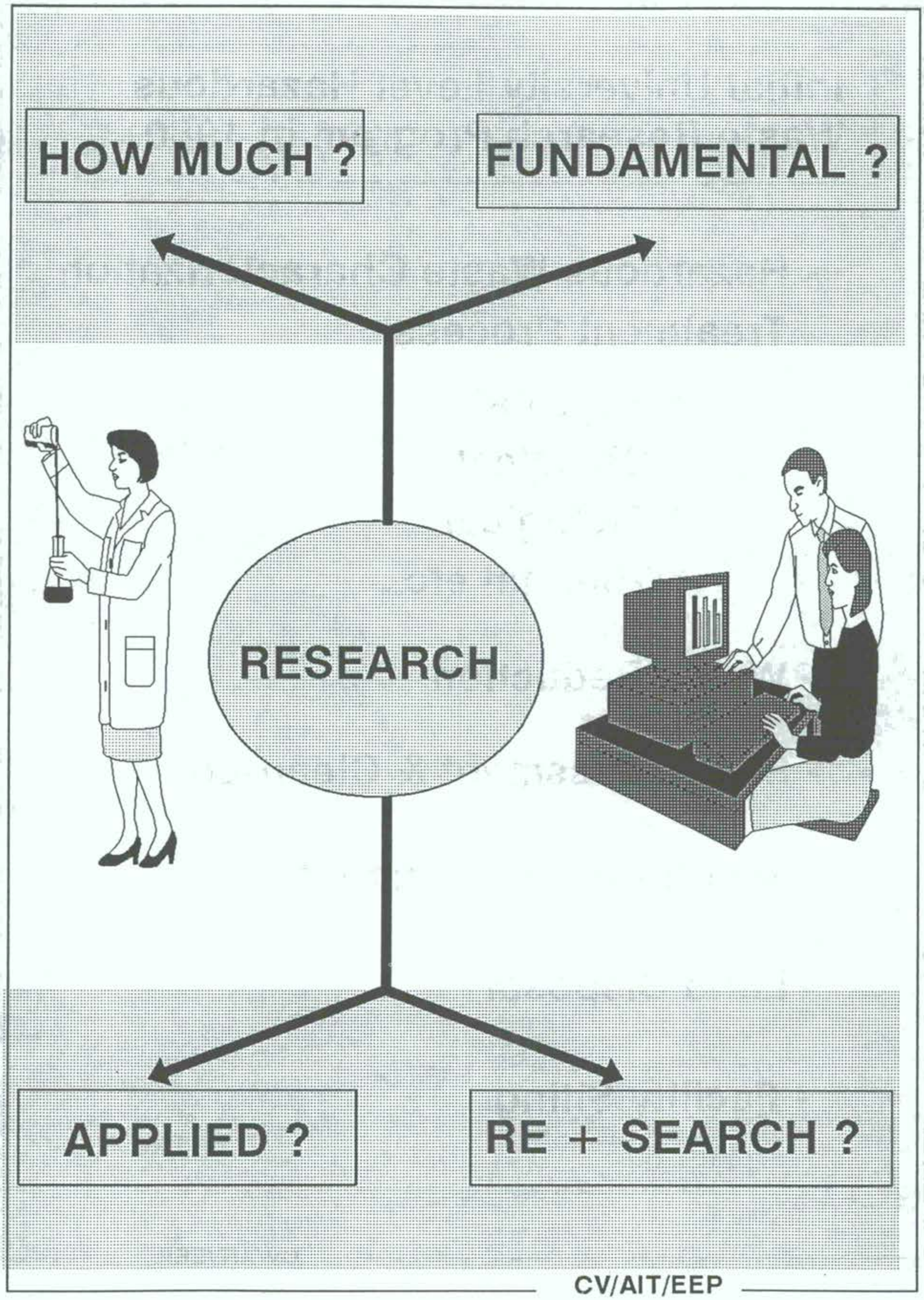
Industrial Wastewater

1990 - THERE CAN BE NO QUESTION THAT HAZARDOUS WASTE MANAGEMENT IS "THE MAJOR ENVIRONMENTAL ISSUE OF THIS DECADE".


HAZARDOUS WASTE MANAGEMENT ALTERNATIVES ??
RE +
PERCENT MINIMIZATION
99
75
50
25
0
Inorganic Non-Metallic
Solvents
Resins and Monomers
Other
Oils
Metals
Easy to minimize
Possible to minimize
CV/AIT/EEP

Initial University Level Hazardous Waste Research Program in 1980.

- Hazardous Waste Characterization
- Treatment Process
    * Physical
    * Chemical
    * Biological
    * Thermal etc..
- Waste Reduction
- Site Assessment & Clean-up
- Groundwater Treatment
- Land Disposal
- Facility Siting

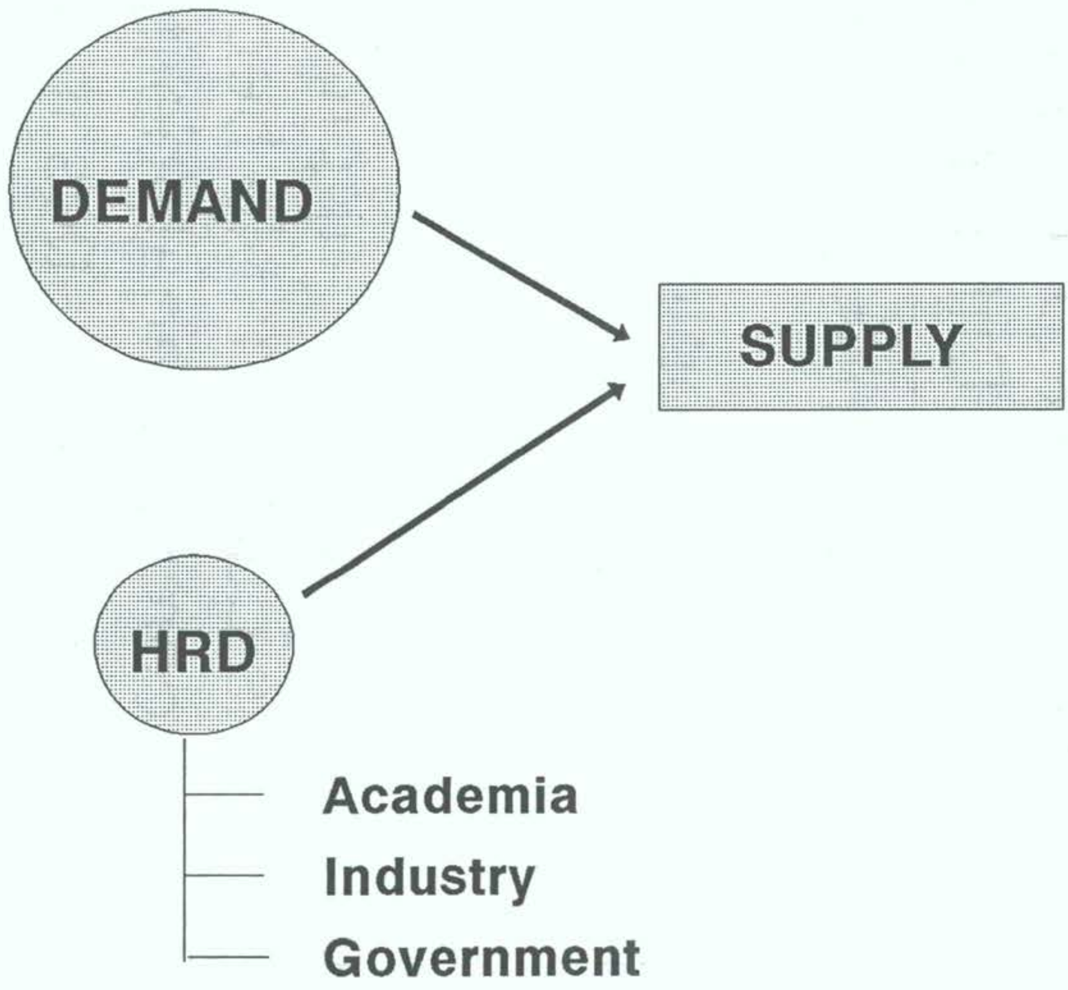

HOW MUCH ?
FUNDAMENTAL ?
RESEARCH
APPLIED ?
RE + SEARCH ?
CV/AIT/EEP

Establishing a Degree Program in HWM : Different Views

- education is too narrow
- it is an application of general scientific principles rather than a separate course entity
- complete or appropriate education is questionable because of the complex legal, political and technical issues involved

WHY ?

- Better Environmental Awareness
- Proliferation of Hazardous Waste
- Environmental Legislation & Regulatory Programs.



Academic Limitation

★ Waste minimization, which has not previously been a part of academia, will need to be taught in Environmental courses to simulate teachers' interest in this hazardous waste management altenatives.

Possible Answers

★ A Master of Engineering in Cleaner Production in RMIT, Australia.

An International PhD programme in Cleaner Production and Sustainability coordinated by Erasmus University, The Netherlands.

INTRODUCTION TO HAZARDOUS WASTE ENGINEERING

Minimization, Treatment, and Management

CONTENTS

Curriculum for the Master of Science in Hazardous Waste Management at Wayne State University.

Required Courses	Credits
Introduction to Industrial Waste Management	2
Thermal Processing of Hazardous Wastes	2
Law and Administration in Industrial Waste Management	2 (no graduate credit)
Transportation and Emergency Spill Response	3
Land Disposal of Hazardous Wastes	2
Biological Treatment of Hazardous Wastes	2
Ground Water	4
Waste Minimization	2
Safety in the Chemical Process Industry	3
Waste Management Internship	2 (minimum)
or	
Hazardous Waste Laboratory	2
or	
Air Sampling and Analysis	3
Public Issues of Hazardous Wastes	2 (no graduate credit)
Principles of Industrial Toxicology	4
Design of Chemical Process Experiments I	3
or	
Probability Models and Data Analysis	4
Minimum Required	29 (33 including noncredit requirements)
Minimum Electives[a]	5
Total Credits	34

[a]Student chooses from an array of 17 courses, including Sanitary Chemistry, Environmental Microbiology, Biochemistry, Soils and Soil Pollution, Environmental Law and Applied Epidemiology.

CV/AIT/EEP

Example Laboratory Course Outline.

Lectures

Quality assurance/quality control
Total organic carbon
Organic chemistry review
Auto analysis
Radioactivity
Introduction to spectroscopy
Nuclear magnetic resonance
Infrared magnetic resonance
Atomic absorption spectrometry
Mass spectrometry
Introduction to chromatography
Liquid chromatography
High pressure liquid chromatography
Sample preparation techniques
Gas Chromatography
Ignitability/corrosivity
Reactivity/EP toxicity
Sampling techniques

Laboratories

QA/QC
TOC
Autoanalyzer
NMR (demonstration)
AA
HPLC/LC (demonstration)
Sample preparation techniques
GC (two sessions)
GC/MS (demonstration)
Unknown (two sessions)

CV/AIT/EEP

Composite List of Laboratory Equipment.

Instruments
- Atomic absorption spectrophotometer with graphite furnace
- Balances
- Bomb calorimeter
- Compaction permeameter
- CO monitor
- COD apparatus
- Gas chromatograph
- Gas chromatograph/mass spectrometer
- EP toxicity apparatus
- Flash point tester
- High pressure liquid chromatograph
- Spectrophotometers
  - Infrared
  - Visible
  - Ultraviolet
- Suction Lysimeter
- Total organic carbon analyzer
- Sampling techniques

Sampling equipment
- Continuous sampler
- Well installation equipment
- Soil core sampler
- Personal protective equipment

Process equipment
- Air stripping column
- Batch still for organic distillation
- Carbon adsorption column
- Hydraulic aquifer model
- Model incinerator
- Soil columns

Other equipments
- Computer software
- Glove boxes rated for hazardous materials
- Hoods rated for hazardous materials

Rationale for Project Work

A worthwhile project should :

- have a useful end product
- involve discovery by the student(s) be in
- be in some measure unpredictable in process and outcome
- involve integration and presentation of skills and knowledge
- offer flexibility both in terms of direction and pacing of work
- comprise a problem which is worth solving
- instruct the student in her / his own abilities
- display the student's abilities on a broad spectrum

It could also involve :

- interaction with others
- learning to present complex sets of research findings

Project Skills

- **Literature searching**
- **`Collating literature**
- **Experimental design**
- **Use of equipment**
- **Data collection** (including observation techniques, interviewing, questionnaire design, measurement, automated data recording systems)
- **Data analysis and statistical analysis** (including computer use)
- **Data interpretation**
- **Report writing**
- **Specific subject-based skills**
- **Teamwork skills**
- **Presentation skills**

TRAINING RESOURCES :

UNEP

- Hazardous Waste Policies & Strategies - Technical Report no. 10, UNEP/ IE/ PAC, Puerto Rico, Jordan, 1991.
- Landfill of Hazardous Industrial Waste - UNEP/ IE/ PAC, Mauritius, 1993.
- Hazardous Identification & Evaluation in a Local Community - Technical Report no. 12, UNEP/ IE/ PAC, 1992

WHO

- Rapid Assessment of Sources of Air, Water & Land Pollution, 1993.

WORLD BANK

- Safe Disposal of Hazardous Wastes : The Special Needs & Problems of Developing County, 3 Volumes, 1989.

ASIA - PACIFIC SCENARIO

COMPLETE DEGREE

AUSTRALIA

Murdoch University - Waste Minimization

NEW ZEALAND

Auckland University - Toxicology

University of Otajo - Toxicology

Numerous Universities with full paper

AIT - Hazardous Waste Engineering

- Waste Minimization & Waste Auditing

CEC/AIT

Toxic & Hazardous Waste Management

4 Weeks Professional Training Course

6 June - 1 July, 1994.
5 - 30 June, 1995.

OBJECTIVE :

★ To enable the participants to plan the development of treatment & disposal systems for hazardous wastes,

★ To gain knowledge on unification measures

★ To prepare hazardous wastes disaster plans in case of an accident.

CEC/AIT

Toxic & Hazardous Waste Management

4 Weeks Professional Training Course

Module :

- ★ Overview
- ★ Pre-disposal Management
- ★ Final Processing & Disposal
- ★ Planning & design of Hazardous Waste Management facilities
- ★ Case Studies/ Study Tours/ Project Work

Waste Avoidance & Minimization in Industry.

INTEGRATION OF TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT IN THE CURRICULUM

Marino M. Mena
College of Engineering
University of the Philippines
The Philippines

I. Introduction.

The role of tertiary education in hazardous waste management in particular, and in environmental management in general, is increasingly recognized. It is appropriate that this Workshop has this issue as one of the major topics for our discussion. Needless to say, education has always been viewed as a long-term solution to relevant issues of this nature. Principle 21 of the 1992 Earth Summit at Rio de Janeiro, Brazil states: "The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all." Section IV, Chapter 4 of UNCED's Agenda 21 focuses on education, public awareness and training. One of the activities proposed in Agenda 21 is for governments to strive in updating and preparing strategies aimed at integrating environment and development as a cross-cutting issue into education at all levels. It is recommended that a thorough review of curricula should be undertaken to ensure a multidisciplinary approach in dealing with environment and development issues and their socio-cultural and demographic aspects and linkages.

The present paper offers some thoughts this environmental issue and, more importantly, encourages an exchange of ideas and experiences among educators in the Asia and Pacific Region. The organizers of this Workshop should be congratulated for their effort in promoting cooperation for the world-wide progress of environmental education and training, specifically in the field of environmentally sound management of toxic chemicals and hazardous wastes. How we might integrate this specific environmental issue in our tertiary curricula is the focus of this paper.

II. The Need for Innovations in Engineering Education.

An innovation in engineering education has been defined by UNESCO as one which implies "some changes in an accepted pattern of education and training which does, or should, in some sense improve the formation of engineers in an engineering college, or improve methods of continuing education for engineers". In this context, innovations can be introduced to achieve a number of aims such as:

1. To equip engineers with attitudes and work methods that will cope with change in technological practices;

2. To encourage students to develop skills in design and give them a chance to show any aptitude for invention;

3. To have students investigate problems, simple and complex, as members of a team and as individuals.

There are other aims for innovations depending on the pattern or structure of the education process. It is therefore recognized that some innovations may have great value and thus be worth adopting in one country, but may be considered as too demanding in other countries. Likewise, some innovations in some schools may not necessarily be practical in other schools. This reality has to be recognized and the following discussion must be viewed in this context.

III. Strategies for Integration.

Strategy I

Whenever appropriate, introduce the students to the history of technology and to the current state of industry and industrial organization.

The students must be able to appreciate fully the role of "technology" in relation to the "development" of society. Technology in its broadest sense is defined as the totality of the means employed by a people to provide itself with the objects of material culture. It is the application of scientific knowledge to practical purposes in a particular field such as engineering, agriculture, medicine, fisheries, forestry, etc. On the other hand, "development" is a continuous process to improve the whole of humankind, which includes economic, political, cultural, spiritual, social conditions and relationships with his fellow beings towards the attainment of a quality of life that protects and promotes the dignity of humanity. It is a means to enhance the economic status of a community which in effect produces the social, cultural and moral values of humanity that brings about freedom, justice, and self-reliance. It can be best achieved by directing development efforts toward fulfilling the basic needs of the people.

Strategy II

In design courses, the students should be encouraged not only to develop skills in design but also to show any aptitude for invention and innovation.

The students should be made to realize that any advance in science creates new potentialities of application. At the same time, the students must equally recognize that in their design, they have to consider not only the technical aspects but also the economic, financial, political and social constraints. It is in this context that one finds why the process of technological development historically has followed a series of "S" curves, each responding to increasing urbanization and resource use. It is therefore very important for the student to realize that certain conditions could make an existing technology obsolete or may no longer be acceptable on environmental grounds. Any information on new and relevant developments in technology are therefore valuable materials or inputs to the education and training of engineers. For example, in addition to the traditional methods of waste treatment, the students must now be introduced to waste minimization techniques as strategies for hazardous waste management and control.

Strategy III

In courses related to special problems students should have the opportunity to investigate problems, both simple and complex, as members of a team and as individuals.

A field and experimental investigation of a problem in industry could be undertaken by a team of students. This could effectively make the students realize and appreciate the multidisciplinary nature of such problems.

The following excerpt from a UNESCO publication about engineering is pertinent to this issue:

> "Engineering is about people, community and society. Every engineering student should have a feeling for the complexities involved, but he (she) cannot have this if he (she) buries himself (herself) away in his (her) technology. The engineer cannot carry out his (her) duties to society properly, nor apply his (her) skills effectively, unless he (she) has interests outside engineering. For example, involvement in community issues can give him (her) the motivation to understand how his (her) education in engineering helps to make him (her) a better and more integrated member of society."

Strategy IV

Institute separate courses on hazardous waste management which can be taken as electives by the students.

The engineering curricula usually contains electives which a student may take either for additional exposure in his/her field of specialization or for some exposure in an area outside his/her field of specialization. A 3-unit course on hazardous waste management could be an attractive elective to undergraduate students in civil, chemical, and metallurgical students. Examples of such courses are given below:

Course 1

Title: Hazardous Waste Management Engineering

Description: Treatment, storage and disposal of hazardous wastes.

Credit: 3 hours a week (class); credit 3 units

Course 2

Title: Hazardous Waste Minimization

Description: Waste minimization techniques in industry; case studies.

Credit: 3 hours a week (class); credit 3 units

Strategy V

In seminar courses, opportunities should be provided for a full exchange of views about up-to-date developments in Hazardous Waste Management between students and senior representatives from a wide range of industries.

These industrial seminars will broaden the knowledge of the students with regards to the problems of industry as well as the economic implications of these problems and of their remedies.

Strategy VI

There must be a teacher training component of the program.

The training of teachers is an important way to promote institutional changes. In practice this should be the first strategy. The integration of environmental topics in existing courses as well as the introduction of new courses can only be successful if the engineering teacher believes in such curricular changes and takes the lead.

IV. Conclusion.

A dilemma faced by curriculum planners is that further input of fresh material would strain an already overcrowded curriculum. However, a curriculum has to be dynamic. It has to respond to change. The first option open to curriculum designers is to introduce new and relevant developments in technological practices in existing courses, wherever possible. In other words, the innovation can be done within the existing framework of the curricula. Otherwise, a curriculum review may have to be undertaken to determine how the necessary changes can be accommodated. In this connection, it is appropriate to refer to a UNESCO recommendation on engineering education: "Engineering education should transform its traditional scientific-technical-economic frame of reference into one in which the social and environmental sciences play a broader multidisciplinary role."

AWARENESS AND PREPAREDNESS FOR EMERGENCIES AT THE LOCAL LEVEL (APELL)[1]

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Coordinator
Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP)
UNEP Regional Office for Asia and the Pacific
Bangkok, Thailand

I. Introduction

The APELL process is designed to build on all emergency plans already in existence and produce a coordinated single plan that will operate effectively at the local level where first response efforts are so critical.

There are several reasons why it is appropriate to focus on the local level. These include:

- the extent of an accident's impact depends heavily on the immediate response to an emergency at the plant site and at the local level;

- in addition to being responsible for safety and accident prevention in their own operations, industrial plant managers and their staff are in the best position to provide information on how the facility operates and on how it could affect its environment and to help prepare appropriate community response plans in the event of an emergency; and

- community members and organizations are the principal stakeholders in public safety and health and environmental quality and they are therefore highly motivated to express concerns and participate in planning for and responding to emergencies.

II. The Two Aspects of APELL

There are two principle components in a strategy for awareness and preparedness for emergencies at the local level. These are:

- the enhancement of COMMUNITY AWARENESS of the possible hazards involved

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[1] This paper is based on the UNEP publication: *APELL - Awareness and Preparedness for Emergencies at Local Level*. The Annexes referred to in the present paper may be found in that report.

in the manufacture, handling, and use of hazardous materials or the use of hazardous processes and the steps taken by authorities and industry to protect the community and environment from the possible effects; and

- development of EMERGENCY RESPONSE PLANS which involve the whole community in reacting to an emergency endangering its safety and welfare, in terms of effects on persons, property or the environment.

III. APELL is a Collective Responsibility

Awareness and preparedness for emergencies is a collective responsibility, involving more than just the local level. The various parties and their roles are as follows:

National Level:

- involves ministries, departments, agencies, boards etc responsible for national planning, industry, the environment, public services, safety and health;
- these agencies will set national goals, priorities and standards; establish regulations; provide support and resources to foster cooperation at the local level and allow participants to achieve better preparedness.

Local Authorities:

- involves state, province, district, city and town officials responsible for providing public with services related to public and environmental health and safety;
- these officials will facilitate the preparation and implementation of response plans and programmes to increase public awareness; ensure cooperative participation of, and adequate training and appropriate resources for public service functions such as police and fire departments; approve emergency response plans and monitoring their performance.

Local Community and Interest Groups:

- includes leaders of the community, such as leaders of NGOs and other groups involved in community services, environmental protection and conservation, religious activities, health and lay care, education, business and communications;
- these people and groups will bring to the attention of government and industry the concerns of the community and inform the community as to what is being done to address their concerns; assist with the training the public on hazards that may exist and the emergency response steps that are necessary.

Industry:

- involves owners and plant managers of industrial facilities where hazardous materials are used or manufactured or where hazardous processes occur; the work force of such establishments; members of the transportation industry involved in conveying or controlling hazardous materials;

- their roles are to ensure that the best possible accident prevention and emergency preparedness procedures are in place within the industrial facility; participate in programmes that will result in a well-informed community capable of effective participation in emergency response programmes without harbouring unfounded fears of hazards; establish close and good working relations with the emergency response agencies in the local community and with local community officials and leaders.

International Organizations:

- includes both governmental and non-governmental organizations at the regional and global levels such as industry, manufacturing and trade associations, consumers associations, workers associations, social welfare, conservation and environmental organizations and technical organizations;

- these organizations and their members will assist in coordination of information, expertise, resources and concerns; promoting and supporting the implementation of emergency response plans and programmes to increase public awareness.

The relationships between these partners are shown in Figure 1.

Development of awareness and preparedness for emergencies requires the close and effective cooperation between local authorities, local leaders and representatives of the industrial facilities to which the local area plays host. The "bridge" can be provided by a "Coordinating Group" (Figure 2). Members of this group must be able to command the respect of their various constituencies and be willing to act cooperatively in the interest of local well-being, safety and property.

Industry is primarily responsible for protective actions within the boundaries of the industrial plant. All industrial facilities have a responsibility to establish and implement a facility emergency response plan. A key foundation for such a plan is a safety review - a list of items which affect the safe operation of a facility and which should therefore be included in such a review is given in Annex 1[2]. One part of this in-depth review is the preparation of an emergency response plan. Typical components of such a plan are listed in Annex 2.

On the other hand, local government is responsible for the safety of the general public and the protection of the environment. The role of the Coordinating Group is to provide the bridge between industry and local government, with the cooperation of community leaders, and to develop a unified and coordinated approach to emergency response planning and communication with the community. Annex 3 contains a list of people or organizations who should be included in the Coordinating Group.

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[2] The annexes may be found in UNEP, 1988.

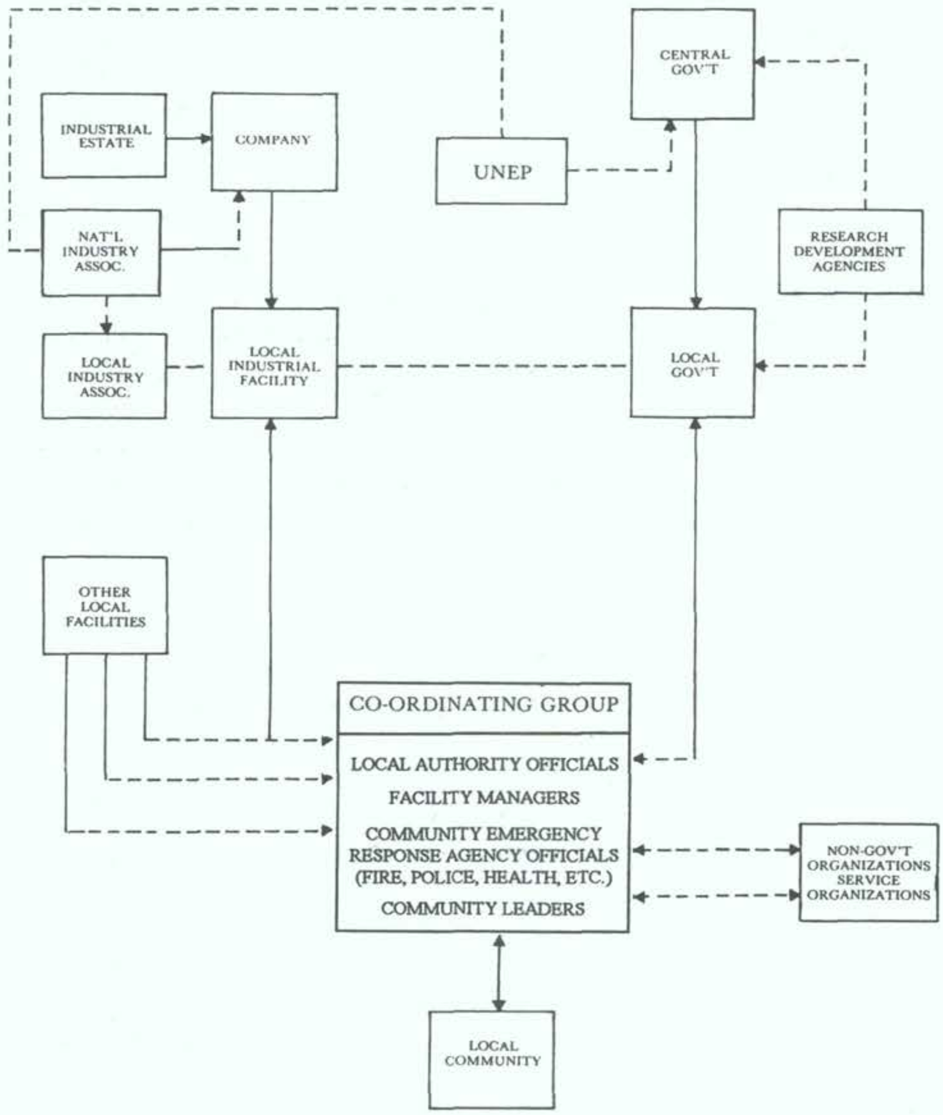

Fig. 1 APELL information and organization flow chart (from UNEP, 1988).

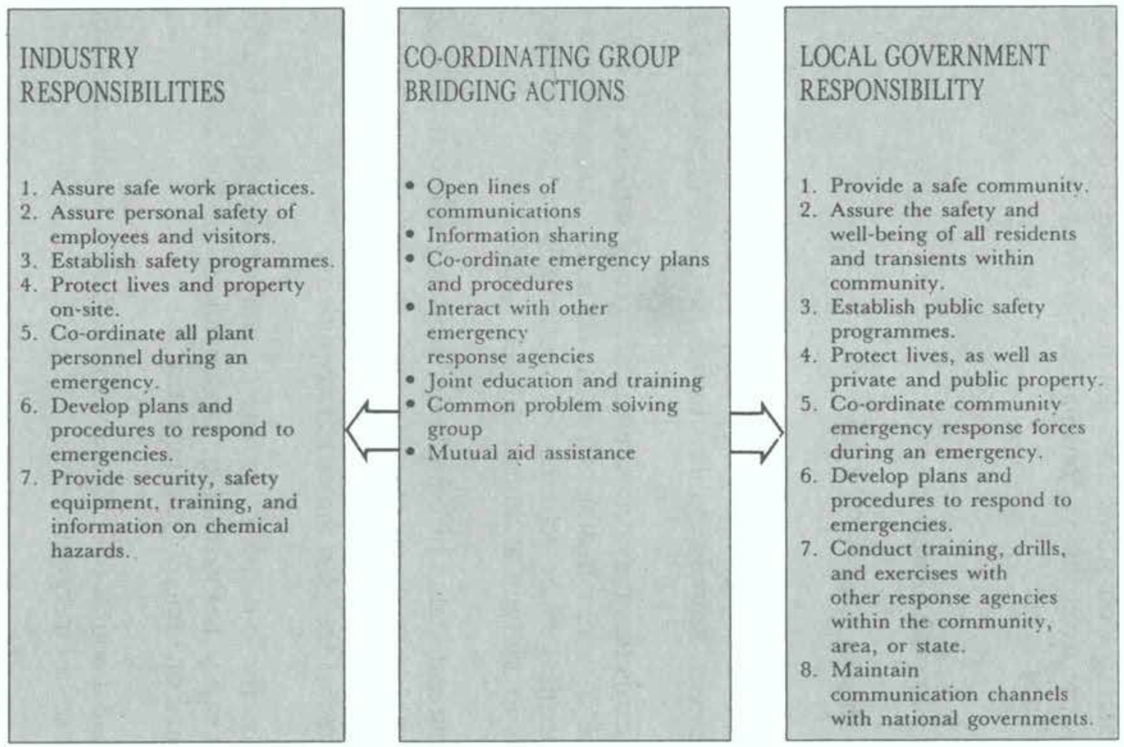

Fig. 2 The "responsibility bridge (from UNEP, 1988).

Note that the Coordinating Committee does not have a direct operational role during an emergency; rather it is preparing the various parties involved to be ready and to know their tasks should an emergency occur.

IV. Assessing the Current Situation

The steps involved in this facet of APELL are:

- identify local agencies making up the potential local awareness and response preparedness network (e.g. emergency health services, civil defence, NGOs such as Red Cross/Crescent, schools, public utilities, religious organizations);

- identify the hazards that may produce an emergency situation (see Annex 3); include operations such as water treatment plants, hospitals, transport and warehousing in addition to chemical manufacturing and potentially hazardous operations; include natural hazards in addition to human-induced hazards;

- establish the current status of community planning and coordination for hazardous materials emergency preparedness and assure that potential overlaps in planning are avoided; assess authority and responsibility, information bases, training programmes and effectiveness of the plan under test conditions;

- identify the specific community points of contact and their responsibilities in an emergency; identify individuals or organizations in the community which have specific chemical or toxicological expertise;

- list the kinds and amounts of equipment and materials which are available at the local level in response to emergencies;

- identify the organization structure for handling emergencies; identify the single person who would be in charge and the chain-of-command;

- determine if the community has specialized emergency response teams to respond to hazardous materials releases - the teams may be government, industry or community based;

- define the community emergency transportation network (e.g. evacuation routes and access routes for emergency services);

- establish the community procedures for protecting citizens during emergencies; and

- establish a mechanism which enables responders to exchange information and ideas during an emergency.

Responses to these tasks should provide a qualitative view of the local area's basic ability to deal with an emergency related to a situation where there is a potential for causing injury to life and health and/or damage to property and/or the environment. The assessment may show the need to enhance the existing or produce a new emergency response plan. The following section outlines an appropriate approach.

V. PREPARING AN EMERGENCY RESPONSE PLAN

Based on experience, a ten-step approach has been developed for preparing a useful and effective integrated community emergency response plan (Figure 3).

1 identify the emergency response participants and establish their roles, resources and concerns (Annex 10 identifies possible participants).

2 evaluate the risks and hazards that may result in emergency situations in the community - compile a list of potential hazards, both natural and human-related; define the magnitude of the risk and the potential seriousness of the impact; for determining probability of occurrence decide if a qualitative approach is sufficient or whether a quantitative risk assessment is necessary - factors to consider include probability of individual events and of simultaneous events, complications from special environmental considerations; prepare a list of scenarios reasonably expected to occur for use throughout the planning process.

3 have participants review their own emergency plan for adequacy relative to a coordinated response (Annexes 4 and 6 would assist this review).

4 identify the required response tasks not covered by an integration of existing plans.

5 match these tasks to the resources available from the identified participants and assess willingness and ability to contribute and participate.

6 make the changes necessary to improve existing plans, integrate them into an overall community plan and gain agreement - review the draft plan and subsequent modifications against the planning elements in Annex 4 to ensure completeness; assess and modify plan using tabletop role-playing exercise; assure integrated community plan is compatible with any regional or national disaster preparedness plan and industry/utility/transportation emergency plans.

7 prepare full documentation for the integrated community plan and obtain the necessary approvals from government and other authorities.

8 educate participating groups about the integrated plan and ensure that all emergency responders are appropriately trained.

9 establish procedures for periodic testing, review and updating of the plan.

10 educate the wider community about the integrated plan - prepare and distribute an explanatory brochure; prepare a media briefing kit and conduct a briefing; implement a broad-based public education programme (see below).

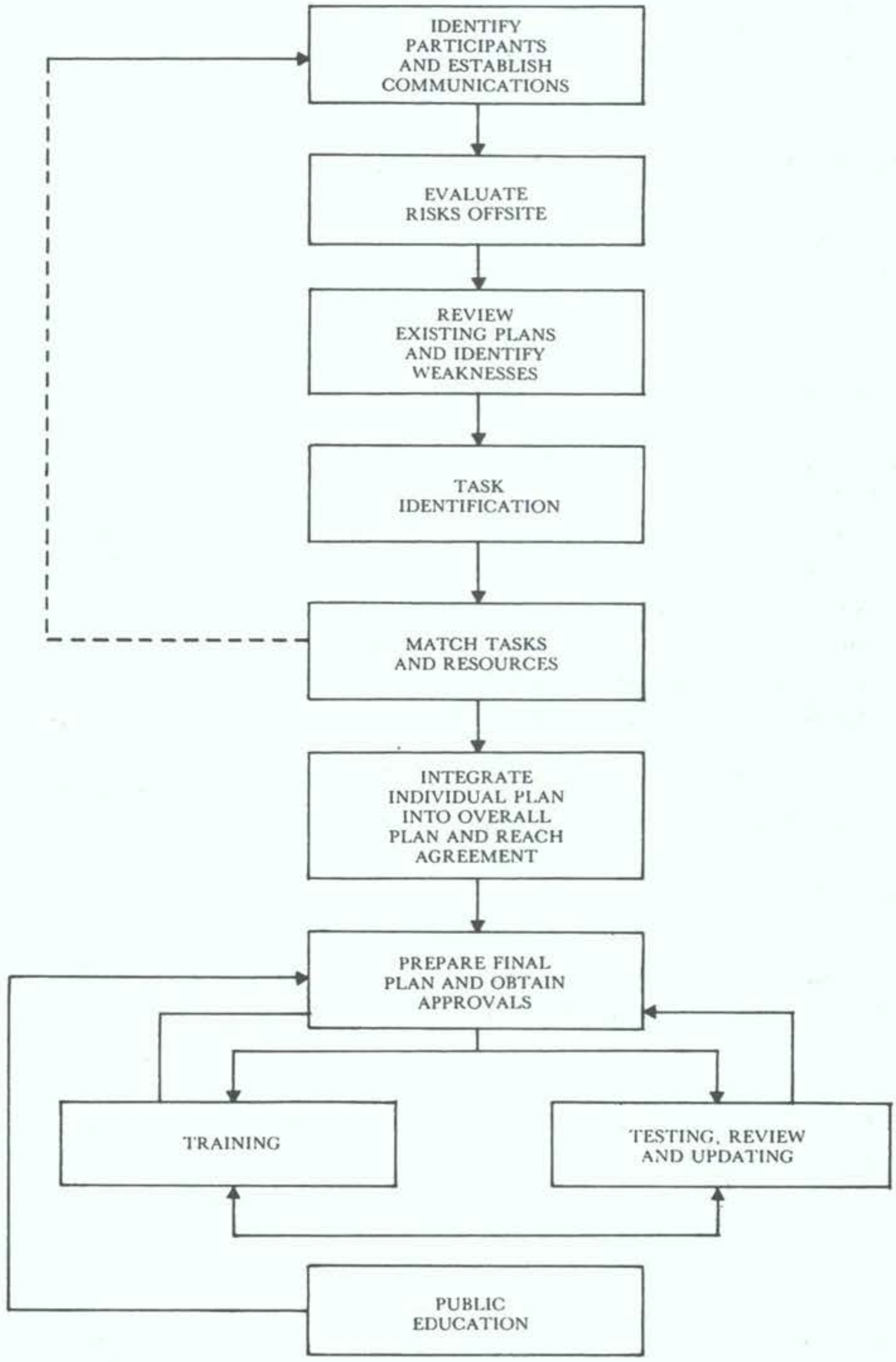

Fig. 3 Community emergency plan implementation flow chart (from UNEP, 1988).

VI. Facilitating Community Awareness, Involvement and Preparedness

The important points to consider in community awareness, involvement and preparedness are:

- define the local community concerned;
- prepare inventory of local community contacts;
- contact other industrial facilities to coordinate community affairs activities;
- develop fact sheets or kits on each industrial operation;
- develop fact sheets on community preparedness;
- assign responsibilities for community tasks;
- look for communications opportunities;
- select methods of communication appropriate for local circumstances (e.g. slide/speech presentations, community newsletters, plant tours, visiting schools);
- use appropriate outside help (e.g. Chamber of Commerce, public relations firms, community and religious leaders); and
- involve employees in the industrial facility, transport company etc, explaining the APELL process and the roles of the company and employees in it.

VII. Keeping the Public Informed

All parties to the APELL process have a duty to keep the public informed in a timely, sensitive and appropriate manner and to ensure that conflicting or confusing information is not passed to the public. Media relations efforts, like local level cooperation programmes, cannot be started after an emergency has occurred.

Considerations for media relations should include:

> preparation - decide who will serve as spokesperson, in all contacts with the media, not only in an emergency; determine what media and which reporters really count, and under what circumstances; prepare a kit of basic facts and graphic materials, using readily understood language, for use in subsequent interactions with the media.

> getting acquainted - get to know local and regional media personnel, and determine what they tend to emphasize; involve local leaders and industry managers in the getting acquainted process.

> cultivate and maintain good relations - ensure that local media are receiving the information they require; seek opportunities to bring "good news" to the attention

of the media.

> develop a public information plan before an emergency arises - plan for the spokesperson to receive current and accurate information about the emergency as it progresses; select a location to act as a media centre and assess access and resources; industry managers should develop a general policy on media access in an emergency situation.

> adhere to the plan in an emergency - the media spokesperson should be included in the first call out of emergency personnel and should be fully briefed; log all enquiries and make notes on name and affiliation, questions and answers; follow-up on questions that cannot be answered immediately.

VIII. Media Relations

The following are important to note in the context of media relations:

- do not expect reporters to be trained in the intricacies of industrial processes and human and environmental toxicology; keep all explanations factual and simple; analogies are useful.

- never speculate or answer hypothetical questions.

- don't be afraid to admit that you "don't know"; but provide an answer later if you can.

- be sensitive to relatives etc in cases of death or injury; for example, do not release names before relatives are definitely notified.

- do not comment on the seriousness of injuries; leave this to the professionals

- be open and cooperative with reporters, but recognize that there is no need to go beyond factual outlines of the situation, even when pressured.

IX. Termination of an Emergency

The termination stage of an emergency is often overlooked. But often it is as important as the initiation of an emergency. There needs to be an explicit system whereby personnel understand that the emergency is terminated. It is important that all personnel understand who has the authority to terminate an emergency status and what the procedure will be. Verbal methods are potentially dangerous and audio, visual or written methods are preferred.

If public emergency services have been involved it is likely that the public emergency service commander will first terminate his/her status by handing control back to the company commander or coordinator.

X. Further Assistance

Sources of additional information and assistance with emergency planning include:

> APELL - Awareness and Preparedness for Emergencies at Local Level. Industry and Environment Office, United Nations Environment Programme, Paris, France, 63pp;

> The APELL Newsletter. Industry and Environment Office, United Nations Environment Programme, Paris, France;

> List of references in Annex 11; and

> CAMEO - Computer-Assisted Management of Emergency Operations. A computer programme that assists local planners in managing information about chemicals in the community and in conducting a hazards analysis and developing integrated emergency response plans for industrial accidents. The computer package includes an extensive data base for over 3000 chemicals. Further information available from Industry and Environment Office, United Nations Environment Programme, Paris, France.

XI. Reference

UNEP, 1988: APELL - Awareness and Preparedness for Emergencies at Local Level. Industry and Environment Office, United Nations Environment Programme, Paris, France, 63pp.

THE BASEL CONVENTION:
A GLOBAL APPROACH FOR THE MANAGEMENT OF HAZARDOUS WASTES

Iwona Rummel-Bulska[1]
Co-ordinator
Secretariat of the Basel Convention/UNEP
Geneva, Switzerland

I. Introduction.

The generation, storage, treatment, transport, recovery, transboundary movement and disposal of hazardous wastes pose a real problem to society and represent a serious danger for human health and the environment. There is great concern for the future if this issue is not properly addressed; it will necessitate vigorous actions by governments, business, industry and international organizations for decades to come.

The actual amount of hazardous wastes generated is not known; the approximate value is around 400 million tonnes a year.

The Organization for Economic Co-operation and Development (OECD) estimates that, on average, a consignment of hazardous wastes crosses an OECD frontier every 5 minutes all year round. Over two million tonnes of those wastes are estimated to cross national frontiers of OECD European countries annually on the way to disposal sites.

Other movements, which are illegal, are motivated by the possibility of important gains in transferring the problem to where controls or standards are less strict or because the vastness of the territory and the scant resources at the disposal of the importing country make any attempt at serious surveillance impossible.

In addition, faced with the increasingly higher costs of safe treating or disposing of hazardous wastes in countries where they are generated, many companies prefer to resolve the problem at a lower cost by transporting them to another countries.

Uncontrolled or inefficient surveillance of transboundary movements and disposal of hazardous wastes result in long-term exposure of the population to their hazards. Illegal traffic of these wastes often had adverse effects, both acute and long-term, on human health and the environment, with related detrimental consequences on the quality of life.

The potential damaging effects of hazardous wastes have led the world community to take measures to manage these wastes in an environmentally sound manner and to aim towards minimizing and preventing their generation.

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[1] Presented at the workshop by Pierre Portas, UNEP/SBC, Geneva, Switzerland.

In response to the growing recognition of the health and environment risks associated with hazardous wastes, governments have brought into force a series of national laws to control the generation, handling, storage, treatment, transport, disposal and recovery of these wastes.

Taking into account the fact that the quantity of generation of wastes of all kinds is still increasing, the rapid pace of industrialization will necessitate careful attention to hazardous wastes prevention and management for decades to come. Moreover, with the development of new chemical products, new sources of hazardous wastes are created. Much remains to be done to properly address this complex challenge. Hazardous wastes are a potential source of environmental pollution or a danger to human health. In order to mitigate such potential threats, measures should be taken urgently: - to avoid or reduce the generation of hazardous wastes; - to optimize the environmentally sound recovery of those wastes; - to reduce to a minimum or eliminate the transboundary movements of hazardous wastes; - to manage those wastes in an environmentally sound and efficient way and dispose of them as close as possible to the place where they are generated.

In exceptional cases and until the appropriate technology and adequate infrastructure are available, or if adequate storage or treatment is not possible in the generating country, it may be safer for human health and the environment to export hazardous wastes to a country capable of eliminating them in an environmentally sound manner.

Increased international co-operation is necessary to assist developing countries to manage and treat the wastes they generate in an environmentally sound way.

II. UNEP Involvement in Hazardous Wastes.

UNEP has, since the early 1980s, been involved in the manifold aspects of hazardous waste management, including control of their transboundary movements and their environmentally sound disposal. Following recommendations of the 1981 Montevideo Meeting of Senior Government Officials Expert in Environmental Law, adopted by the UNEP Governing Council in 1982, UNEP initiated work with government experts on guidelines for the environmentally sound management of hazardous wastes. The work was completed in 1985 and the guidelines were adopted in 1987 by the UNEP Governing Council. The guidelines are known as the Cairo Guidelines.

At the time of adopting the Cairo Guidelines, in view of increasing awareness of uncontrolled movements of hazardous wastes particularly to developing countries, the Governing Council requested the Executive Director to prepare a global legal instrument to control transboundary movements of such wastes and their disposal. That led to the adoption of the Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal.

Recently UNEP has launched a programme, in close co- operation with governments and industry, to advocate low- and non- waste technologies through its Cleaner Production Programme.

Recognizing UNEP's long-term involvement in the various aspects of hazardous wastes, including the successful adoption of the Basel Convention, the Governing Council requested the Executive Director, by its decision 16/30 of May 1991, to prepare draft elements of an international strategy and an action programme, including technical guidelines, for the environmentally-sound management of hazardous wastes. The ad hoc meeting of Government-designated experts met in Nairobi from 9-11 December 1991 and provided elements for a comprehensive framework for the integrated life-cycle management of hazardous wastes. Within this framework, the following objectives should be attained: Prevent to the extent possible and minimize the generation of hazardous wastes; treat and dispose of those wastes in such a way that they do not cause harm to health and the environment; and eliminate or reduce transboundary movements of hazardous wastes to a minimum consistent with their environmentally sound management.

III. Basel Convention.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted unanimously on 22 March 1989 by the 116 States participating in the Conference of Plenipotentiaries. This was convened by the Executive Director of the United Nations Environment Programme (UNEP) and held in Basel at the invitation of the Government of Switzerland. The Final Act of the Basel Conference was signed by 105 States and the European Economic Community (EEC).

The Basel Convention is the result of six sessions of the Ad-Hoc Working Group: Budapest, 27-29 October 1987, (organizational meeting); Geneva, 1-5 February 1988; Caracas, 6- 10 June 1988; Geneva, 7-16 November 1988; Luxembourg, 30 January - 3 February 1989; and Basel, 13-17 March 1989), in which experts from 96 States and representatives of over 50 organizations participated. Informal negotiations conducted by the Executive Director with governments, intergovernmental and non-governmental organizations and industry also played an important part in the success of the preparatory process. As of January 1993, 53 States and the European Economic Community had signed the Basel Convention. In all, as of October 14, 1993, 50 countries have ratified or acceded to the Convention which entered into force on 5 May 1992. Table 1 lists the countries which have ratified or acceded to the Convention.

Intense work has been going on with the European Economic Community and the United States to ensure that these countries, which are the main generators of hazardous wastes, become Party to the Convention. In December 1992, the Council of Ministers of the European Community took the political decision that the Commission and the eleven Member States (France is already Party to the Convention) ratify the Convention at the latest three months before the second meeting of the Conference of the Parties, i.e. November 1993. In February 1993 the Council adopted the Regulation on the supervision and control of shipment of wastes within, into and out of the European Community, which provides States of the Community and EEC itself with effective legal tool for the implementation of the Basel Convention.

The Senate of the United States has given in 1992 its advice and consent for ratification of the Basel Convention which is expected in 1993.

Table 1

Countries which have Ratified or Acceded to the Basel Convention

Antigua and Barbuda	Argentina	Australia	Austria
Bahamas	Bahrain	Bangladesh	Brazil
Canada	Chile	China	Cyprus
Czech Republic	Ecuador	Egypt	El Salvador
Estonia	Finland	France	Hungary
India	Indonesia	Iran	Jordan
Kuwait	Latvia	Liechtenstein	Malaysia
Maldives	Mauritius	Mexico	Monaco
Netherlands	Nigeria	Norway	Panama
Poland	Romania	Saudi Arabia	Senegal
Seychelles	Slovak Republic	Slovenia	Sri Lanka
Sweden	Switzerland	Syrian Arab Republic	United Arab Republic
United Republic of Tanzania	Uruguay		

IV. The Provisions of the Convention.

(a) The generation of hazardous wastes as well as their transboundary movements shall be reduced to a minimum. The wastes should be disposed of as close as possible to their source of generation.

(b) Every State has the sovereign right to ban the import of hazardous wastes. The Parties to the Convention shall not allow any transboundary movement of hazardous wastes to a State that has prohibited their import. Transboundary movements shall also be prohibited if the exporting State has reason to believe that the wastes in question shall not be managed in an environmentally sound manner.

(c) A Party shall not permit hazardous wastes to be exported to a non-Party or to be imported from a non-Party, unless it is in accordance with a bilateral, multilateral or regional agreements or arrangements, the provisions of which are no less environmentally sound than those of the Basel Convention.

(d) The State of export shall not allow a transboundary movement of hazardous wastes to commence until it has received the written consent, based on prior detailed information of the State of import, as well as of any State of transit.

(e) When a transboundary movement of hazardous wastes which is carried out in accordance with the Convention cannot be completed in an environmentally sound manner, the State of export has the duty to ensure the re-importation of the wastes.

(f) Transboundary movements of hazardous wastes which do not conform to the provisions of the Convention are deemed to be illegal traffic. The Convention states that "illegal traffic in hazardous wastes is criminal". The State responsible for an illegal movement of hazardous wastes has the obligation to ensure their environmentally sound disposal, by re-importing the wastes or otherwise. Every Party shall introduce national legislation to prevent and punish illegal traffic in hazardous wastes.

The wastes covered by the Convention are defined in its Annexes, which include a list of categories of wastes to be controlled (47 categories) and a list of hazardous characteristics. Hazardous wastes subject to transboundary movement must be packaged, labelled and transported in conformity with generally recognized international rules and standards. Since the authorities of many countries, especially developing ones, frequently do not have the trained specialists and technical know-how to assess information concerning hazardous wastes and handle it efficiently, the Convention calls for international co-operation involving, among other things, the training of technicians, the exchange of information, and the transfer of technology. Technical guidelines to assist competent authorities in implementation of the Convention are being prepared.

The Secretariat of the Basel Convention has, as its main functions, to process and disseminate information provided to it by the Parties, to ensure co-operation between Parties, and to provide assistance to them in implementing the Convention.

V. Implementation of the Resolutions adopted in Basel (1989).

The Interim Secretariat for the Basel Convention (ISBC), which was established by UNEP in November 1989 in Geneva, finalized in 1992 the implementation of the Resolutions included in the Final Act of the Conference of Plenipotentiaries which adopted the Basel Convention.

The Ad-hoc Working Group which was established by the Executive Director of UNEP in order to implement Resolution 1 to consider the necessity of establishing mechanisms for the implementation of the Basel Convention, recommended the establishment and terms of reference of an open-ended Ad-hoc Committee to meet between the meetings of the Contracting Parties.

In order to implement Resolution 2 on the relationship between the Basel Convention and the London Dumping Convention (LDC), the Fourteenth Consultative Meeting of the LDC (November 1991), adopted the Resolution on the Control of Transboundary Movement of

Wastes at Sea (45/14), which incorporates a set of standards to make the LDC compatible with the Basel Convention.

As for the implementation of Resolution 3 on Liability and Compensation, the Ad-hoc Working Group of Legal and Technical Experts, which had two meetings, was able to finalize its work in March 1991 by developing elements which might be included in a Protocol on Liability and Compensation for damage resulting from the transboundary movement and disposal of hazardous wastes and other wastes. This set of elements was recommended by the Executive Director of UNEP to the first meeting of the Conference of the Parties to the Basel Convention for consideration with a view to adopting, in accordance with Article 12 of the Convention, a protocol setting out appropriate rules and procedures in the field of liability and compensation for damage resulting from transboundary movement of hazardous wastes.

Resolution 5 referred to the harmonization of procedures of the Basel Convention and the Code of Practice for International Transactions Involving Radioactive Wastes. The Code of Practice was adopted at the General Conference of the International Atomic Energy Agency (IAEA) in October 1990. This Code affirms the general principles and practices of the Basel Convention and requires that transboundary movements of radioactive wastes should only take place in accordance with internationally accepted safety standards, with prior notification consent of the sending, receiving and transit States. The Code also prescribes that all States involved should have the administrative and technical capacity as well as the regulatory structure required to manage and dispose of radioactive wastes in a manner consistent with international safety standards.

For the implementation of Resolution 7 on co-operation between the International Maritime Organization (IMO) and UNEP in the review of existing rules, regulations and practices with respect to transport of hazardous wastes by sea, ISBC and IMO collaborated closely to review and provide guidance to the relevant Committees of IMO on the development of draft provisions of existing IMO codes which regulate the transport of wastes to ensure their compatibility with the provisions of the Basel Convention.

According to the above Resolution, the Maritime Safety Committee of IMO at its May 1991 session adopted appropriate revision to the International Maritime Dangerous Goods (IMDG) Code and a new section to the Code of Safe Practice for Solid Bulk Cargoes. These revisions and amendments provide, in practice, for the implementation of the Basel Convention as far as the transport of hazardous wastes subject to two Maritime Conventions (SOLAS 74 and MARPOL 72/78, Annex III), is concerned.

The informal geographically-balanced experts consultation meeting on the development of technical guidelines for the environmentally sound management of hazardous wastes requested by Resolution 8 of the Basel Conference took place in October 1991 in Geneva. The meeting made proposals for the preparation and use of the draft technical guidelines. These proposals were seen as the most practical way to provide guidance to the competent authority in evaluating the environmental soundness of the disposal options presented in the notification and in the making of the decision to consent to or reject a transboundary movement taking place.

The Technical Working Group established by the Executive Director of UNEP met three times in Geneva (February, May and September 1992). The mandate of the Group was to prepare draft technical guidelines for the environmentally sound management of wastes subject to the Basel Convention for consideration by the Parties at their first meeting, and eventual adoption. The draft technical guidelines were accordingly presented to the Conference of the Parties. They focused in particular on the prevention and minimization of the generation of hazardous wastes, the identification and characterization of hazardous wastes, the reduction of transboundary movements of such wastes, the various aspects of recycling, treatment and disposal facilities, and the capacity and capabilities of competent authorities.

VI. Other International Activities in the Field of Hazardous Wastes.

The General Assembly of the United Nations at its 44th session adopted the Resolution (44/226) entitled: Traffic in Toxic and Dangerous Products and Wastes, by which it requested each regional Economic Commission of the United Nations to contribute to the prevention of the illegal traffic in toxic and dangerous products and wastes by monitoring and making regional assessments of this illegal traffic and its environmental and health implications in each region, in co-operation with UNEP and other relevant bodies of the UN. To implement this Resolution UNEP, inter alia, developed in 1991 the regional project on this subject in close co-operation with ESCAP.

A series of training workshops on the management of hazardous wastes have been organized between 1990 and 1991 by the Industry and Environment Office of UNEP in collaboration with other UNEP offices, at which the participants exchanged information and experience in the field of legislation and institutions regarding management and disposal of hazardous wastes and its implementation.

The Governing Council of UNEP in May 1991 also considered that a comprehensive approach to hazardous waste was needed in order to minimize or eliminate the generation of hazardous wastes, and brought this to the attention of the United Nations Conference on Environment and Development. Chapter 20 of the Agenda 21 adopted in June in Rio de Janeiro concentrates on the environmentally sound management of hazardous wastes.

In January 1991, the Governments of the States members of the Organization of African Unity (OAU) adopted the Bamako Convention on the Ban on the Import into Africa and Control of Transboundary Movements and Management of Hazardous Wastes within Africa, a regional African agreement which runs parallel to the Basel Convention, indicating the growing political will to address the problems on transboundary movements of hazardous waste and their disposal. The Convention covers hazardous wastes including radioactive wastes. This Convention was signed by the following 17 African countries: Benin, Burkina Fasso, Burundi, Cameroon, Central African Republic, Egypt, Guinea, Guinea Bissau, Chte d'Ivoire, Lesotho, Libya, Mali, Niger, Senegal, Togo, Uganda, Somalia and ratified by three countries.

VII. First Meeting of the Conference of the Parties.

The First Meeting of the Conference of the Parties to the Basel Convention was held in Piriapolis in December 1992 at the kind invitation of the Government of Uruguay. It was attended by 28 States Parties to the Convention and by the same number of States not Parties, by the EEC, as well as by observers from 13 international, governmental and non-governmental organizations.

The Conference decided that the second meeting of the Conference of the Parties shall take place in February/March 1994. The Conference adopted 23 decisions regarding the implementation of the Convention.

The Conference of the Parties requested UNEP to carry out the functions of the permanent Secretariat. Pursuant to this request and effective 1 January 1993, the Executive Director of UNEP has established the Secretariat in accordance with the structure contained in the budget as approved by the Conference for the years 1993 and 1994. The Secretariat is located in Geneva at the invitation of the Swiss Government and as approved by the First Meeting of the Conference of the Parties.

In accordance with Decision I/7 on Institutional and Financial Arrangements adopted by the Parties, two Trust Funds were established: the Trust Fund for the Basel Convention, with the Budget for Implementation of the Convention in 1993 estimated at $ 1.47 millions and the Technical Co-operation Trust Fund to Support Developing Countries and other countries in need of such assistance to implement the Convention with the Budget of $ 788.740 for 1993. Parties and non-Parties to the Convention were requested to make their voluntary contributions to both Trust Funds.

The Conference of the Parties has established, by Decision I/2, its Open-ended ad hoc Committee to meet as necessary between the meetings of the Contracting Parties, and also requested the Bureau to work together with the Secretariat between the meetings of the Conference of the Parties.

The main task of the Secretariat, in light of the provisions and principles contained in the Basel Convention, and the Decisions adopted by the First Meeting of the Contracting Parties, is to work towards: - Reducing transboundary movements of hazardous wastes to a minimum consistent with their environmentally sound management; - Collecting and disseminating data on the generation of hazardous wastes, their movements and disposal; - Minimizing the generation of hazardous wastes; - Ensuring environmentally sound management and disposal of hazardous wastes, aiming at national self-sufficiency in this respect, including preparing technical guidelines for this purpose; - Providing assistance to Parties, in particular developing countries, in the technical and legal fields covered by the Convention with a view to facilitating the implementation of the Convention; - Preventing and eliminating illegal traffic in hazardous wastes; - Preparing a protocol on liability and compensation, including drafting the elements for a compensation fund and emergency funds.

The Conference of the Parties adopted a number of Decisions, in particular with regard to the development and adoption of a protocol on liability and compensation, on technical guidelines, on notification and movement documents, on model national legislation, on training activities and on establishment of regional centres. The Conference requested industrialized countries to prohibit transboundary movements of hazardous and other wastes for disposal in developing countries and requested developing countries to prohibit the import of hazardous wastes from industrialized countries. Compromise was reached allowing transboundary movements of hazardous waste destined for recovery and recycling: provided they are in accordance with the provisions of the Convention. Most of the meeting representatives supported this compromise decision as a first step, although a technical working group is to develop criteria that determine whether such wastes are suitable for recovery operations. The second meeting of the Parties is expected to evaluate the effectiveness of implementation of these decisions in the light of the results of the review of the issue by the Technical Working Group.

A working group was created to further develop a protocol on liability and compensation; the draft presented to the Conference prepared by the Secretariat includes civil liability provisions of unlimited financial liability and, in the case of an illegal shipment, no time limits on liability. The group is also to consider how to establish an international fund to provide for emergency response to accidents involving transport or disposal of hazardous waste. The meeting adopted provisionally, technical guidelines for the "environmentally sound management" of solvents, waste oils, polychlorinated biphenyls and domestic waste, as the basis of a formal guideline document. In the context of Agenda 21, a list of priority activities to be carried out was referred to by the Conference, focusing particularly on such issues as support to developing countries for strengthening their national capacities in dealing with hazardous wastes, including control and prevention of illegal traffic, training and education programmes, monitoring and surveillance systems of transboundary movements, inventories of hazardous waste treatment and disposal sites, health and environmental risks from exposure to hazardous wastes and public information and information dissemination on hazardous waste matters. Several references to the Basel Convention included in Agenda 21 Chapter 20 regarding implementation of the Basel Convention refer also to such issues as protocol on liability and compensation, control procedures, costing and illegal traffic.

The Conference of the Parties requested the Secretariat to further co-operate with the United Nations bodies to achieve the objectives of the Basel Convention, in particular with the IMO and its Secretariat for the London Convention 1972, as well as with its Maritime Safety Committee and Marine Environment Protection Committee on the development of criteria for the definition of hazardous characteristics, with IAEA in regard to the question of international transboundary movements of radio- active waste and the possibility of developing a legally-binding instrument for the control of these movements, with the Customs Co-operation Council to improve control of hazardous wastes at border points, with the UNIDO, UN Regional Commissions, OECD, EEC, Commonwealth, and other organizations.

VIII. Implementation of the Basel Convention - Work Programme for 1993.

The main tasks for activities in 1993 is to co-operate with and assist Parties in the implementation of the provisions of the Convention and to implement the decisions adopted by the Conference of the Parties at their first meeting. These require the Secretariat to undertake, inter alia, the following activities:

* Review of current actions and programmes aiming at identifying, monitoring, preventing, reducing or eliminating illegal traffic in hazardous wastes, with a view to proposing ways and means of enhancing the monitoring and prevention of such traffic; upon assessment of the needs and priorities of a number of Parties for assistance in the identification of illegal traffic, to provide, whenever possible, assistance to them in this field (Decision I/15).

* Finalization of the work on the Protocol on Liability and Compensation including preparation of the elements that would be required for establishing compensation and emergency funds (Decisions I/5 and I/14) and review of existing compensation mechanisms and liability regime work.

* Identification and review of the control procedures applied by States to the transboundary movements of hazardous wastes destined for recovery operations with a view to providing the second meeting of the Conference of the Parties with recommendations on guidelines and procedures with respect to such movements (Decision I/16).

* Review of the provisional technical guidelines already prepared on the environmentally sound management of wastes subject to the Basel Convention and preparation of revised draft technical guidelines (Decision I/19).

* Identification of the needs of Parties in promulgating laws or adapting existing laws or regulations in line with the provisions of the Basel Convention and providing assistance in this regard upon request (Decision I/12).

* Examination of the bilateral, multilateral and regional agreements or arrangements communicated by the Parties to assess their conformity with the provisions of the Convention (Decision I/9).

* Preparation of an analytical summary of the reports submitted by the Parties on the implementation of the Convention (Decision I/11).

* Compilation of information received from developed countries on measures taken to prohibit export of hazardous wastes to developing countries as well as measures taken by the latter to ban import of such wastes (Decision I/22).

* Preliminary assessment of the feasibility of establishing regional centres for training and technology transfer (Decision I/13).

* Preparation of a manual for the implementation of the Convention (Decision I/3).

In addition, the Secretariat shall perform other functions such as mobilizing financial resources to provide, upon request, technical assistance to Parties in need of such assistance in the implementation of the Convention. A technical assistance programme prepared for the Caribbean, for Asia and the Pacific, and West Africa is expected to be funded, in addition to the existing budget, by the Commission of the European Community.

With the Basel Convention, the world community has the opportunity to implement a truly global legal instrument dealing with the control of transboundary movements of hazardous wastes and their disposal.

The Basel Convention could contribute substantially to improving the situation world-wide by reducing transboundary movements and by promoting environmentally sound management of hazardous wastes. The Parties to the Convention should co- operate actively with each other to implement the Convention and, in particular, to assist developing countries in the development of sound management practices and adoption of cleaner technology methods. It is therefore of great importance that the provisions of the Basel Convention be implemented as soon as possible, effectively and efficiently, in a spirit of solidarity, to be able to truly contribute to solving hazardous wastes management problems world-wide and to render accessible, practicable and environmentally acceptable options to deal with hazardous wastes.

IX. Summaries of Main Decisions Adopted by the First Meeting of the Conference of the Parties to the Basel Convention.

* Liability and compensation

The Conference of the Parties decided to establish an ad hoc working group of legal and technical experts to consider and develop, having regard to the elements on liability and compensation developed by the experts group during 1990-91, a draft protocol on liability and compensation, possibly including the establishment of an international fund for compensation for damage resulting from the transboundary movement of hazardous wastes and their disposal (Decision I/5).

* Technical guidelines

Referring to Article 4 paragraph 8 of the Convention, the Conference of the Parties accepted the technical guidelines developed by the Technical Working Group established in the implementation of Resolution 8 of the Final Act of the Basel Conference, as provisional technical guidelines forming the basis for the production of a formal document and invited all States to comment on these provisional technical guidelines to allow the Technical Working Group to continue its work on their further development for the adoption by the second meeting of the Conference of the Parties (Decision I/19).

* Notification and movement document

To facilitate the implementation of Article 4 paragraph 2 (f) and Annexes VA and VB of the Basel Convention, the Conference adopted provisionally the notification and movement documents as prepared by the Secretariat and recommended to the Parties their use when consenting to or rejecting a proposed transboundary movement of hazardous wastes. It also requested Parties and relevant international bodies to provide information to the Secretariat on the use of documents and on any suggested revisions to such documents for consideration at the next meeting of the Parties (Decision I/21 and I/18).

* Model National Legislation

To facilitate the implementation of Article 4 paragraph 4 of the Convention requesting Parties to take appropriate legal, administrative and other measures to implement and enforce its provisions, the Conference of the Parties urged the countries, which have not yet developed laws in conformity with the Convention, to do so taking into account the elements of both the model law on the management of hazardous wastes and the model law on the control of transboundary movements of hazardous wastes developed by the Secretariat with the assistance of a group of experts, and requested the Secretariat to continue its work on the development of the model national legislation and to promote co-operation and assist Parties in aligning their laws and regulations on the provisions of the Basel Convention (Decision I/12).

* Training and regional centres

With reference to the implementation of Article 14 paragraph 1, the Conference took note of interest expressed by a number of countries in the establishment of regional centres for training and technology transfer and requested its Open-ended ad hoc committee to identify the specific needs of the regions in this field taking into account ongoing and future activities, as well as ways and means of the establishment of appropriate funding mechanisms of a voluntary nature for such centres (Decision I/13).

Referring to Article 10 paragraph 1 of the Convention, the Conference requested the Secretariat, in co-operation with other relevant bodies, to organize national and regional seminars, workshops and training programmes for the implementation of the Convention and to help promote the adoption of cleaner production methods and new low-waste technologies (Decision I/20).

X. CONCLUDING REMARKS.

The Organization for Economic Co-operation and Development (OECD) estimates that in 1984, on average, a consignment of hazardous wastes crosses an OECD frontier every 5 minutes all year round. Over two million tonnes of those wastes are estimated to cross national frontiers of OECD European countries annually on the way to legal disposal sites. This figure represents 8 to 10% of all such wastes generated in these countries.

Such criminal acts prompted strong reactions by Governments, international organizations and non-government groups.

In addition, faced with the increasingly higher costs of safely treating or disposing of hazardous wastes in countries where they are produced, many companies prefer to resolve their problem at a lower cost by transporting them to another State.

Their implementation without close co-operation with Industry will be difficult. That is why the co-operation of the Industry with Basel Convention Secretariat is very important.

COMPUTER ASSISTED LEARNING AND SIMULATION PACKAGES

C. Visvanathan
Environmental Engineering Programme
School of Environment, Resources and Development
Asian Institute of Technology
Bangkok, Thailand

In his presentation Dr Visvanathan provided information on and demonstrated several computer software packages which can be used to enhance education and training activities related to toxic chemicals and hazardous wastes. He also demonstrated computer programmes which simulate conditions or processes relevant to the management of toxic chemicals and/or hazardous wastes.

The following packages were demonstrated or described:

Label Master - DocuWaste: commercially available software for waste tracking, manifesting, labelling and compliance reporting.

USEPA RREL - Treatability Data Base: developed by the US Environmental Protection Agency for provision of information on the physical and chemical properties of chemicals and on the treatability of chemicals.

UNEP Textile Working Group Data Base: contains CP data base, Textile Equipment Manufacturers list, working group members list and training documentation.

INWASTE: developed by IIT, Bombay, and WHO; provides a rapid assessment of industrial wastes.

CPBASE: developed by the International Cleaner Production Information Clearinghouse (ICPIC).

Global Waste Survey: developed by the International Maritime Organization.

WRAS - Waste Reduction Advisory System: contains a waste reduction audit checklist, waste reduction information and a bibliography on waste reduction.

SWAMI - Strategic WAste Minimization Initiative: conducts process analysis for pollution prevention.

AIT - ADEME HazWaste software.

DEMONSTRATION OF UNEP IE/PAC'S INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC) MESSAGE CENTRE AND DATABASES

Mahesh Pradhan
Project Officer
Network for Environment Training at Tertiary Level in Asia and the Pacific (NETTLAP)
UNEP Regional Office for Asia and the Pacific
Bangkok, Thailand

The following pages contain edited screen images of the real-time demonstration of the ICPIC message centre and data bases.

UNEP's International Cleaner Production Information Clearing-house (ICPIC) supports a network which gives access to:

* Message centres ... for communicating among all users and UNEP-Industry & Environment Activity Centre
* Bulletins ... the latest news about cleaner production worldwide
* Calendar of events ... conferences, training, seminars, and workshops
* Case study data base ... over 600 technical and programmatic case studies that highlight the industry and wastes involved, economic incentives, cost recovery time, and other data
* Programme summary data base ... descriptions of country and corporate cleaner production programmes
* Bibliographic data base ... hundreds of cleaner production document abstracts
* Contacts data base ... the names of experts and how to contact them, worldwide

Through ICPIC it is also possible to access the OZONACTION Information Clearinghouse, which provides technical, programmatic, and policy options for phasing out the use of ozone depleting substances controlled under the Montreal Protocol. Users of the information system have access to and can become an active part of the Cleaner Production Network. Cleaner production information requests or announcements can be left with the message center. Network members can even answer requests made by others. The network is a partnership between users and ICPIC to exchange cleaner production information.

There are three ways to access ICPIC:

- by direct dialing the system via a public telephone system
- by using a data packet switching network (PSN) and linking with ICPIC via Sprintnet: Sprintnet is connected directly to ICPIC and for calls from outside of France, it may be the least costly way to access the system.
- Most PSNs offer a subscription service that provides access to databases and other networks throughout the world for the price of a local call.

ICPIC Demonstration

Mahesh Pradhan
NETTLAP

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UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND ENVIRONMENT PROGRAMME ACTIVITY CENTRE

Enter:    1          Cleaner Production Information
                     (ICPIC -and- PIES)

Enter:    2          OzonAction Information
                     Clearinghouse  (OAIC)

                  Enter 0 To Exit
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Enter Choice (1-2, 0 or Q to Quit): 1

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UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND ENVIRONMENT PROGRAMME ACTIVITY CENTRE

Enter:    1          International Cleaner Production
                     Information Clearinghouse  (ICPIC)

Enter:    2          Pollution Prevention Information
                     Exchange System (PIES)

                  Enter 0 To Exit
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Enter Choice (1-2, 0 or Q to Quit): 1

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                          Welcome to the
INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)

For information on UNEP's Cleaner Poduction Programme and ICPIC,
select from the categories below, or enter "0" to proceed directly
to the ICPIC system:

          1... What is Cleaner Production
          2... UNEP IE/PAC Cleaner Production Programme
          3... What is Available on ICPIC

Choose topics 1-3, or enter 0 to proceed to the ICPIC Main Menu
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Enter (1-3), or enter 0 to proceed to ICPIC: 1

WHAT IS CLEANER PRODUCTION?
Cleaner production is the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment.

For production processes the strategy includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process.

For products the strategy focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product.

Cleaner production is achieved by supplying know-how, by improving technology, and by changing attitudes.

THE UNEP-IE/PAC CLEANER PRODUCTION PROGRAMME
The programme was launched in response to a decision from the UNEP Governing Council on the need to reduce global industrial pollution and waste. The objectives of the programme are to increase worldwide awareness of the cleaner production concept, help governments and industry develop cleaner production programmes, foster the adoption of cleaner production, and facilitate the transfer of cleaner production technologies.

To meet these objectives, the programme focuses on the collection and dissemination of information on cleaner production that explains the concept, illustrates technical applications, and helps people develop cleaner production programmes. The programme contains five major elements: ICPIC, Working Groups, Publications, Training Activities, and Technical Assistance. For more information on the programme, see Bulletins 4 and 7, available from the ICPIC Main Menu.

ICPIC contains: a message centre for communicating with all users and UNEP IE/PAC; bulletins of the latest news in the cleaner production community; a calendar of events; case studies of cleaner production applications; cleaner production programme summaries from countries and industries; a bibliography of cleaner production document abstracts; a directory of contacts; and access to other information such as the USA Environmental Protection Agency Pollution Prevention Information Exchange System.

ICPIC is a living system -- it depends upon information from the users. UNEP IE/PAC urges all users to provide new cleaner production information and comments about ICPIC's structure. You can leave comments on the message centre for the System Operator (SYSOP) or contact UNEP IE/PAC directly at UNEP IE/PAC, Tour Mirabeau, 39-43, quai Andre Citroen 75739 Paris CEDEX 15, France. Tel: 33 (1) 40 58 88 50. Fax: 33 (1) 40 58 88 74. TELEX: UNITERRA 204 997 F

Strike a key when ready . . .

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                         Welcome to the
  INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)

  For information on UNEP's Cleaner Poduction Programme and ICPIC,
  select from the categories below, or enter "0" to proceed directly
  to the ICPIC system:

            1... What is Cleaner Production
            2... UNEP IE/PAC Cleaner Production Programme
            3... What is Available on ICPIC

    Choose topics 1-3, or enter 0 to proceed to the ICPIC Main Menu
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                         Welcome to the

  International Cleaner Production Information Clearinghouse (ICPIC)

                          operated by

            United Nations Environment Programme (UNEP)
      Industry and Environment Programme Activity Centre (IEPAC)
                         Tour Mirabeau
                     39-43, quai Andre Citroen
                   75739 Paris CEDEX 15, France

                      in co-operation with

          The US Environmental Protection Agency (US-EPA)
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                                 Enter your first name? Mahesh
                                 Enter your last name? Pradhan

MAHESH PRADHAN
BANGKOK, THAILAND
Is this correct? ()Y

Enter your personal password? ()..

21 June 1993
                       IMPORTANT NOTICE

Due to UNEP IE/PAC's relocation to a new office, the ICPIC/OAIC
telephone number will permanently change on Friday June 25th to
(33-1) 45.79.40.59.  The access number via Sprintnet Packet Switching
Network remains unchanged, i.e. (3110) 7620 0604. There will be a brief
interruption of service on that day while we are relocating --
we apologize in advance for any inconvenience this may cause you.
Normal service will resume immediately.

UNEP IE/PAC's telephone and fax numbers have also been changed. To
contact us please use the following numbers:
    Telephone:
        switchboard            (33-1) 4437 1450
        ICPIC/OZAT Sysop       (33-1) 4437 1425 or 44371455
    Fax:                       (33-1) 4437 1474
```

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Our mailing address does not change:
    Industry and Environment/Programme Activities Centre
    Tour Mirabeau
    39-43 Quai André Citroën
    75739 Paris Cedex 15
    France.

Press (Enter) to continue?
```

INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)		
MESSAGES (Q)uick messages scan (Y)our personal mail (E)nter a message (R)ead messages (REPLY) to Message(s) (K)ill a Message (C)omment to System Operator	BULLETINS (B)ulletin listings DATA BASES (OPEN) for database menu OTHER INFORMATION SYSTEMS (J)oin another system	OTHER COMMANDS (H)elp (G)ood-bye/logoff (X)pert On/Off (NEWS) screen display (CHAT) between nodes FILES/DIRECTORIES (F)ile directories (D)ownload a file (U)pload a file
Type the Command Indicated in the Parentheses		

```
(58 min. left) Main Board Command? open
```

```
- ICPIC Data Bases -

To "open" a data base, select a number from the list displayed below.

 1.  ICPIC Data Bases (International calendar, Case studies,
       Publications, Contact directory)
 2.  Enter Full Text Search Data Base
       (Access Temporarily Restricted)
 3.  Usage Statistics
       (Access Temporarily Restricted)
 4.  KMail Door

  Note: Additional data bases (2 & 3) are currently under development
             and their access is temporarily restricted.
```

```
Number of the Data Base to Open (Enter)=none? 1
Loading ICPICDOR, please wait...
```

```
ICPIC DATA BASES

Please enter the number of the data base you wish to enter,
or type Q to quit:

    (1) - International Calendar of Events
    (2) - Case Study Abstracts
    (3) - General Publication Abstracts
    (4) - International Cleaner Production Contact List

    (Q) - QUIT - RETURN TO ICPIC MAIN MENU
```

```
Enter (1-4) or Q to return to the ICPIC Main Menu: 1
```

```
DOORWAY to unlimited doors V 2.20 - Copyright (C) 1987-1991 by Marshall Dudley
                                                    Registered to: SAIC

                  Mahesh, your time available in door is  57 Minutes

          CLEANER PRODUCTION/POLLUTION PREVENTION CALENDAR OF EVENTS

ENTER for 1993, type in a YEAR (ex: 1993), or Q to return to data base menu.
                              (ENTER, YEAR or Q):

          1 - January      4 - April     7 - July        10 - October
          2 - February     5 - May       8 - August      11 - November
          3 - March        6 - June      9 - September   12 - December

ENTER for NEXT EVENT, type in MONTH (1-12), or Q to return to data base menu.
                              (ENTER, 1-12, or Q)? 10

-----------------------------  OCTOBER, 1993  -----------------------------
     No:    Date:      To:        Title
      1  10/05/93  10/06/93   ENVIRONMEXASIA / ASIA International Conference:
                              "Environmental Technology and Economics - The New
                              Competitive Strategy" (Singapore)
      2  10/12/93  10/14/93   Emerging Technologies for Environmental Protection
      3  10/18/93  10/22/93   ENERGEX '93: The Fifth International Energy
                               Conference, (Seoul, Korea)
      4  10/25/93  10/27/93   International RILEM Symposium on Demolition and
                               Reuse of Concrete and Masonry
---------------------------------------------------------------------------

  ENTER to view NEXT MONTH, type in an EVENT NO. to see Event Description,
     P to return to Previous Menu, or Q to return to the data base menu.
                        (ENTER, EVENT NO., P or Q): 1
```

Date: October 5 - 6, 1993

Title: ENVIRONMEXASIA / ASIA 93 International Conference: "Environmental Technology and Economics - The New Competitive Strategy"

Sponsor: Singapore Ministry of the Environment
United Nations Environment Programme
International Solid Wastes and Public Cleansing Association

Location: World Trade Centre
Singapore

Topic: The conference sessions include: Updates on Global and Regional Trends; Clean Technologies; Industrial Waste Management; the Use of Environmental Technology as a Competitive Tool; and Technology for Energy Conservation. Under these sessions there are specific presentations on cleaner production topics such as minimization at source and innovative product design.

Language: English

Contact: Singapore Exhibition Services Pte Ltd
11 Dhoby Ghaut #15-09 Cathay Bldg
Singapore 0922

TEL: +65 338 4747
FAX: +65 339 5651
TELEX: RS 28733 SINGEX

```
ENTER to view NEXT MONTH, type in an EVENT NO. to see Event Description,
P to return to Previous Menu, or Q to return to the data base menu.
(ENTER, EVENT NO., P or Q): q

RETURNING TO BOARD, Please wait...
```

ICPIC DATA BASES

Please enter the number of the data base you wish to enter,
or type Q to quit:

(1) - International Calendar of Events
(2) - Case Study Abstracts
(3) - General Publication Abstracts
(4) - International Cleaner Production Contact List

(Q) - QUIT - RETURN TO ICPIC MAIN MENU

Enter (1-4) or Q to return to the ICPIC Main Menu: 4

DOORWAY to unlimited doors V 2.20 - Copyright (C) 1987-1991 by Marshall Dudley
Registered to: SAIC

Mahesh, your time available in door is 57 Minutes

INTRODUCTION

This directory was prepared by the United Nations Environment Programme Industry and Environment Programme Activity Centre (UNEP IE-PAC) as one of UNEP's responsibilities. This directory provides contact information for individuals knowledgeable about technical, scientific, policy, and programmatic issues relating to cleaner production.

DISCLAIMER

The information in the ICPIC Contacts Directory is supplied by the individuals themselves. Accordingly, UNEP is not liable for any misrepresentations made by the individuals. Since there are no restrictions on who may submit information to this directory, UNEP makes no claim to the qualifications, expertise, or legitimacy of the individuals. It is incumbent upon the user him/herself to verify the claims made by the individuals.

In furnishing the information contained in this directory, UNEP does not make any warranty or representation, either express or implied, with respect to its accuracy, completeness, or utility; nor does UNEP assume any liability of any kind whatsoever resulting from the use of, or reliance on, andy information contained herein, including but not limited to any claims made by the source of the information.

SYSTEM OVERVIEW

The ICPIC Contacts Directory enables users to retrieve information pertaining to one or more individuals based on various selection criteria. Through a series of menus, a user compiles a list of contacts that meets the specified criteria. The system then displays this list, from which individual contacts can be selected. Selecting an individual from the list retrieves and displays all data pertaining to that contact.

Data from another contact matching the same selection criteria can then be viewed by returning to the list and selecting another individual. Alternately, the search can be modified by stepping back through the menus, selecting new search criteria, and creating a new list of contacts.

Press [Enter] for the Main Selection Menu

```
ICPIC Contacts Directory MAIN MENU

You May Search for a Contact By:

[1]  Industry
[2]  Expertise
[3]  Organization Type
[4]  Country of Origin
[5]  Last Name

[I]  Redisplay Introduction
[Q]  Quit Search/Return to ICPIC

Selection: 5

Type [the entire LAST NAME],  only [the FIRST one or more LETTERS],
[ENTER] to list ALL contacts, -or- [0] for the Main Menu: huisingh

Category: LAST NAME    Selection: HUISINGH

[1] Huisingh, Professor Donald
LEIDERDORP, PAY BS, HOLLAND
ERASMUS UNIVERSITY

Select [1], [P]revious Menu, [M]ain Menu, or [Q]uit to ICPIC: 1

Huisingh, Professor Donald
PROFESSOR
ERASMUS UNIVERSITY
PENNING S
LEIDERDORP, PAY BS  2353 TD
HOLLAND

PHONE:
FAX:
CABLE:
E-MAIL:

AFFILIATION:
LANGUAGES:
FEES/REQUIRE:
INDUSTRY..........:
EXPERTISE.........: SOLVENTS
ORGANIZATION TYPES: Academic Organization

---------------------------------- MORE ----------------------------------
[D]own, [L]ist, [P]revious Menu, [M]ain Menu, [Q]uit to ICPIC: q

                    RETURNING TO BOARD, Please wait...

                      ICPIC DATA BASES

   Please enter the number of the data base you wish to enter,
                      or type Q to quit:

       (1) - International Calendar of Events
       (2) - Case Study Abstracts
       (3) - General Publication Abstracts
       (4) - International Cleaner Production Contact List

       (Q) - QUIT - RETURN TO ICPIC MAIN MENU

        Enter (1-4) or Q to return to the ICPIC Main Menu: 2
```

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Compiled on November 24, 1988.

Pollution Prevention/Cleaner Production Case Study Data Base

Case Study abstracts can be selected and viewed on screen using a keyword search routine. To view a list of available keywords you may enter selection "H" while in the Case Studies data base.

DATE OF LAST UPDATE: 03/19/92
NUMBER OF CASE STUDIES: 648

Case Study Search Menu

E .... Enter keyword for search
Q .... Quit (Return to the Data Base menu)
H .... Help
G .... Goodbye (Logoff)

(53 min. left) (E), (H), (X), (M), (O), (V), (Q), (G)? e

Enter your search string below. Press <Enter> when done.
|--------------------------------------|
nickel plating

I will be searching for the following:
"nickel plating"
Is this correct? (Y/N, <cr>=Y)? y

Searching ....
11 items matched !

Case Study Search Menu

E ... Enter keyword for search	S ... Scan abstract keywords
Q ... Quit (Return to the Data Base menu)	# ... Select abstract to display
H ... Help	A ... Display all abstracts
G ... Goodbye (Logoff)	<Enter> ... Display next abstract

(52 min. left) (S), (#), (A), (E), (H), (X), (M), (O), (V), (Q), (G)
(Enter = Next Item)?

Displaying ...

****

1.0 Headline:Meeting Clean Water Standards by In-line Measures in an Electroplating Shop

2.0 SIC Code: 3471Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company
Information not provided.

4.0 Clean Technology Category

Technology Principle: This technology involves use of in-process measures, such as static and spray rinsing, and neutralization of wastewater from plating baths.

5.0 Case Study Summary

5.1 Process and Waste Information:
The plant operates four plating lines: an automated chrome-nickel line with one chrome and three nickel plating baths, a silver line with a cyanide containing pre-silver plating bath and a cyanidic silver plating bath, a bath for bright nickel plating, and a hard chrome plating bath. Before 1978, none of the lines contained static or spray rinse baths. These have now been installed and a chemelec cellwas installed in 1980. The chrome rinse is followed by a static rinse and a reduction tank for chrome (VI). Water from the

static rinse is returned to the nickel bath at a rate of 200 liters/day and to the chrome bath at a rate of 50 liters/day. All rinse water comes together in a final stream for neutralization and is then sewered. In the original process, wastewater was sewered without treatment.

The small quantities of cyanides are not detoxified, but the Cr (VI) is detoxified with caustic soda and bisulfite. No new waste products are generated. Due to spray rinsing, water consumption has decreased about 5,000 m3/yr. The chemelec cell recovers about 80 kg/yr of nickel and spray rinsing results in 80 kg/yr less of nickel and chromium being released to the sewer system.

5.2 Scale of Operation: The production capacity is 9,000 m2/yr and employs 12 people, 9 of them in the electroplating shop. The shop operates 12 hours/day, 360 days/yr.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: All components needed are widely available.

5.5 Material/Energy Balances and Substitutions:
No data was provided for the process before 1978. In 1986, 16-20 kg/yr of heavy metals are lost in the wastewater.

```
          More: (Y)es, (N)o, (NS)NonStop, (S)kip curr. item?  N

--------------------------------------------------------------------------
                     Case Study Search Menu

E ... Enter keyword for search                S ... Scan abstract keywords
Q ... Quit (Return to the Data Base menu)     # ... Select abstract to display
H ... Help                                    A ... Display all abstracts
G ... Goodbye (Logoff)                        <Enter> ... Display next abstract
--------------------------------------------------------------------------
   (50 min. left) (S), (#), (A), (E), (H), (X), (M), (O), (V), (Q), (G)
                    (Enter = Next Item)? q


               Returning to PCBoard ... Please wait.

                        ICPIC DATA BASES

      Please enter the number of the data base you wish to enter,
                        or type Q to quit:

        (1) - International Calendar of Events
        (2) - Case Study Abstracts
        (3) - General Publication Abstracts
        (4) - International Cleaner Production Contact List

        (Q) - QUIT - RETURN TO ICPIC MAIN MENU

        Enter (1-4) or Q to return to the ICPIC Main Menu: 3


          InfoDoor v3.00 Copyright 1987, 1988 by R. P. Byrne
                   Compiled on November 24, 1988.
```

Pollution Prevention/Cleaner Production Publications Data Base Publication abstracts can be selected and viewed on screen using a keyword search routine. To view a list of available keywords you may enter selection "H" while in the publications data base.

NUMBER OF ABSTRACTS CURRENTLY AVAILABLE: 1153
DATE OF LAST UPDATE: 04/21/93

Publications Search Menu

E .... Enter keyword for search
Q .... Quit (Return to the Data Base menu)
H .... Help
G .... Goodbye (Logoff)

(50 min. left) (E), (H), (X), (M), (O), (V), (Q), (G)? q

INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)		
MESSAGES (Q)uick messages scan (Y)our personal mail (E)nter a message (R)ead messages (REPLY) to Message(s) (K)ill a Message (C)omment to System Operator	BULLETINS (B)ulletin listings DATA BASES (OPEN) for database menu OTHER INFORMATION SYSTEMS (J)oin another system	OTHER COMMANDS (H)elp (G)ood-bye/logoff (X)pert On/Off (NEWS) screen display (CHAT) between nodes FILES/DIRECTORIES (F)ile directories (D)ownload a file (U)pload a file
Type the Command Indicated in the Parentheses		

(48 min. left) Main Board Command? b

INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)
--BULLETIN MENU--

Number	Contents/Description
1.	Cleaner Production News
2.	New Cleaner Production publications
3.	ICPIC User Statistics
4.	Cleaner Products
5.	UNEP IE/PAC Cleaner Production Programme
6.	UNEP IE/PAC Cleaner Production Initiatives
7.	Previous Bulletins
8.	OzonAction Programme

Enter Bulletin Number (1-56), (L)ist Bulletin Menu, (H)elp? 1

BULLETIN #1:INTERNATIONAL CLEANER PRODUCTION NEWS

Updated 21 May 1993

New Cleaner Production Video

This video, "Pollution Prevention: Swedish Experiences," produced by the Dutch research institute TEM, describes the results of the Landskrona project, a pilot project to implement pollution prevention (cleaner production) in small and medium sized enterprises. The managers who implemented cleaner production efforts are interviewed. They describe the virtues and impediments they found to implementing pollution prevention.

This video is available from:
The Foundation of TEM
University of Lund
Asumsgatan 38
S-275 37 SJOBO, Sweden
TEL:+46 (0) 416 27300
FAX:+46 (0) 416 27312

Accepting Applications for the National Cleaner Production Centers

The United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme Industry and Environment Programme Activity Centre (UNEP IE/PAC) are jointly launching a new field programme on a pilot basis to promote cleaner production.

This new programme will support National Cleaner Production Centres (NCPCs) in approximately 20 countries for a five-year period. The NCPCs will play a coordinating and catalytic role in promoting cleaner production by providing technical information and advice, stimulating demonstration projects, and training industry and government professionals. They will be managed by experienced country nationals and hosted preferably in existing non-governmental organizations.

For more information contact:

Cleaner Production Programme
UNEP IE/PAC
Tour Mirabeau
39-43 Quai André Citroen
75739 Paris Cedex 15, France

Fax: (33-1) 40 58 88 74

US EPA Launches Design for the Environment Program

The mandate for the Design for the Environment Programme, recently launched by the United States Environmental Protection Agency, encompasses pollution prevention efforts to design products and processes in ways that eliminate or minimize the creation of associated pollution (cleaner production). The Programme is aimed at businesses because it offers ways to reduce the costs of waste disposal and reduces regulation compliance expenses. It is a voluntary programme that promotes the use of safer chemicals processes and technologies in the design phase by providing business with analytical tools to evaluate risk and performance of chemicals and processes. By helping translate pollution prevention into meaningful terms for professional groups, the Programme contributes to building the necessary institutional ...

(Enter)=More, (N)=Stop, (NS)=Scroll Non-stop, (H)=Help? N

Press (Enter) to continue?

INTERNATIONAL CLEANER PRODUCTION INFORMATION CLEARINGHOUSE (ICPIC)		
MESSAGES (Q)uick messages scan (Y)our personal mail (E)nter a message (R)ead messages (REPLY) to Message(s) (K)ill a Message (C)omment to System Operator	BULLETINS (B)ulletin listings DATA BASES (OPEN) for database menu	OTHER COMMANDS (H)elp (G)ood-bye/logoff (X)pert On/Off (NEWS) screen display (CHAT) between nodes
	OTHER INFORMATION SYSTEMS (J)oin another system	FILES/DIRECTORIES (F)ile directories (D)ownload a file (U)pload a file
Type the Command Indicated in the Parentheses		

(46 min. left) Main Board Command? g

Proceed with logoff? ()y

```
UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND ENVIRONMENT PROGRAMME ACTIVITY CENTRE

Enter:   1          Cleaner Production Information
                    (ICPIC -and- PIES)

Enter:   2          OzonAction Information
                    Clearinghouse  (OAIC)

Enter 0 To Exit
```

Enter Choice (1-2, 0 or Q to Quit): 1

```
UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND ENVIRONMENT PROGRAMME ACTIVITY CENTRE

Enter:   1          International Cleaner Production
                    Information Clearinghouse  (ICPIC)

Enter:   2          Pollution Prevention Information
                    Exchange System (PIES)

Enter 0 To Exit
```

Enter Choice (1-2, 0 or Q to Quit): 2

CONNECT 2400 / 10-28-93 (09:41:52)

«« U.S.EPA PPIC - PIES »»
PCBoard (R) v14.5a/U - Node 4 - UFEE84981B75

Welcome to the:

Pollution Prevention Information Clearinghouse (PPIC)
Pollution Prevention Information Exchange System (PIES)

Sponsored by:

The United States Environmental Protection Agency
Office of Environmental Engineering and Technology Demonstration (OEETD)
-and-
Office of Pollution Prevention
401 M Street
Washington, DC 20460

Enter your first name? Mahesh
Enter your last name? Pradhan

MAHESH PRADHAN
BANGKOK
Is this correct? ()Y
Enter your personal password? ()..

Updated 4/22/93

```
                    WELCOME TO THE U.S. EPA
      POLLUTION PREVENTION INFORMATION EXCHANGE SYSTEM (PIES)

           +---------------------------------+
           |   Calls to PIES to date: 51,851 |
           +---------------------------------+

* * * THE ENVIRONMENTAL LIBRARIANS' INFORMATION EXCHANGE IS NOW OPEN * * *

The ENVIRONMENTAL LIBRARIANS' INFORMATION EXCHANGE is a product of, and is maintained by, members of the
Environment and Resource Management Division (ERMD) of the Special Libraries Association (SLA). Its purpose
is to encourage communication among information professionals in the environmental field and to improve
current awareness and access to environmental information resources in all formats: print, audiovisual,
CDs/computer software, online databases and other electronic media. Of immediate interest to Environmental
Librarians is the 84th Annual Special Libraries Association (SLA) Conference to be held in Cincinnati
                              - - - - - - -

              * * * POLLUTION PREVENTION WORKSHOP * * *
  A Four-Day Intensive Course with Case Studies and Computer Workshops
              June 28 to July 1, 1993,  Santa Monica, CA

Presented by the Army Environmental Policy Institute and the University of California at Los Angeles. This
workshop will present methodologies available for identifying and solving design and operating problems
related to waste minimization.

No course fees -- participants are responsible for food, lodging, travel.
Who can attend:  Government employees from all levels of government
Who to contact:
    Mr. Robert E. Jarrett of the Army Environmental Policy Institute
    (217) 373-3320, FAX (217) 373-3350
    Ms. Kirsten Sinclair Rosselot, UCLA Department of Chemical Engineering
    (310) 206-5877 or (818) 364-0454, FAX (310) 206-4107.
                              - - - - - - -

* * * 1993 REFERENCE GUIDE TO POLLUTION PREVENTION RESOURCES * * *

EPA's "1993 Reference Guide to Pollution Prevention Resources" is now available. This is the replacement
for the "Pollution Prevention Resources and Training Opportunities in 1992" This updated publication serves
as a directory and reference guide to pollution prevention resources nationwide.
oIt provides information on EPA programs and personnel both at the Headquarters and throughout the Regions,
state programs, and university programs.
oIt identifies Federal grants as well as available EPA and DOE assistance.
oIt contains listings of helpful training, hotlines, documents and videos.

To obtain a copy, contact the Pollution Prevention Information Clearinghouse (PPIC) at 202-260-1023, or
write them at:  PPIC,  U.S. EPA
                401 M St., S.W., (PM-211A)
                Washington, D.C.  20460
                              - - - - - - -

Hit (Enter) for more or (N) to continue? N


 U.S. EPA POLLUTION PREVENTION INFORMATION EXCHANGE SYSTEM (PIES) MAIN MENU

 You may enter the following options at the "Command?" prompt:
 ---------------------------------------------------------------------------
      MESSAGES          |   FILES/DIRECTORIES      |   SETTINGS & MISC.
 (Q)uick messages scan  |  (F)ile directories      |  (NEWS) screen display
 (Y)our personal mail   |  (D)ownload a file       |  (CHAT) between nodes
 (E)nter a message      |  (U)pload a file         |  (X)pert On/Off
 (R)ead messages        |                          |  (G)ood-bye/logoff
 (REPLY) to Message(s)  |--------------------------|----------------------
 (C)omment to Sysop     |                          |
 (K)ill a Message       |       DATA BASES         |    MINI-EXCHANGES
 -----------------------|  (OPEN) for database menu|  (J)oin a
      BULLETINS         |   and literature search  |     Mini-Exchange
 (B)ulletin listings    |   functions              |
 ---------------------------------------------------------------------------
For HELP, type "H;" and the first letter of the command.
(85 min. left) Main Menu Command? g
```

```
Proceed with logoff? () y

                 UNITED NATIONS ENVIRONMENT PROGRAMME
          INDUSTRY AND ENVIRONMENT PROGRAMME ACTIVITY CENTRE

     Enter:    1                 Cleaner Production Information
                                 (ICPIC -and- PIES)

     Enter:    2                 OzonAction Information
                                 Clearinghouse  (OAIC)

                             Enter 0 To Exit

              Enter Choice (1-2, 0 or Q to Quit): Q

                 Exiting the Information Network
                               OK
```

AUSTRALIAN CONTRIBUTION TO UNEP'S NETWORK FOR ENVIRONMENTAL TRAINING AT TERTIARY LEVEL IN ASIA AND THE PACIFIC - TOXIC CHEMICALS AND HAZARDOUS WASTES

David Stokes, Paul Clarey and Christopher Gray
Faculty of Science and Technology
Deakin University
Australia

I. Overview

Deakin University is a Government funded university located on five campuses in the state of Victoria, in South Eastern Australia. The University has over 25,000 students and many of these students are from South East Asia. The Faculty of Science and Technology is one of five faculties in the University. The Faculty has over 5000 students and over 300 staff. Many of these students are upgrading their professional qualifications.

Within the Faculty, the School of Aquatic Science and Natural Resources Management offers a Bachelor of Applied Science degree in Environmental Management of Hazardous Materials and the School of Biological and Chemical Sciences offers a series of postgraduate awards in Occupational and Environmental Hygiene. These latter awards are offered in an off-campus mode.

These courses at undergraduate and postgraduate levels represent a major concentration of expertise and innovation in the training of professionals for the hazardous materials industry. It is these courses which are the subject of this paper.

II. Local Issues in Training Relating to TCHW

The Faculty of Science and Technology has had a long involvement with the broad area of environmental management. The Bachelors degree in Environmental Management is based on the growing acceptance of the need for environmental managers to be trained in technical areas and also in what we have called the human interaction area (e.g. Stokes, 1992). The linking of management training in areas such as communication, conflict resolution, and leadership, combined with the technical aspects of dealing with hazardous materials, is a key feature of both the undergraduate and the postgraduate awards (see Figure 1).

In Victoria, the management of hazardous materials and dealing with the attendant risks, has been a priority of governments for a number of years. In a recent speech to the Institution of Engineers the Hon. Mark Birrell, Minister for Conservation and Environment in Victoria, stressed that "end of pipe" environmental control was not suitable as an approach in the 1990s.

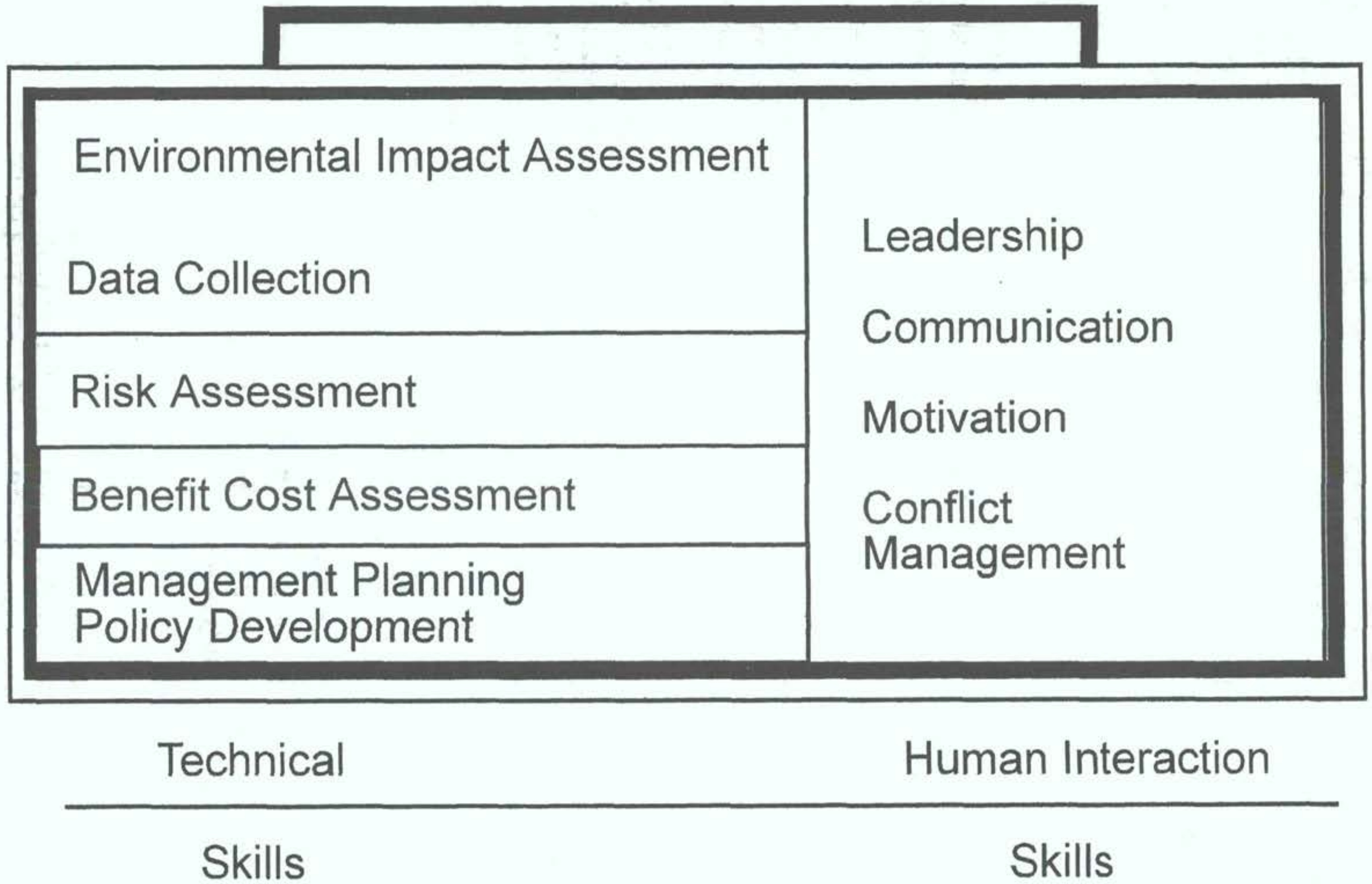


Fig. 1 The Environmental Manager's 'bag of tricks' (after Stubbs and Salih Verzosa, 1981).

DEAKIN UNIVERSITY

He said that the acceptable approach will be one where "Government, the community and industry work together to achieve high environmental standards, and to prevent problems before they arise". This collaborative approach is entirely consistent with our major thrust in training, where key players in the community, environmental groups, industry and the experts will have to work together as a team.

The proposal to establish a national body in Australia to formulate by consensus a national set of standards on air and water quality and the management of hazardous wastes is currently under consideration.

III. The Courses

The Postgraduate Program

The postgraduate program is specifically designed to provide a sound knowledge in occupational hygiene for people who already have a science or engineering background. These people, with suitable professional experience, will become full members of the Australian Institute of Occupational Hygienists. The core of the program is a two years part-time Graduate Diploma.

The Postgraduate Diploma can be taken after a fully articulated Graduate Certificate in Industrial Hygiene Science. The Diploma can lead to Masters degree in Occupational and Environmental Hygiene Management (Figure 2).

The Graduate Diploma consists of six units:

Chemical Environment - 1 credit point
Toxicology - 1 credit point
Control and Radiation - 1 credit point
Human Factors - 1 credit point
Occupational Hygiene Practice - 2 credit points
Workplace Project - 2 credit points.

The Graduate Certificate consists of the following:

Chemical Environment - 1 credit point
Toxicology - 1 credit point
Control and Radiation - 1 credit point
Human Factors - 1 credit point.

Students who undertake the Graduate Certificate obtain advanced standing upon entering into the Graduate Diploma and students who complete the Graduate Diploma obtain advanced standing into the Masters degree. The Masters degree is approved and will be introduced for the first time in 1995. Key features of the Masters degree will be course work units on management of occupational health and the environment and the human skills which are necessary to manage the workplace environment.

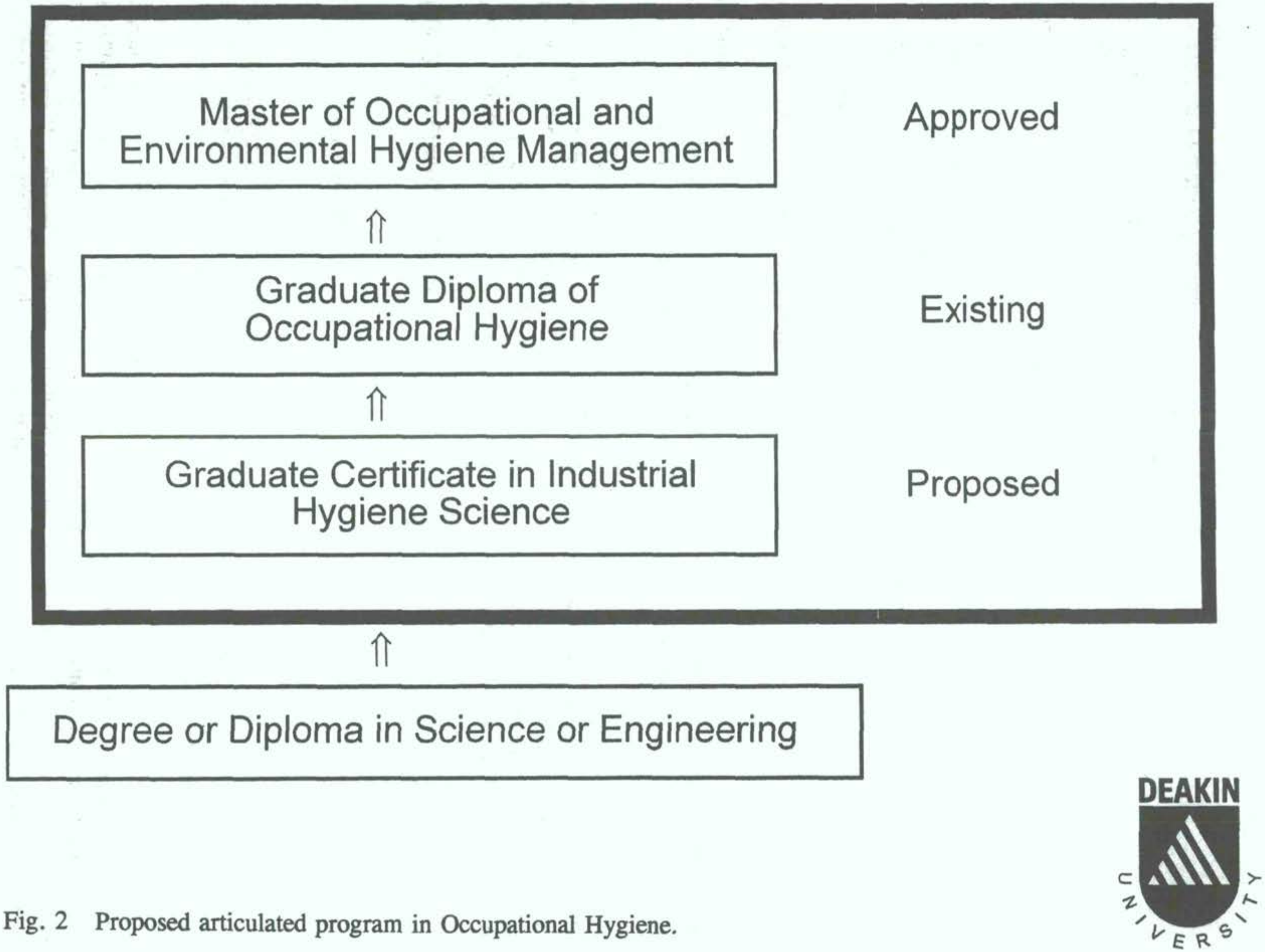


Fig. 2 Proposed articulated program in Occupational Hygiene.

The Undergraduate Program

The course is specifically designed for school leavers who want to specialise in chemistry and the environmental management of hazardous materials. Since its introduction four years ago the course has proved to be very popular. The small group of graduates who finished the pilot course last year have found employment in industry or continued to postgraduate study.

The main aim of the course is to provide graduates with an appropriate knowledge of chemistry, together with the skills and knowledge of the principles and practice of all aspects of the management of hazardous materials.

The basic structure of the bachelors degree is shown in Figure 3. In the specialisation in Environmental Management of Hazardous Materials all students undertake Chemistry as the science sequence.

The professional sequence consists of a series of multidisciplinary units at first, second and third year of the degree. The units are set out below. Each of these units has well defined aims which are listed in Appendix 1.

First year

Introduction to Environmental Management

- Component 1 Current Issues
- Component 2 Use and Management of Hazardous Materials
- Component 3 Data Collection and Presentation

In addition to the above, students must maintain a diary concerning current environmental issues and how they are reported by the media (print, radio, TV) and compare and analyse reports. Verbal presentation of their views is required for both their diary work and their case study.

Second year

The Integrated Management of Hazardous Materials.

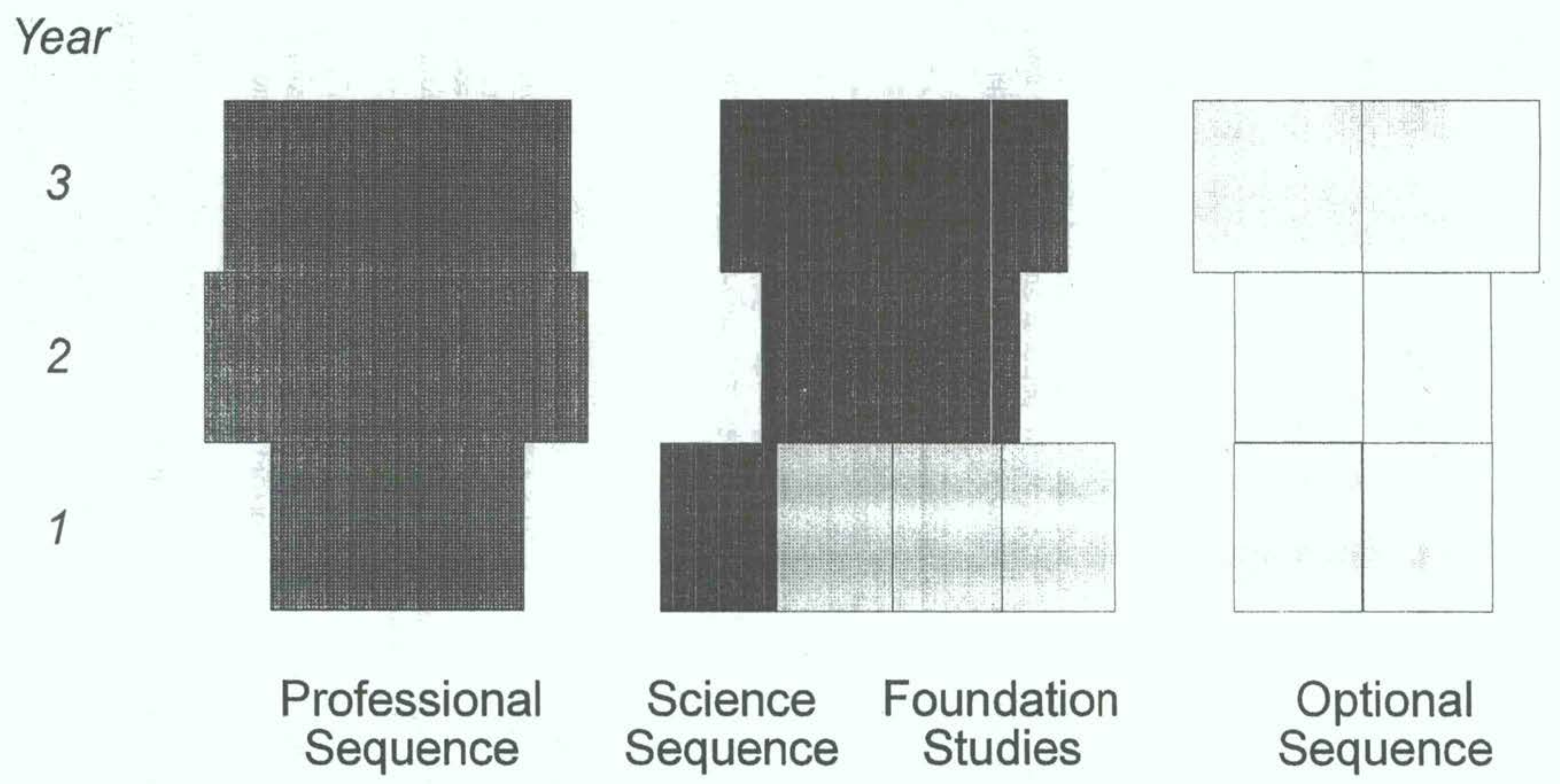
Planning and Environmental Impact Assessment.

Risk Assessment and Avoidance in Hazardous Materials

Environmental Protection and Occupational Health and Safety

Third year

Human Relations and Project Management



DEAKIN UNIVERSITY

Fig. 3 Sructure of the Applied Science degree.

Development, Implementation and Review of Environmental Policy

Studies in Waste Minimisation, Recycling, and Techniques of Treatment and Disposal

Risk Evaluation of Wastes and New Chemical Products in Australia

The content of these units is presented in the Deakin Handbook.

IV. Innovations

The courses presented here include the following major innovations. At the postgraduate level the courses are designed for people in industry. All the units are available in distance education or flexible delivery mode. In 1993 the students undertaking the Graduate Diploma are working in diverse industries across Australia. Preliminary negotiations with other universities and professional organisations indicate that there is considerable scope for expansion of this course and also adaptation to other cultures and settings.

In the undergraduate program the structure of the course is one which has been specifically designed with the emerging interest in hazardous materials in mind. The course is up to date and particularly focused on the legislative issues in Australia. Although the course is set firmly in the context of national and international guidelines, the specific examples from the Australian scene make this course relevant to undergraduate learners.

The course is staffed, in part, with people drawn from Government and industry. The evaluation which has been completed on the course shows that the mix of academic material combined with actual examples drawn from prior events in Australia have been particularly effective.

Some of the assessment and project work undertaken in this course has been particularly successful. The opportunities for students to undertake site audits, and to participate in an appeal to the planning division of the administrative appeals tribunal, as it relates to environmental protection approval or the granting of a planning permit, have been very successful. Some of the senior students have submitted expressions of interest for environmental audits to be undertaken on particular community facilities e.g. hospitals.

A mock "Administrative Appeals Tribunal (AAT)" Hearing has been used particularly effectively. The hypothetical scenario is designed by staff and involves conflict resolution and environmental management and land use planning issues. An independent lawyer is hired to act as chairperson of the proceedings which are formally administered. Submissions are presented and cross examination takes place. Within a week of the hearing a final determination is issued on the scenario. Feedback from professional people that have become involved in this exercise is that the submissions made by the students are as good as, and in some instances better than, the submissions that are made to the "real" AAT. The students themselves find the exercise one of the more exciting and beneficial projects that they undertake.

The use of videos obtained from the fire brigade and news services of incidents involving hazardous materials are used in the classroom during lectures to highlight various points about emergency management and response. This is then translated into "table top" exercises that give the students some appreciation of the pressures, changing circumstances and management expertise that is required in the allocation of roles, responsibilities and logistical support and planning. A visit to a major fire station to review equipment used and to see it demonstrated also gives the students a more complete understanding of the operations and limitations of the fire services in combating incidents involving hazardous materials.

Risk assessment in its many facets is a challenging and fast developing area that has traditionally been the domain of engineers. To our knowledge this is the first time it has been formally offered to scientists at an undergraduate level. In recent years various software packages have become available, but there is a danger that the "black box" will be used and not understood (particularly errors and inherent design limitations). Therefore students are taught long hand techniques at a simple level, recognising that at a more complex level this is what the computer software is doing.

The case study that students undertake gives them a set of designs for which they must submit design modifications that will make the plant safer (this must be quantified). They must also establish the safety separation distance that would be appropriate for its separation from a sensitive land use eg. residential area. Although one of the more onerous tasks in the course, students gain much satisfaction in applying these skills in a practical and useful way.

In waste minimisation and recycling, students are expected to apply knowledge gained to develop an approach which facilitates waste avoidance programs. A major focus of the teaching is developing approaches to conducting audits, assessment of alternatives, development of implementation schedules, and ways of overcoming procedural and work-culture barriers. Examples are drawn from experience of staff in developing and implementing waste minimisation schedules, and this is complemented by examples from the literature. Students are expected to research issues with a view to determining the feasibility of implementing disposal/treatment technology versus cleaner production.

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Appendix 1

Aims of the Multidisciplinary Units

First year

Introduction to Environmental Management.

- Component 1 Current Issues

Aims. To enable students to:

(a) identify and describe conflicts in present and past practices with respect to industry, land-use planning, technological innovation and environmental management;

(b) analyse factors affecting these issues in Australia and elsewhere and participate in problem identification and solution management strategies; and

(c) present a group report (potentially for publication for secondary students studying Environmental Science) on a case study involving the environmental management of hazardous materials.

- Component 2 Use and Management of Hazardous Materials

Aims. To enable students to:

(a) identify the role of chemicals, in their various usage types, within contemporary Australian society;

(b) gain an understanding of chemical production from raw materials to final products and the generic wastes produced, especially the petrochemical and related industries;

(c) define the nature of hazardous materials and identify those substances that are potentially deleterious, their use and the fate of those substances in the environment

- Component 3 Data Collection and Presentation

Aims. To enable students to:

(a) participate in problem identification;

(b) participate in first-hand data collection;

(c) process data;

(d) present data in a meaningful way.

Second year
The Integrated Management of Hazardous Materials

Aims. To enable students to:

(a) become familiar with the basic philosophies, principles and strategies involved in the integrated process of industrial waste management;

(b) become familiar with the United Nations Dangerous Goods system used in identification, labelling, packaging, storage and transport of dangerous goods;

(c) identify the physical and chemical properties of a material that would designate it as hazardous and examine ways in which to control such hazards;

(d) develop a basic understanding of chemical engineering;

(e) develop an understanding of the social, political and economic factors involved in the management of hazardous materials;

(f) identify the factors which contribute to the accumulation of hazardous materials and wastes;

(g) identify the range of waste products produced by industry and the various methods available for their recycling, treatment and disposal;

(h) apply the integrated process approach to the management of hazardous materials; and

(i) introduce the concept of waste minimisation.

Planning and Environmental Impact Assessment

Aims. To enable students to:

(a) develop an understanding of the basic principles and practices of land use planning;

(b) identify the factors which should be taken into account in selecting appropriate techniques for gathering and synthesising information in various situations and for differing purposes;

(c) employ such techniques in a variety of contexts, including Environmental Impact Assessment (EIA);

(d) understand the processes and procedures of EIA;

(e) study the development and implementation of land use policies and how they are controlled;

(f) gain an understanding of the origins of, and the present nature of, the legislative and administrative bases that control land use planning in Victoria; and

(g) examine links between environmental protection, hazard and risk and land use planning in relation to industries involving hazardous materials.

Risk Assessment and Avoidance in Hazardous Materials

Aims. To enable students to:

(a) understand the concepts of hazard and risk management and characteristics and classify hazardous materials and hazards using current concepts and risk assessment data;

(b) understand the basic processes involved in the risk analysis of chemicals;

(c) formulate plans and practices for the safe handling, reclamation, disposal or stabilisation of a hazardous material in a controlled manner and develop safe emergency procedures for handling hazardous materials in the case of an accident or other emergency;

(d) appreciate the implications of incompatibilities and life-time in handling, storage and transport of hazardous materials and wastes;

(e) analyse the causes and consequences of accidents in chemical process industries;

(f) understand the issues relating to land use planning around chemical industry and the concepts of individual and societal risk in relation to such facilities;

(g) appreciate the various methods for fire prevention and protection;

(h) undertake a quantitative risk assessment study using the processes of HAZAN and HAZOP;

(i) prepare material safety data sheets; and

(j) appreciate the potential hazards and risks associated with the treatment and disposal of hazardous wastes.

Environmental Protection and Occupational Health and Safety

Aims. To enable students to:

(a) understand the basic principles of toxicology;

(b) understand the principles of international law and law in Australia as it relates to the control and management of Occupational Health and Safety, Environment Protection and Dangerous Goods;

(c) examine a range of air pollution control devices, their applications and principles of operation;

(d) examine a range of techniques and devices used to control and manage oil spills in an aquatic and foreshore environment;

(e) examine a range of techniques and equipment used in the remediation of contaminated land;

(f) understand the processes involved in conducting audits on environmental, occupational health and safety and dangerous goods compliance;

(g) appreciate the range of protective personal equipment that is available and its limitations;

(h) examine a range of portable hazardous materials monitors that would be used for health and safety monitoring and hazard indicators in emergency response; and

(i) examine the dynamics of the workplace and critically assess the processes through which occupational health and safety is managed in the workplace and the methods by which it may be improved.

Human Relations and Project Management

Aims. To enable students to:

(a) practice and develop a range of interpersonal skills relevant to their tasks as managers;

(b) interpret research evidence on interpersonal influence and develop strategies for intervention in organisations;

(c) develop interaction analysis skills to deal more effectively with group situations;

(d) identify project needs and identify objectives in the light of existing policy;

(e) use project management techniques to set up multidisciplinary research projects;

(f) apply organisational guidelines and obtain work experience in multidisciplinary teams;

(g) evaluate the processes of project procedures and project methodology;

(h) write and present reports.

Development Implementation and Review of Environmental Policy

Aims. To enable students to:

(a) identify the roles and responsibilities of individuals, community groups, institutions and various levels of government and authorities in policy processes;

(b) analyse the nature of policy-making and the range of processes which lead to policy formulation, interpretation and implementation;

(c) describe the purposes (explicit and implicit) of various policies;

(d) assess the role of political and social factors in the development of policy;

(e) evaluate the effectiveness of policies;

(f) relate environmental policies to governmental strategies;

(g) relate processes of management to the policy content; and

(h) reflect on the role of environmental management and science in society.

Studies in Waste Minimisation, Recycling, and Techniques of Treatment and Disposal

Aims. To enable students to:

(a) evaluate recycling and waste minimisation techniques for a variety of materials;

(b) analyse various disposal techniques for a variety of hazardous materials and determine appropriate guidelines for the disposal of a variety of waste materials;

(c) evaluate waste audits and waste management plans as essential tools for managing wastes;

(d) apply a "cleaner production" approach to waste management with a focus on the reduction/avoidance of waste; and

(e) recognise the issues (economical/technical/environmental) that interact in developing waste management strategies.

Risk Evaluation of Wastes and New Chemical Products in Australia

Aims. To enable students to:

(a) estimate the potential environmental and occupational risk posed by new chemical products, products of industrial processes, and wastes;

(b) obtain, evaluate and use physicochemical, biological and toxicological data to estimate the potential risks of a material when released into the environment;

(c) propose recommendations on the acceptability, use, handling, storage, transport and disposal of chemicals and materials;

(d) develop further skills in risk management, in particular in ecotoxicology;

(e) study the various requirements for the different modes of transport of dangerous goods by air, sea and land at an international level;

(f) appreciate the various exposure routes in the calculation of an environmental exposure (i.e food, water, air, soil, dusts, etc); and

(g) appreciate how therapeutic goods, agricultural and veterinary chemicals, foodstuffs, and industrial chemicals are evaluated and regulated for exposures to workers, the community and the environment via federal administration.

ENVIRONMENTAL EDUCATION FOR UNDERGRADUATE STUDENTS

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I. Introduction

During the recent two decades, the explosion of the world population and the expansion of the human activities have caused environmental problems on a global scale, e.g., green-house effect by CO_2 emissions, acid rain, and contamination of soil and seawater with radioactivity from defense wastes and toxic chemicals and hazardous wastes in various types. Much effort is expended for the remediation of contaminated areas, because the most effective way is an in-situ decontamination by appropriate chemical treatments, if possible. In Japan, high-tech pollution is becoming an important issue for environmental scientists. An example is the air and water pollution by toxic materials used in production of semiconductors.

Universities and institutions in Japan are involved in academic research activities and have themselves generated various forms of waste. Generated laboratory wastes are composed of various kinds of hazardous materials, and hence have to be treated carefully to convert non-toxic compounds. The wastes from these institutions have to be considered from the global environment point of view, because these institutions also play a leading role in environmental research and education. Environmental education for undergraduate students will be one of the most important ways for environmental preservation as well as administrative control and regulations.

Environmental resources (e.g., river water and air) were heavily polluted with discharge of liquid and gaseous wastes from industrial activities in the 1970s. The importance of waste treatment within an individual university campus was also recognized as being necessary for preservation of the local environment. Waste treatment facilities were therefore built in many universities. Currently, technical information and experiences on the waste treatment in universities, including national, public and private ones, have been exchanged through the Japanese Association for Laboratory Waste Treatment Facilities of University (JALWTFU), organized in 1982. The JALWTFU held the First Asian Symposium on Academic Activity for Waste Management (AAWM) in 1993 (JALWTFU, 1993).

The objective of this presentation is to introduce a case study of environmental education for undergraduate students in Tokyo Institute of Technology (TIT) using a laboratory waste treatment facility as the teaching and training center.

II. Faculties and Graduate Schools

Background information on the Tokyo Institute of Technology and on waste management practices at universities in Japan is to be found in TIT (1993a; 1993b), Ministry of Education (1992) and JALWTFU (1992). Figure 1 shows the organization of Tokyo Institute of Technology. The Faculty of Science, Faculty of Engineering, Graduate School of Science & Engineering and the Research Laboratory for Nuclear Reactors are located at Ookayama campus (Tokyo), as well as the Research Center for Carbon Recycling and Utilization and others. Other laboratories are located at Nagatsuta campus (Yokohama). These campuses are separated by ca. 25 km. The numbers of undergraduate and graduate students, and teaching and administrative staff are 1,687 and 8,396 (546 students from abroad), respectively as of 1 May 1993. The total undergraduate enrollment is 5,380, including 362 students from abroad. All these students are users of potentially toxic materials at various phases of the curriculum and are involved in generation of hazardous wastes and waste water. The gross quantity of these wastes is negligibly small in comparison with those from industrial activities. However, the range of waste is enormously large and universities are just like a "waste museum". A specific approach has to be taken corresponding to the characteristics of each waste. It requires considerable time and expense for the treatment. Nevertheless, universities are obliged to treat these wastes safely. Also universities have an important role of teaching and training students who will tomorrow be decision-makers and tax payers. Therefore, a laboratory waste treatment facility at a university should be utilized as a cooperative facility for environmental education and environment protection.

III. Environmental Education involving Handling Laboratory Wastes

The total quantity is of waste is voluminous at TIT and increasing year by year (Fig. 2). The situation has reinforced the need of environmental education. Lecture courses on environmental science commence at the beginning of the first and second semesters and are highly recommended for all freshmen given the relevance to global environment preservation, as has been mentioned previously. The aids of teaching are texts (JALWTFU, 1992; TIT, 1993b; Ministry of Education, 1992) and videos prepared by members of the Research Center for Carbon Recycling and Utilization.

The waste water and other liquid wastes from universities are also under regulation by the Basic Law for Environmental Pollution Control (hereafter, abbreviated as the law) by the central government and other regulations by city government. When these treated liquids are released to environment the concentration levels of hazardous and toxic materials are required to be lower than those prescribed in these regulations. Those for mercury and PCB are set taking into consideration the possibility of health hazard through their accumulation due in the food chain and concentration in fish and shellfish which are often gathered by Japanese. In the law regulation levels are given, including BOD, COD, phosphate (total phosphorus) and nitrate (total nitrogen), with a view to preserving aquatic environments. According to the guidelines, undergraduate students are informed of the importance of chemical treatment of toxic and hazardous materials by which the effluent is made free from those materials. They attend a class for environmental education twice a year, 2 h each. It is held in the beginning of the general chemistry experiment for the first and second semesters. In the former, basic knowledge for environmental protection and practical procedures of liquid

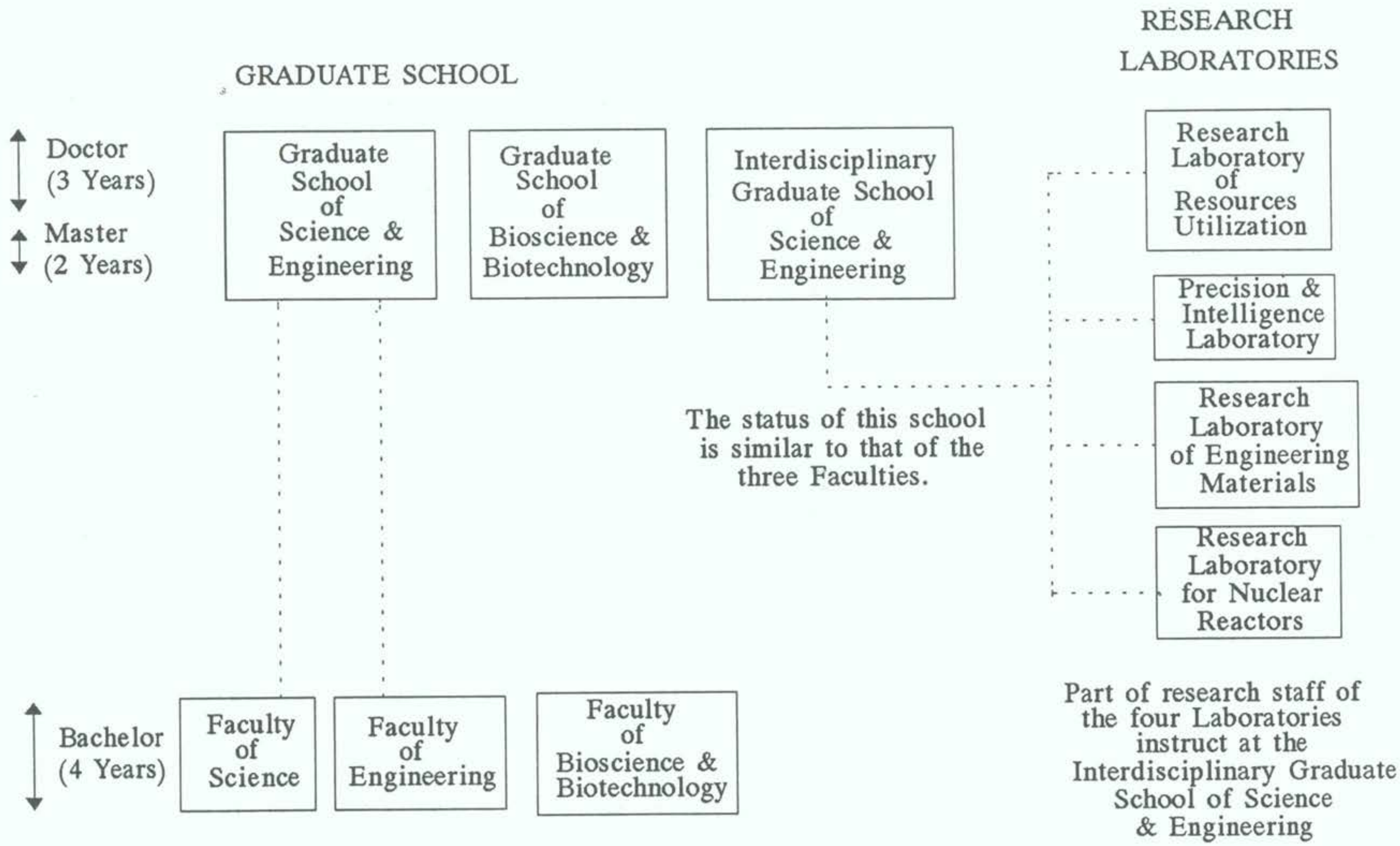

Fig. 1 Faculties and Graduate Schools of the Tokyo Institute of Technology.

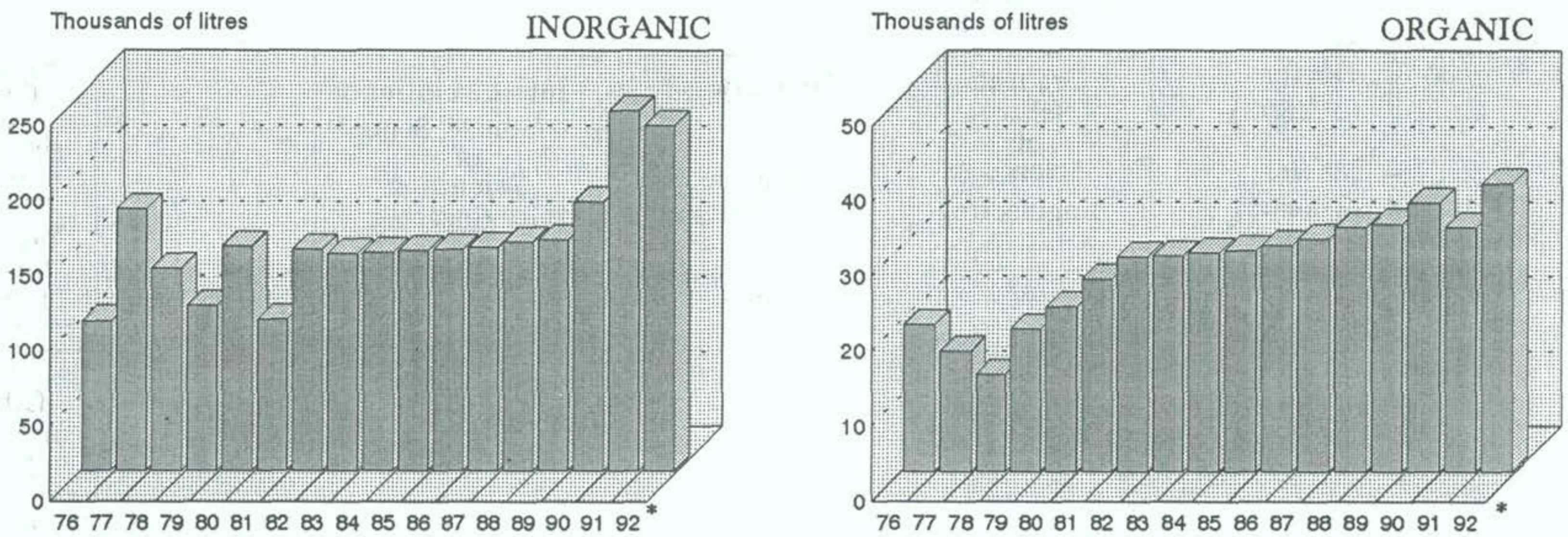

Fig. 2 Quantities of inorganic (top) and organic (bottom) liquid wastes. For academic year 1992 the quantity is the waste received by December.

waste handling are covered. In the latter major emphasis is placed on global environmental issues. These lectures are given by faculty members of the Research Center for Carbon Recycling and Utilization. Besides this program, undergraduate students of 3rd to 8th semesters are given practical instruction on waste handling methods in each laboratory or on-the-job type of training by the faculty members. A TIT manual for safe handling and operation of chemicals and wastes (TIT, 1993b) is made available to all the students and they are asked to read through it in advance. Many comics are used for explanation of details for handling toxic chemicals and wastes. The liquid hazardous wastes are stored and prepared in each laboratory for transport to the TIT Waste Treatment Facility (TITWTF) according to the prescribed criteria.

The TITWTF is located at the Ookayama campus and receives liquid wastes from education and research facilities on the Ookayama and Nagatsuta campuses. Laboratory liquid wastes generated at Nagatsuta campus are transported to Ookayama campus by vehicle, because a waste treatment facility is not available. Paper is burned in a small incinerator within each campus. Activities performed at the TITWTF consist primarily of ferrite processing of inorganic liquid waste containing heavy metals, decomposition and incineration of organic wastes, continuous monitoring for toxic and hazardous materials, chemical analyses, storage and transportation to a permanent offsite disposal facility.

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INSTITUTIONAL CAPACITIES FOR HAZARDOUS WASTE MANAGEMENT IN INDONESIA

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I. Introduction

Indonesia is the world's largest archipelago (more than 13,700 islands) with a total territory of approximately 7.7 million km^2, among which a total land area of approximately 1.93 million km^2, straddled across the equator between the Indonesian and Pacific oceans, and lying at the zone of collision between the main Asian and Australian continental plates.

Indonesia's population of 176 million (1990) is rapidly growing (1.97 per cent per annum) and concentrated (population density of 500-800 persons per km^2) mainly on the "Inner islands" (Java, Madura and Bali) where young rich soils have made intensive agriculture possible and enabled the support high population density.

This concentration population has provided a labor force and attracted investments in the majority (83 per cent) of secondary and tertiary industries in comparison to the "Outer Islands", thereby contributing to environmental degradation of this region.

Waste management is a basic human need to be fulfilled for the people of any country. Many countries face the common problems of waste disposal problems. Those are proper management of industrial waste, hazardous waste and medical waste, waste reduction and recycling, siting disposal facilities, and environmental control for waste disposal facilities.

In recent years, wastes are quantitatively increasing because of redevelopment in urban areas and the development of industrial productivity, and are becoming qualitatively diversified as high technology industries are developed.

The Government of Indonesia has formulated an environmental policy intended to incorporate the full participation of all its people, where each person, both as an individual and as a community member, has the obligation to maintain the living environment and to prevent and abate environmental damage and population.

One of the most important elements of this policy is Act No. 4 of 1982, on the Basic Provisions for the Management of the Living Environment.

Indonesia is currently facing some hazardous waste management problems, such as pesticides and pharmaceutical residues and wastes, lead sludge from battery manufacturing, phenol formaldehyde sludge, leather tanning and electroplating industries.

This paper will discuss the sources of hazardous wastes, the institutional capacities in hazardous waste management, and the management and strategic approach related to hazardous wastes.

II. Sources of Hazardous Wastes

Hazardous wastes are produced by the industrial, mining, agricultural and forestry sectors, as well as other sectors such as trades, community services (hospitals, laboratories) and domestic. Hazardous waste can be generated during mining, synthesis or manufacturing, transportation, distribution, storage, utilization, and disposal. The substantial industrial growth that is needed to achieve the balance between the agricultural and industrial sectors, results in an increase of industrial pollution. With this expansion of the industrial sectors, the potential of hazardous wastes, especially generated by industry, become a major problem in Indonesia.

The amount of hazardous wastes produced by the respected provinces have not yet been reported, but there are inventory studies on industrial wastes in several provinces or industrial zones, from where we are able to estimate the amount of hazardous wastes.

Data on the amount of the toxic and hazardous waste at some industrial zones in Indonesia, available at the Office of the Minister of State for Population and Environment is listed in Table 1.

Table 1

Amount of Toxic & Hazardous Waste at Various Industrial Zones in Indonesia

From Hilman, M., KLH (Office of the Minister of State for Population and Environment), 1988.

No.	Cities	Total toxic & Hazardous waste at various industrial zones in Indonesia
1.	Lhok Seumawe (3 industries)	- 90 ton activated carbon containing Hg
2.	Batam Island	- 1,200 m^3, sponge iron containing sulphur
3.	Palembang	- 1,150
4.	Jabotabek (Greater in Jakarta)	- 4,138,989.6 ton (total industrial waste)
5.	Surabaya	- 400,000 - 850,000 ton (total industrial waste)
6.	Gresik	- 4,100,000 ton from 25 industries
7.	Bekasi - Cibinong	- 49,381.5 ton

Studies of hazardous and toxic material disposal and management carried out in JABOTABEK (Jakarta, Bogor, Tangerang, Bekasi), were conducted by the Office of the Minister of State for Population and the Environment in 1983 and 1984, in cooperation with NAEP-Denmark & Chemcontrol AS. Some of the findings were that 50% of the industries having more than 100 employees produced an industrial waste amount of 800,000 ton/year, and approximately 50% was claimed to be hazardous waste that needed special treatment. It was estimated that in JABOTABEK more than 400,000 ton/year of hazardous waste are produced which need special treatment. The total amount of industrial waste in Jakarta from 103 factories in 1983 was 431,340 tons/year, of which approximately 200,000 ton must be claimed as hazardous waste which needs specific handling and treatment. Another study in 1990, conducted by KLH in cooperation with EMDI, and undertaken by Dames & Moore and PT Environment Nusa Geotechnica, estimated that the total amount of hazardous wastes (solid, sludge and liquid) generated in the JABOTABEK region was approximately 2,000,000 ton in 1990. It will increase to approximately 2,250,000 ton in 1995, and approximately 2,500,000 ton in the year 2000.

People have from long ago been worried about the effect of toxic chemicals on human health and the environment. Organic and inorganic chemicals and heavy metals are especially dangerous, as these pollutants are not fully removed by standard water treatment facilities. Traces of these toxicants can become concentrated in the food chain, potentially exposing human beings to chronic diseases that may be revealed over time. In some urban areas, industrial pollution is almost as pervasive as pollution from human and municipal waste.

A study of Tangerang (West Java) Industrial zone found serious pollution at all 10 monitoring locations (World Bank, 1989). The most alarming finding was the high concentrations of heavy metals and other toxic substances in a number of sampling stations along the Cisadane river. These included chromium, primarily used in metal alloys and plating; cadmium, used in protective plating and bearing metals; high mercury levels at all locations and more than 100 times the allowable level at one location; and selenium, a non metallic element used in the electronic industries for the production of computer wafers.

Analysis of fish and shellfish taken from the Jakarta Bay indicated that WHO standards for heavy metals were exceeded in 76% of the samples for cadmium (Cd), 51% for copper (Cu), 44% for lead (Pb), 38% for mercury (Hg), and 2% for chromium (Cr). PCB and DDT in the Bay's waters reached 9 ppb and 13 ppb respectively, exceeding the limit of 0.5 ppb considered to be the threshold level.

Heavy metal concentrations (Hg, Cd, Cu and Zn) in samples of rice, maize, soya, green peas, wheat flour, tapioca, sticky rice, and also vegetables were found to be under the tolerance level, based on FAO/WHO standards; and in 30 samples of vegetables that have been taken, no Pb or Cd could be detected. Table 2 shows the extent of heavy metal concentration in vegetables and grains.

Table 2

Heavy Metal Concentrations in Vegetables and Grains

From Suwirma S and Surtipanti (1980, 1985) and Lubis (1986) in Environmental Quality of Indonesia, KLH, 1990

	Grains (1980)	Vegetables (1985)	Vegetables (1986)
Cu	2.63 - 7.77	n.s	0.52 - 2.57
Zn	13.13 - 22.47	0.06 - 206.23	2-19 - 47.00
Hg	0.02 - 0.04	0.04 - 1.23	0.002 - 0.011
Cd	0.04 - 0.05	n.s. - 0.26	n.s.
Pb	0.09 - 0.14	0.02 - 2.39	n.s.

n.s = not surveyed

Table 3 shows waste amounts from 103 registered factories in Jakarta, by type of industrial waste.

III. Institutional Capacities in Hazardous Wastes Management

Parallel to the rapid economic growth of Indonesia, the utilization and the production of hazardous substances are increasing. More important is that the hazardous wastes generated from many activities are also increasing, and should be managed in a deliberate and committed manner, to protect our environment from the hazardous waste pollution.

Indonesia has already issued regulations to deal with the hazardous substances/wastes generated by many sectors, which should be responsible for the management of the hazardous materials/wastes.

Some of the regulations are :

1. Regulation of the Ministry of Industry No. 148/M/SK/4/1985 concerning "Safety on Toxic and Hazardous Materials in Industries".

2. Regulation of the Director General of Supervision of Drug and Food, Ministry of Health No. 239/Menkes/Per/V/85 concerning "Hazardous Dyestuffs".

3. Government Regulation No. 13 of 1975, concerning "The Transportation of Radioactive Materials".

Table 3

KLH Categories and Amount of Industrial Waste
from 103 Registered Factories in Jakarta, 1984

From Kantor Menteri Negara KL, 1984

No.	Types of Industrial Waste	Waste amount in ton/year	
		Total Registered	Special Treatment *
1.	Arsenic, Mercury, Cadmium, Chromium, Lead, etc.	57,330	57,730
2.	Organic Halogen	0	0
3.	Chlorinated Solvents	124	62
4.	Aromatic Solvents	204	102
5.	Pesticides	25	25
6.	Petroleum, Asphalt, etc.	1,080	540
7.	Pharmaceutical	730	730
8.	Materials/Chemicals	0.1	0.1
9.	Asbestos	224	224
10.	Selenium	0	0
11.	Copper, Zinc.Tin	495	0
12.	Acid Alkalies	3,110	3,110
13.	Other Solvent	0	0
14.	Mineral Oils	16	0
15.	Solid Chemicals	24,103	24,103
16.	Liquid Chemicals	8,031	8,031
17.	Mixed Process Wastes	84,930	62,465
18.	PCB Wastes	0	0
19.	Others	250,550	62,638
Total		430,952.1	199,760.1

* Waste amounts from the 103 registered factories which need special treatment,

4. Regulation of the Ministry of Agriculture No. 429/Kpts/vm/1973 concerning "Stipulation of Wrapping and Labelling of Pesticide".

5. Regulation of the Ministry of Trade and Cooperation No. 349/kp/ix/82 concerning "Pentachlorophenol Pesticides and Sodium Salts".

6. Regulation of the Ministry of Home Affairs, Ministry of Health and Ministry of Agriculture : No. 33/1983. No. 203/Menkes/Inst/v/1983, No. H.K. 050/04/inst/9/1983 concerning "The Utilization of DDT".

In cooperation among the Ministry of State for Population and Environment, the Ministry of Health, and the World health Organization (WHO), a draft of Act on controlling hazardous substances over their complete life cycle has been prepared. This act provides requirements for importers, producers, transporters and users of hazardous substances. There is a need to develop a consensus on the program responsibilities for the government departments that have a mandate in handling or managing the hazardous substance. These are The State for Population and the Environment, the Environmental Impact Control Agency for Indonesia (BAPEDAL), Ministry of Health, Ministry of Manpower, Ministry of Communications, Ministry of Trade, Ministry of Manpower, Ministry of Agriculture, Ministry of Mining and Energy, and the National Agency of Atomic Energy (BATAN).

As a supplement to this hazardous substance regulation, which is incorporated in the next Five Year Plan, Indonesia will implement a National Register of Potentially Toxic Chemical (NRPTC). This will ensure that relevant information is readily available.

In parallel with the hazardous substance program, a cradle to grave system to control the hazardous wastes is now under development. It is planned that the hazardous waste program will be phased-in over the next fifteen years.

By the end of 1990, the State Ministry for Population and Environment, in cooperation with Environmental Management Development in Indonesia (EMDI), developed the final report of the "Hazardous Waste Program Development in Indonesia".

This report consists of:

- Regulatory development: technical drafting of the regulation and hazardous waste priority list;
- Guidelines and training: guidelines for facilities, guidelines for generators, waste oil guidelines, industrial sector guidelines;
- Facility development;
- Waste reduction, reuse and recycling, including the "waste exchange"; and
- Hazardous waste strategy and project management.

A cornerstone of a effective control system is the provision of treatment, storage and disposal facilities for those wastes that cannot be reduced or managed by the generators. Recently, ten priority locations for the establishment of the facilities have been identified.

Those ten locations are :

- The Greater jakarta including the industrial areas of Jakarta, Bogor, Tangerang, and Bakasi (JABOTABEK area);
- Surabaya, the capital city of East Java;
- Lhokseumawe industrial zone, in the province of Aceh, Sumatra;
- Medan, the capital city of North Sumatra;
- Batam Island Authority in Riau province;
- Palembang, the capital city of South Sumatra;
- Bandung, the capital city of West Java;
- Semarang, the capital city of Central Java;
- Balikpapan, the oil-boom town in East Kalimantan; and
- Samarinda, the capital-city of East Kalimantan.

In these locations, an initial inventory of hazardous wastes generation, including producers, types and amount generated, has been prepared. Ecological conditions and other considerations have also been identified. Feasibility studies for facilities in the Greater jakarta and Surabaya are already completed. These studies lead to the establishment of integrated facilities including physical/chemical treatment, incineration and sanitary landfill.

Before the integrated facilities are available, temporary storage facilities are being considered for Jakarta, Bandung, Surabaya and other key areas.

Waste reduction, reuse and recycling (3 R's) are now being promoted. The 3 R's management option will reduce the emission of waste to the environment, reduce the amount as well as the cost of raw materials, thereby conserving the non-renewable natural resources and minimizing the long term liabilities associated with landfilling.

Initial work was also undertaken to establish a "Waste exchange" programme for Indonesia, as one of the provisions of the 3 R's.

IV. Management and Strategic Approach to Hazardous Waste Management

The purpose of waste management includes improvement of public health, protection of the living environment and conservation of natural resources. When considering the strategy of waste management, the purpose and target of waste management must be clarified. In order to accomplish these targets, restrictive conditions exist must be identified and analyzed.

In general the following restrictive conditions are considered:

(a) Land Space for Final Disposal

Since the land area size is limited, the acquisition of a landfill site is extremely difficult. The level of difficulty depends on the urban area, rural area and the distance from the waste generation point.

(b) **Environmental Impact**

Waste management has the purpose of environmental protection. But the waste management facility itself will likely affect the environment. Whether or not this effect on the environment offsets the environmental protection benefits and whether or not the degree of effect to environment is acceptable must be checked.

(c) **Health Impact**

Whether or not the effect to health from pollution generated by a waste management facility is within acceptable levels must be confirmed.

(d) **Conservation of Natural Resources**

All over the world, everybody understands that the conservation of natural resources is required. It must be confirmed that the waste management plan has no obstacle for the accomplishment of the conservation of natural resources, an objective which must be given priority.

(e) **Limitation of Equipment, Material and Workers**

There is a limit imposed by the number of workers who are engaged in waste management activities, by equipment and by material and disposal technology, etc. There is a limit on the ability to accomplish the waste management objectives mentioned above given such limited equipment, material and manpower. How effectively the management target is accomplished with the limited resources is important.

(f) **Budget Limitation**

The funding available for waste management is also limited. What should be done to accomplish the above mentioned target with limited resources is described in the strategy already presented in this paper. Figure 1 shows the strategy for industrial and hazardous waste management.

Items numbered "2" show the various restrictive conditions for accomplishing the target. At the point indicating how the target (identified by "1") should be accomplished, various strategies or tactics must be used.

Items numbered "3" describe the work methods - the importance of recycling is pointed out.

By the promotion of recycling, the conservation of natural resources, which is a restrictive condition, can be satisfied to some extent. At the same time, the reduction

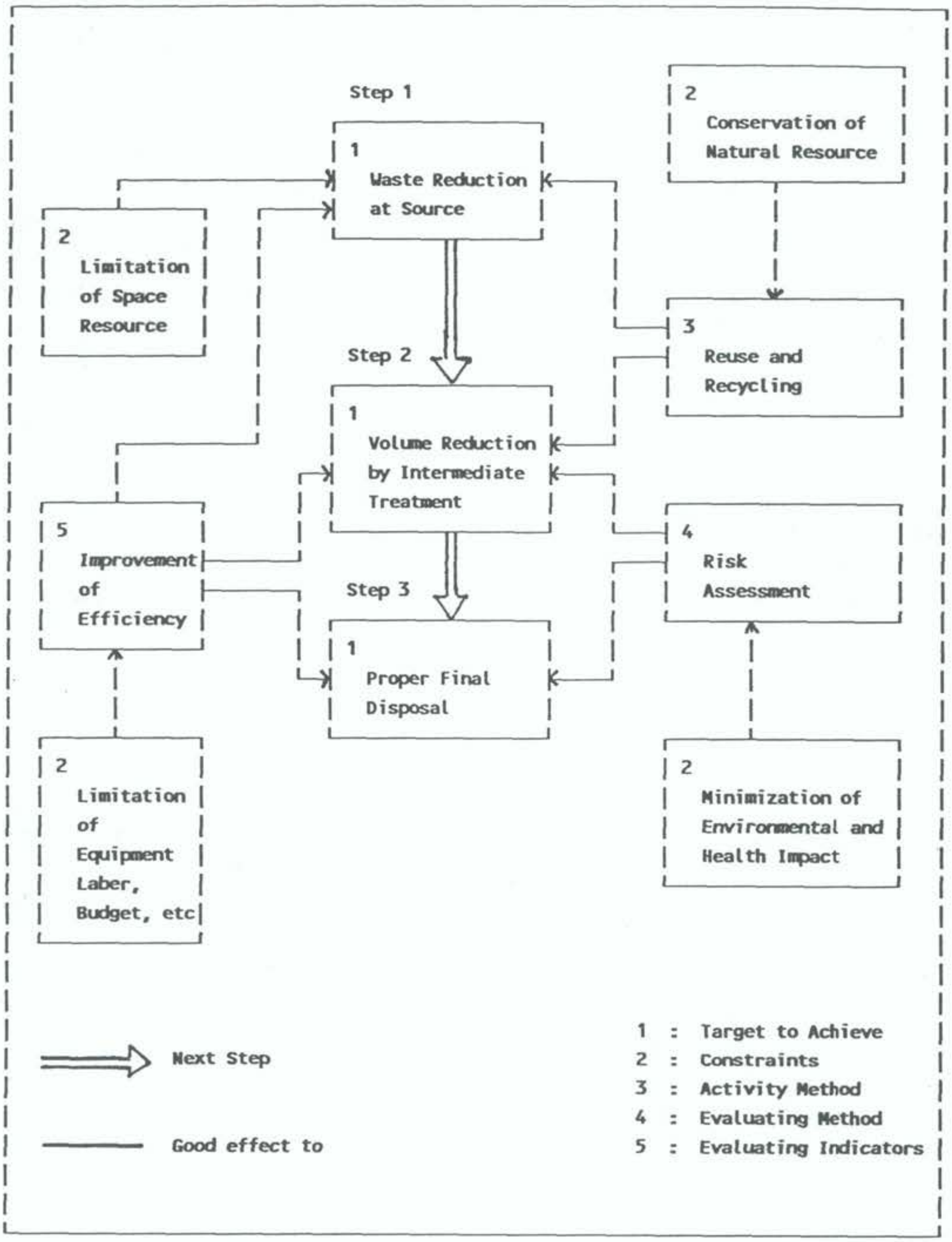

Fig. 1 Strategy for hazardous waste management (adapted from Tanaka, 1991).

of wastes at the generation source can be accomplished.

Furthermore, the reduction of waste volume can be accomplished by the recycling, Items with number "4" shows the evaluation method to be used to determine whether or not the effects on the living environment and influences on health are acceptably small. With this risk assessment, an overall scientific judgement is made and the appropriate disposal level will be determined. The item numbered "5" shows the evaluation indicator used for the result.

In order to accomplish the objectives despite the limited resources (equipment, material and manpower) and within the restrictions imposed by the budget, the efficiency must be enhanced. The evaluation parameters for the efficiency (the cost per ton, wastes collected or disposed of per worker) must always be analyzed. The data should be prepared to demonstrate whether or not proper and efficient waste management is achieved, or indicate how to enhance the efficiency.

V. Conclusion

Hazardous waste management in Indonesia has several dimensions: approaches, programs and objectives. Through consensus of understanding of environmental concepts and management, it is expected that attitude, commitments and the capability of experts in various disciplines and professions can be improved in support of environmentally sound and sustainable development.

References

Ex-Corporation (1992). Indonesia : Resources and the Environment - Toward on International Cooperation for the Environmental management. Tokyo - Japan.

Kantor Menteri Negara KL (1989). Population and the Living Environment, An Overview.

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Soerjani, M, Soetaryono, R and Kusnoputranto, H (Eds) (1991) Environmental Profile of Indonesia 1990. Published by Overseas Economic Cooperation Fund (OECF) and Prepared by Centre for Research of Human Resources and the Environment, University of Indonesia.

Tanaka, M (1991). Industrial Waste and It's Management. Seminar on Industrial and Hazardous Waste Management, August 2, 1991, Jakarta : Cipta Karya and JICWELS.

FIJI CONTRIBUTION TO UNEP NETTLAP TCHW WORKSHOP

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I. Country Overview

Fiji is a South Pacific island nation occupying 18,300 square kilometers. It has a population of about 750,000 and in 1991 the per capita GNP was $US1500. The main contributors to the economy are agriculture and tourism.

II. The Local Issue Relating to TCHW

There appears to be a need to dispel the popular notion that toxic chemicals and hazardous wastes are a problem for more industrialized countries to grapple with. It is also essential to create an awareness of the environmental risks associated with the improper management of such substances in Pacific island countries. The following sections develop a lecture to address these requirements.

III. The Objective of the Lecture

This lecture is primarily intended for tertiary level students, particularly those undertaking programmes in environmental studies. Students will not be expected to have an advanced level of knowledge in the pure sciences. However some basic understanding of scientific principles will be assumed.

The objective of the lecture is to create an awareness among students that, although the level of industrialization in Pacific island nations is considerably lower than some other countries, the prevalence of the toxic chemicals and hazardous waste issue is still very much a concern. The risks associated with the mismanagement of such substances are outlined, with the use of local examples and situations, as far as availability of appropriate documentation allows.

IV. The Lecture and Presentation Methodology

1) Title

The Assessment of Chemical Risk Associated with Toxic Chemicals and Hazardous Wastes in Pacific Island Environments.

Total Time: 1 hour

2) Toxic Chemicals and Hazardous Wastes - What are they?

An outline of the criteria used for the definition and classification of toxic chemicals and hazardous wastes, both locally and elsewhere.

References:

Batstone, R, Smith, J E and D Wilson (Eds) (1984) The Safe Disposal of Hazardous Wastes - The Special Needs and Problems of Developing Countries. Vol 1. World Bank Technical Paper, 0253-7494. Chps 1, 2.

Haines, R and Bardsley, D (1992). The Education and Training of Personnel Involved in the Handling and Monitoring of Hazardous Wastes. European Foundation for the Improvement of Living and Working Conditions. Official Publication of the European Community.

Time: 10 minutes

3) Relevance to Pacific Island Countries

It is quite common for people in Pacific island nations to perceive toxic chemicals and hazardous wastes as substances which are produced by highly industrialized countries. As a result, considerable importance in regional meetings is given to strategies for the prevention of toxic waste dumping by industrialized countries in pristine island environments (this point will be supported by a newspaper report). While it is generally true that chemicals used or wastes generated in industrialized countries are more hazardous in nature, the need for proper management of toxic chemicals and hazardous wastes is not restricted to such countries. There have been several occasions when newspaper articles have highlighted concerns regarding such substances in Fiji. These will be brought to the attention of the students.

People also tend to regard hazardous substances as those which produce an immediate, dramatic and harmful effect when released into the environment. Under this misconception, a waste containing cyanide, for example, may be considered toxic but another containing high levels of nutrients may not be considered in the same light. Obviously, the risk associated with such substances may not be manifested immediately and it is important to make students realize this.

References:

This section makes use of newspaper articles to support the issues being addressed.

Time: 5 minutes

4) Toxic Chemicals and Hazardous Wastes in Fiji

There is very little information available on the generation, storage or disposal of toxic chemicals and hazardous wastes in Fiji. A knowledge of the level of industrial and other development allows some deductions to be made about the types of substances that are likely to be of concern. This has been done in the recently-published, *The National State of the Environment Report for Fiji* and the information contained therein will be presented to the students. It could also be pointed out that the situation with other regional island countries could follow the same course as they begin to undertake similar development activities.

References:

Watling, D and S P Chape (Eds) (1992) Environment Fiji - The National State of the Environment Report. IUCN, Gland, Switzerland. 154pp

Brodie, J and J Morrison. (1984) The management and disposal of hazardous wastes in the Pacific islands. Ambio. Vol 13, p331 - 333.

Time: 5 minutes

5) Chemical Toxicity

The toxicity of the substances is outlined with the use of LD_{50} values for some relevant substances. The difference between acute hazard and chronic hazard is emphasized.

References:

Guidelines to Drinking Water Quality. Vol 2. Health Criteria and Other Supporting Information. WHO. 1984

Time: 10 minutes

6) Environmental Chemistry of Hazardous Substances

The magnitude of the impact of a hazardous substance in the environment will be determined to a large extent by its chemistry. No specific studies have been carried out on the chemistry of hazardous substances in the context of South Pacific island environments. The chemistry, however, will probably be not that much different from other places, except that special emphasis has to be placed on the role of the marine environment because of the close proximity of the sea to most activities on land. The chemistry of hazardous substances such as solubility and speciation in solid and solution phases will be discussed.

References:

Moriarty, F (1983) Ecotoxicology - the Study of Pollutants in Ecosystems, Academic Press, London, p10.

Stumm, W and J J Morgan (1981). Aquatic Chemistry. John Wiley and Sons. New York. Chp 11.

Time: 10 minutes

7) Environmental Assessment

Before any assessment can be made the potential pathways in the environment have to be established. A diagram summarizing pathways will be presented. Following this, a number of studies on the dispersion of hazardous substances in South Pacific island environments are outlined:

wood treatment chemicals (copper, chromium and arsenic) in the vicinity of a timber mill in Fiji

arsenic in the marine environment following arsenic spillage in Vila harbour, Vanuatu

tri-butyl tin in the marine sediments in Suva, Fiji

References:

Gangaiya, P, Brodie, J E and R J Morrison (1988). Baseline study of the Vitogo River and associated environment. UNEP Regional Seas Report and Studies No. 93, UNEP, Nairobi, 27 p.

Gangaiya, P and J E Brodie (1986). Arsenic levels in water and marine organisms after a spillage of arsenic (V) oxide in Vila harbour, Vanuatu. INR Environmental Studies Report No. 31, University of the South Pacific, 13p.

Stewart, C and S J de Mora (1992). Elevated tri (n-butyl) tin concentrations in shellfish and sediments from Suva Harbour, Fiji. Applied Organometallic Chem. Vol 6, p502 - 512.

Time: 15 minutes

8) Conclusion

Summary and reconsolidation of ideas on the potential environmental impact of hazardous substances.

Time: 5 minutes

V. Evaluation

The assessment of this topic should take into consideration that the material has been presented over one lecture only. The topic could therefore form part of an assignment or examination question. Practical experience of environmental assessment techniques could also be planned and evaluated.

PROJECT CASEWORK (PCW) APPROACH FOR HAZARDOUS WASTE MANAGEMENT TRAINING PROGRAM

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I. Introduction

With rapid economic progress in the region, countries of Southeast Asia have emerged as new growth centers of the world economy. The industrial sector is the growth engine of the Southeast Asian economy. These industries produce increasing amounts of hazardous wastes and other pollutants. In particular the untreated release of heavy metals into the environment is causing increasing concern in the region. The dangers resulting from industrial hazardous wastes are aggravated by the fact that most polluting industries are concentrated in the urban growth centers.

In the last three decades, the electroplating industry has been playing an important role in the growth of engineering industries. The increased demand for consumer items has also resulted in the establishment of many small-to-medium-scale plants engaging in electroplating works. The growth of these independent small-to-medium-scale industries in the region may be attributed to the growth of light and medium engineering industries which found it more convenient and economical to have their metal products plated by independent electroplaters.

In comparison with other industries, electroplating industries use much less water. Hence the volumes of the wastewater produced are comparatively smaller. However, the wastewaters are highly toxic in nature because of the presence of metals such as copper, nickel, zinc, cadmium, chromium and cyanides.

There were 615 electroplating industries registered in Thailand in 1985, and most of them were located in Bangkok. These metal finishing industries discharged annually about 30 tonnes of heavy metals into the water courses. In Malaysia, it was estimated that there are as many as 100 operating electroplating shops in the Klang Valley. In Hong Kong, there are about 770 registered electroplating industries. A large number of unregistered small electroplating workshops are also operating in the area. There are 87 workshops that carry out electroplating activities in Singapore.

Although methods of treating electroplating wastes are well established, most of these electroplating plants in the region have no or inadequate treatment facilities. The main factors are their sporadic distribution, small scale operation, lack of space for installing waste treatment facilities in view of being located mostly in areas of high activity or in a composite industrial complex in multistoried buildings (as in Hong Kong) and the high capital and recurring cost of treatment to meet the effluent guidelines, particularly for the small workshops.

Hazardous waste legislation has been established recently in the Southeast Asia countries. However, for most countries there is a general lack of experience and training in hazardous waste management,in both government and the private sector. Most of the countries in the region do not have the capability for environmental legislation enforcement. The main reasons are manpower shortage and brain drain.

The Carl Duisberg Gesellschaft - South East Asia Program Office (CDG-SEAPO) launched a Hazardous Waste Management (HWM) training program in 1986 in order to address the issue of training for the region. CDG-SEAPO commissioned several consultants from the region to prepare training manuals for HWM in metal finishing industries by using an innovative approach - the Project Casework (PCW) method. The PCW was developed by Mr Guenter Tharun, the Head of CDG-SEAPO. CDG-SEAPO has been using the training manual and PCW methodology to provide numerous HWM training courses in the nine East and Southeast Asian countries. This report briefly describes the innovative PCW method for HWM training program.

II. The Project Casework (PCW) Approach

Project casework (PCW) is mainly a blend of three types of active learning methods: (a) the "prospective" project method; (b) the "retrospective" case method; and (c) "interactive" group work. The PCW approach, with its prestructured tasks for group work such as a case study, is intended to generate sufficient motivation and pressure to build feasible solutions under pressure of time. The approach is flexible and open to additional inputs like role playing, simulation games, and/or actual project work. These would definitely enrich the learning experience.

The PCW approach stresses problem analysis and assessment, development of strategies, selection of options, and reasoning. These components facilitate decision-making processes. The participants, playing realistic roles, will be put in situations of decision-making and acting. Thereby, they experience simulated consequences of their decisions and the inter-relationship between decisions and resulting outcomes.

The main objective of the PCW-based training program is to produce environmental professionals from different institutions in various countries who are able to make appropriate decisions on environmental issues, taking account of unique local conditions, constraints and resources. While working through the different stages of the PCW, the participants can realize that at many turning points numerous decisions have to be taken by them in order to proceed. This experience, together with the varied results of the different working groups, demonstrate to participants the fact that numerous, even small, decisions can lead to many different outcomes. These are simulated real-world planning and decision-making processes which might prepare them better for staging actual environmental projects.

Instead of merely providing technical information, PCW seeks to develop and strengthen participants' decision-making capacities regarding complex environmental issues. To meet these objectives, PCW proceeds in three major steps. The first step is the assessment of a problem by taking into account available resources and existing constraints, risks, and opportunities. The second step is to devise strategies for action, analyzing, costing, and comparing various feasible options. The final step is to select a most viable option, based on the available resources and constraints.

These steps are mainly performed by the trainees themselves. PCW offers real world scenarios that demand solutions designed by the participants. Real world situations are further simulated by group work and role games. The participants will act as factory owners, technical consultants, and representatives of government regulatory bodies. Both group work and role games are designed to stimulate interaction and communication among the participants that resemble the experience of their daily work. Trainers and resource persons are not acting as all-competent teachers. They are the advisors, facilitators and consultants. They cautiously guide participants in their analytical, problem-solving, and planning efforts, especially when they get into a deadlock situation. Further explanations and other relevant inputs are given by them in the form of technical presentations and lectures. The presentations are integrated into the program at junctions where information is needed.

III. Scope of the Training Material

The training material for HWM by the PCW approach presents a typical pollution problem scenario faced by small and medium industries in the developing countries in the Asia-Pacific region. It centers around pollution and waste production caused by an electroplating industry.

To enable the participants to develop feasible solutions to the case presented, sufficient background information and data are provided. These include mainly technical and financial data as well as institutional/legislative information on government regulations. An additional dimension of social, political and economic constraints is also included.

The training program is intended for engineers with a few years background or experience in pollution control. The program will also be helpful for government regulatory agency personnel and academic/research professionals to understand the problems encountered by the small and medium industrial establishments. Upon intensive examination of the technical and financial capabilities and constraints, balanced by a sense of social responsibility to society, the training material would pave the way for a more effective approach to environmental problem-solving.

IV. Structure of the PCW Material

The PCW material is packaged in the framework of a simulation exercise and role play, in which the participants act as members of a pollution control project team in an industry and/or members of a consulting group, while the trainers will guide and work along with participants, and serve as external consultants, if needed.

Project Casework is presented through background information in the form of documents and correspondence relating to the industry. Part A of the manual presents the general conditions, location, area development plan and pollution control ordinances of the project. Information in part B include treatment options, resources recovery, waste recycling and reuse. Part C provides the cost data of the chemicals, utilities, facilities and equipment.

The whole exercise can be worked out according to a suggested sessional work program as follows:

Session 1: Assessment of Pollution Problems and Development of Control Objectives
Session 2: Development of Pollution Control Options and Resource Recovery Alternatives
Session 3: Cost Evaluation of Options
Session 4: Overall Analysis and Selection of Solution.

Each session program contains the following:

- Objectives
- Activities and Discussion Guidelines
- Time Allocation
- Measurable Outputs
- Information Inputs.

Some information is deliberately withheld and will be supplied by the resource persons only upon request.

V. Summary

An innovative Project Casework (PCW) approach was developed by Mr Guenter Tharun, Head of Carl Duisberg Gasellschaft - South East Asia Program Office (CDG-SEAPO) as an effective training program for hazardous waste management. Training manuals were prepared by several consultants from the region for the training program. The PCW is mainly blended with three types of active learning methods: a) the "prospective" project method; b) the "retrospective" case method: and c) "interactive" group work.

The PCW approach is different from other existing environmental training programs. The PCW approach stresses problem analysis and assessment, development of strategies, selection of options and reasoning. The participants acquire knowledge of hazardous waste management by working on a real world problem and develop a viable solution based on the available resources and other constraints.

PCW can be simply an additional input to any seminar or training course, or alternatively, it can comprise the dominant feature of the whole course. The course material could be expanded or modified to reflect the current requirements, local conditions and resource constraints.

The PCW approach for hazardous waste management for the metal finishing industries has been used for numerous training courses in 9 Asian countries. The responses from the participants are overwhelmingly favourable for the PCW approach. The training material has been translated into Chinese and Thai for the benefit of Chinese and Thai speaking participants.

Acknowledgements

The author wishes to thank Mr Guenter Tharun, Head of CDG-SEAPO, for granting the permission to present the PCW approach in the Workshop, and for his invitations to participate in various training programs organized by CDG-SEAPO in the Asian countries. Some of the material presented in this manuscript was extracted from the following publications:

1. Guenter Tharun, "Approaches and Methods of Training in Environmental Planning and Management for Local and Regional Development", in: Regional Development Dialogue, Vol.8, No.3, pp 196-228, 1987.

2. Guenter Tharun, "Approaches to Manpower Development in the Field of Solid Waste Management in Asian Metropolises", in: Regional Development Dialogue, Vol.10, No.3, pp 90-106, 1989.

3. Guenter Tharun, "Future Trends in Environmental Education and Training", Mimeographed Paper, Asian Institute of Technology, Bangkok, Thailand, 1989.

AN APPROACH TO THE PREVENTION AND MINIMIZATION OF INDUSTRIAL TOXIC AND HAZARDOUS WASTES IN VIETNAM

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I. Introduction

The recent momentum of development activities in Vietnam signals an urgent need to address the environmental protection and natural resources management needs of the country strategies which begin the transition toward sustainable forms of development. Concerned about the future demands that economic development would place upon the environment, the Government of Vietnam requested UNDP assistance for the formulation of a National Environmental Plan and for convening an International Conference on Environment and Sustainable Development.

In Vietnam's National Plan for Environment and Sustainable Development 1991-2000, the framework for action related to pollution control and waste management advocates:

a) appropriate technologies for waste reduction, reuse and recycling

b) control and treatment of air, water and soil pollution

c) control of toxic chemicals and hazardous substances.

II. Current Industrial Pollution Situation and Control Approaches

Vietnam has over 3,000 major factories, many of them are located in industrial zones such as Vinh Phu, Ha Bac, Hanoi, Bac Thai, Hai Phong, Quang Ninh, Ho Chi Minh City, Bien Hoa and Vung Tau. Even though the country does not have a well-developed industrial base, industrial development was proceeded in the past without any consideration being given to the effects on the environment. This is coupled with the fact that many industries have obsolete equipment and hence produce more pollutants than their counterparts in industrialized countries. Very few of them are equipped with pollution control facilities. Hence industrial wastes in Vietnam have been posing serious threats to the environment. There are very few systems or no system at all for controlling hazardous and toxic wastes in Vietnam, although important quantities of these wastes are generated each year, endangering the health of the population. Much of the waste is disposed, without treatment or controls, in lakes, rivers and canals and on land. Some examples are shown in Tables 1,2 and 3. As the industrial base expands and develops, the quantity and toxicity of these wastes

Table 1

Water Quality of To Lich River in Hanoi

(From Tran Hieu Nhue, 1990)

Parameter (in mg L^{-1}, except Ph)	At Cau Moi (Thuong Dinh Industrial Zone)	At Kim Giang (1 km below Thuong Dinh)
D.O.	2.0 - 2.6	3.0
Ph	7.7 - 8.2	7.5
S.S.	230 - 570	545
COD	183 - 328	242
BOD5	21 - 120	17 - 125
H_2S	30	3
NH_4	5 - 7	9
NO_2	0.4	0.7

Table 2

Water Quality in the Canal Nhieu Loc
in Ho Chi Minh City

(From Lam Minh Triet, 1990)

Station	Ph	DO	BOD_5	COD	NH_3	TS	SS	C1	SO_4
Thi Nghe Bridge	6.0	0.4	94	214	27	288	70	360	18
Cong Ly Bridge	6.4	0	164	217	22	465	84	300	60
Truong Minh Giang Bridge	6.9	0	86	112	29	327	92	440	88
Kieu Bridge	6.7	0	180	287	21	316	27	546	62
Dien Bien Bridge	6.6	0	87	147	35	858	36	476	46

Table 3

Toxic Chemicals at the Work Place

(From Nguyen Cong Thanh, undated)

Chemical	MAC	Example of Pollution
Carbon monoxide	0.03 mg L^{-1}	Coal Gas Stations of textile plants: 0.11 mg L^{-1} Vapour stoves of various factories: 0.075-0.150 mg L^{-1}
Chlorine gas	0.005 mg L^{-1}	Chemical factories: 3.7-22 times higher than MAC
Hydrogen fluoride	0.005 mg L^{-1}	Chemical fertilizer factories: 5-6 times higher than MAC
Lead dust	0.00001 mg L^{-1}	Printing and battery factories:
Benzene Toluene	0.050 mg L^{-1}	16-60 times higher than MAC in some enterprises: 0.75 mg L^{-1}
Diisocyanate	0.0005 mg L^{-1}	Polyurethane porous loan factories: 20 times higher than MAC

are increasing. In the framework of the National Environment Research Programme activity (KT - 02), the project on investigating treatment, recycling and reuse of industrial wastes and development of some cleaner technologies of production (KT -02-06) is being conducted by the Department of Environmental Engineering, Hanoi University of Technology. In order to achieve the objectives of the project, a waste audit approach was applied.

The shift from waste treatment towards waste prevention has the following benefits:

- Waste quantities, and therefore their effects on the environment, are reduced;
- Raw material consumption and therefore costs are reduced;
- Waste treatment costs are reduced;
- Working conditions are improved; and
- Process efficiency is improved

A waste audit is the first step in an on-going programme designed to achieve maximum resource optimization and improved process performance. It is a common sense approach to problem identification and problem solving.

Undertaking a waste audit involves observing, measuring, recording data, and collecting and analyzing wastes samples. To be effective is must be done methodically and thoroughly, together with full management and operator support.

A good waste audit:

- defines sources, quantities and types of the wastes being generated;
- collates information on unit operations, raw materials, products, water usage and wastes;
- highlights process inefficiencies and areas of poor management;
- helps set targets for waste reduction;
- permits the development of cost-effective waste management strategies;
- raises awareness in the workforce regarding the benefits of waste reduction;
- increases knowledge of the process; and
- helps to improve process efficiency.

The waste audit procedure illustrated in Figure 1.

The project KT-02-06 is going-on as the first phase of the waste audit procedure. Due to limitation of the time and budget of the project, it was decided that in the period of 1992 and the first half of 1993 year the study should concentrate on:

- evaluation of the present situation of production technologies and waste generation in the major industry sectors; and

- determination of the major problems/wastes associated with a particular process or industrial sector in order to prioritize the needs for waste minimization in the years to come, based on hazard, urgency and feasibility.

All existing documentation and information regarding the processes, the plant, or the regional industrial sector were collated and reviewed. Surveys of industrial zones and individual plants have been undertaken. A number of experts of key industry sectors and the research institutions were invited to participate to the project workshop on "Industry and Environment", which was held on January, 1993 at the Hanoi University of Technology.

Following are some of the preliminary conclusions:

1. In general, the industrialization level of Vietnam is very low compared with other countries. But due to very old equipment, backward production technologies, the norms of ratios: raw material per product as well as the amount of waste generated per product unit being very high. In addition, legislation on the management of waste sources does not existed. In situations where industrial zones have been constructed near or inside population quarters, plus the rapid urbanization rate occurring in cities, industrial productivity is not great but the waste quantity in each zone at any point of time is very great. Many river sections, ricefields and villages adjacent to industrial zones are becoming more and more polluted.

2. Priority should be given to the industrial sectors according to the order of hazard potential. The urgent need for solving environmental problems is as follows:

a) Basic chemicals and fertilizers:
H_2SO_4 production and phosphate fertilizers,

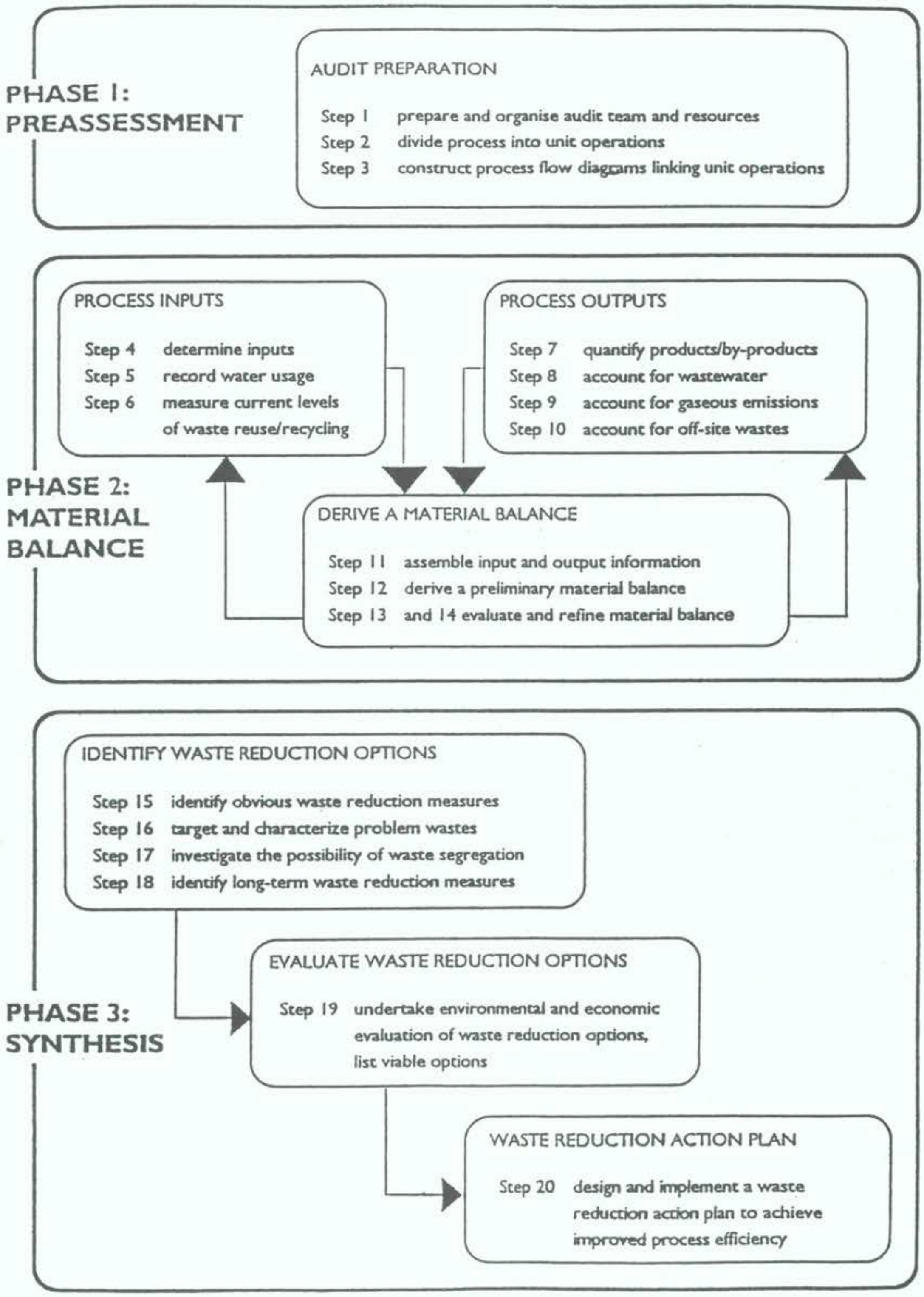

Fig. 1 Flow diagram of waste audit procedure.

Electrolysis [see table 4]

b) Consumer goods

Wastewater from dying workshop of textile factories

Wastewater from pulp and paper production

c) Thermo-electric and machinery plants

Main pollutants: dust particles and SO_2

d) Food processing industry

Main pollutants;

- Wastewater from meat and marine product processing plants
- Wastewater from fruit and vegetable canning
- Wastewater from alcohol - wine - beer production

e) Metallurgy, mechanical and mining engineering

- Wastes from non-ferrous metallurgy
- Wastes from electroplating

III. Conclusions

The development of industry in Vietnam in recent past time has resulted in pollution influences on the environment. This issue will increase rapidly, particularly in areas of economic development. The problem of environmental protection is a problem of high systematization, requiring many people deeply knowledgeable of the subject. It is regretted that up to now Vietnam does not have conditions enabling it to invest in this research work. Therefore, firstly there is a serious scientific task to study all aspects of the shortcomings and development of the country's industry.

Based on the preliminary results during the first phase of auditing industrial wastes, it can be concluded that a waste reduction action plan should first concentrate on:

- Treatment and management of toxic chemicals and hazardous wastes from chemical and fertilizer industries, particularly ones containing Fluor, chlorine and their compounds; attention should be paid to SO_2 emission and water usage aspects.

- Identifying a fertilizer and insecticide suitable for ricefield applications. Reducing excess toxic quantities in water and the same as limiting stable toxins in the biological link to have harvested agricultural products with high quantity and quality.

In addition, there is a need to have a rational zoning plan for the factories and a selection of production technologies providing a new industrial base and leading to industrial development and sustainable development of the society. This requires education, raising people's cultural standard to meet the demand for environmental protection in the industry.

Table 4

Major Factories of Chemicals and Fertilizers

No	Factories	Main Product	Capacity of product tonne $year^{-1}$	Raw Material	Notes of Wastes
1	Viet Tri Chemicals (Vinh Phu Province)		5,000	White salt	WW containing sludge of $Mg(OH)_2$, $CaCO_3$, $Ca(OCl)_2$ (200 m^3 day^{-1}) - Cl_2 gas emission much higher than permissible. Limited concentration
2	Bai Bang pulp and paper (Vinh Phu Province)	NaOH		White salt	a workshop of pulp and paper factory
3	Bien Hoa chemicals (Ho Chi Minh City)	NaOH HCl, HCl(37%) Na_2SiO_3 $Ca(OH)_2$	3,700 6,000 8,600 12,000	White salt sand White salt	by product $Ca(OCl)_2$ use for bleaching purpose in the city
4	Dong Nai Sodium hydroxide (Dong Nai Province)	NaOH Cl2	300		a workshop of COGIDO pulp & paper factory
5	HaBac Nitrogenous Fertilizer & Chemicals (HaBac province)	NH_3 urea	70,000 -70,000	HonGay	-WW 12,000 m^3 h^{-1} (containing NH_3, CN, As, Phospho, phenol, goudron) -NH_3 emission-negligible -coal scoria was reused
6	LamThao Superphosphate & chemicals (VinhPhu province)	H_2SO_4 $Ca(HPO_4)_2$ H_2O	100,000 300,000	FeS_2 $Ca_5(FPO_4)_3$	Gaseous emission: -SO_2 -Fluor (in forms of SiF_4 & H_2SiF_6:45-40%; the rest remained in the final product in form of Fluoruasilicat. -F. recovered in form: Na_2SiF_6 -Dust particles WW:2,500 m^3 h^{-1} with pH<2

Table 4 (cont.)

Major Factories of Chemicals and Fertilizers

No	Factories	Main Product	Capacity of product tonne/year	Raw Material	Notes of Wastes
7	Long Thanh superphosphate (Dong Nai Province)	H_2SO_4 $Ca(H_2PO4)_2$ H_2O	8,000	Imported S Laocai Apatit	Gaseous emissions -SO_2 -flour
8	ThuDuc chemicals (Ho Chi Minh City)	H_2SO_4	2,200	Imported S	-SO_2 gas emission
9	TanBinh chemicals (Ho Chi Minh City)	H_2SO_4 Al_2SO_3,	4,000 1,500	Imported S LamDong boxit	-SO_2 gas emission
10	Dongnai chemicals (Ho Chi Minh City 1974)	Na_2SO_4	600	$(NH_4)_2SO_4$	
11	VanDien Thermo-phosphate Fertilizer (Hanoi)	Thermo-phosphate	70,000	Laocai apatit Serpentine	-Flour gas emission
12	NinhBinh Thermo phosphate Fertilizer (NinhBinh province)		30,000	Gaseous emissions -Fluor	-Fluor gas emission

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MANAGEMENT AND ASSESSMENT OF ECOLOGICAL TOXICITY OF CHEMICALS IN CHINA

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I. General Situation of Management of Chemicals

It has been estimated that there are more than 40,000 chemicals produced in China. The annual value of chemicals produced reached 30 billion US dollars in 1992. At the same time, a considerable number of chemicals are imported. Chemicals valued at more than 6 billion US dollars are imported each year. The scale of the problem faced is very great. The process of production, transportation, storage, use and waste disposal of chemicals cause pollution of the natural environment due to a lack of appropriate management regulations and measures to prevent pollution. In recent years, the National Environment Protection Agency (NEPA) in China has been developing environmental management laws and regulations for chemicals so that there may be sound management of the potential pollution of toxic chemical substances and hazard wastes. For environmental management purposes, the registration of imported and new chemical pesticides has been undertaken. Regulations for the Environmental Management of Imported (Exported) chemicals will be issued soon.

"Guidelines for Testing of Chemicals" and "Guidelines for Assessment of Ecological Toxicity to Pesticides" have been developed. The draft list of priority controlled chemicals in China and a list of banned and severely restricted chemicals for importation and exportation have been completed and will be issued soon. The guidelines for assessment of the ecological hazards of chemicals are now being developed.

II. Assessment of Ecological Toxicity of Chemical Pesticides

The registration system of chemical pesticides in China was introduced in 1982. The producers and managers of chemical pesticides are required to make an application for registration to the Agriculture Ministry and National Environmental Protection Agency (NEPA) before new chemical pesticides are put on the market and chemical pesticides are imported (exported). The applicants provide materials and data as follow:

(a) Description of product (name, composition, physical and chemical properties, type of formulation and structural form);

(b) Analytical method of product;

(c) Brief description of production techniques;

(d) Data on toxicity (acute toxicity, sub-acute toxicity, chronic toxicity, reproduction and teratogenicity, mutagenicity, biochemical tests for test animals, delayed neurotoxicity, data from human exposure, the maximum concentration in air, first aid and antidote);

(e) Residues and their effects on environmental quality. To give an outline of the method of residue analysis on crop, soil and water. Residue in food and residue data. Photodegradation. Biochemical tests on crops including metabolism and toxicity of mutabilities. Effect on ecological system including toxicity; and

(f) Application technique : Efficacy. The criteria for safe use and phyto-toxicity.

1. Requirement of materials and data for ecological toxicity of chemical pesticides

(a) Data on use : type of formulation, amounts, methods, time and region of use;

(b) Physical and chemical properties: Vapor pressure, water solubility and partition coefficient (n-octanol/water);

(c) Data of environmental behavior: photodegradation, soil degradation, hydrolysis, absorption and vapour action; and

(d) Data of toxicity of living beings.

2. Scheme for assessment of ecological toxicity of chemical pesticides

See Figure 1.

3. Example: Assessment of ecological toxicity of 2-ethyl-N (ethoxymethyl) -X-chloroacetyl anilide

2-ethyl-N(ethoxymethyl)-X-chloroacetyl anilide is a new selective herbicide. Its molecular formula is: $C_{13}H_{18}ONCl$, M=239.5
Structural formula: C_2H_5-C_6H_5-N(CH_2O-C_2H_5)-CO-CH_2Cl

3.1 Assessment of toxicity of aquatic organisms

Table 1

Toxicity for fish (Cyprinus carpio)

Concentration (ppm)	Death Rate (%)			
	24h	48h	72h	96h
0.13	0	0	0	0
0.18	0	0	10	50
0.23	0	0	20	80
0.30	0	30	40	100
0.38	0	30	70	100
0.65	10	100	100	100
0.85	20	100	100	100
1.10	30	100	100	100
1.43	80	100	100	100
1.86	100	100	100	100
LC_{50}(ppm)	1.13	0.43	0.30	0.19
95% Confidence limit	(0.99-1.28)	(0.37-0.49)	(0.27-0.35)	(0.17-0.21)

Table 2

Toxicity for Tadpole (Rana limnocharis)

Concentration (ppm)	Death Rate (%)			
	24h	48h	72h	96h
0.15	0	0	0	10
0.22	0	0	10	50
0.33	0	50	100	100
0.50	60	100	100	100
0.75	90	100	100	100
1.13	100	100	100	100
LC_{50}(ppm)	0.50	0.33	0.26	0.21
95% Confidence limit	(0.43-0.58)	(0.29-0.37)	(0.24-0.28)	(0.18-0.24)

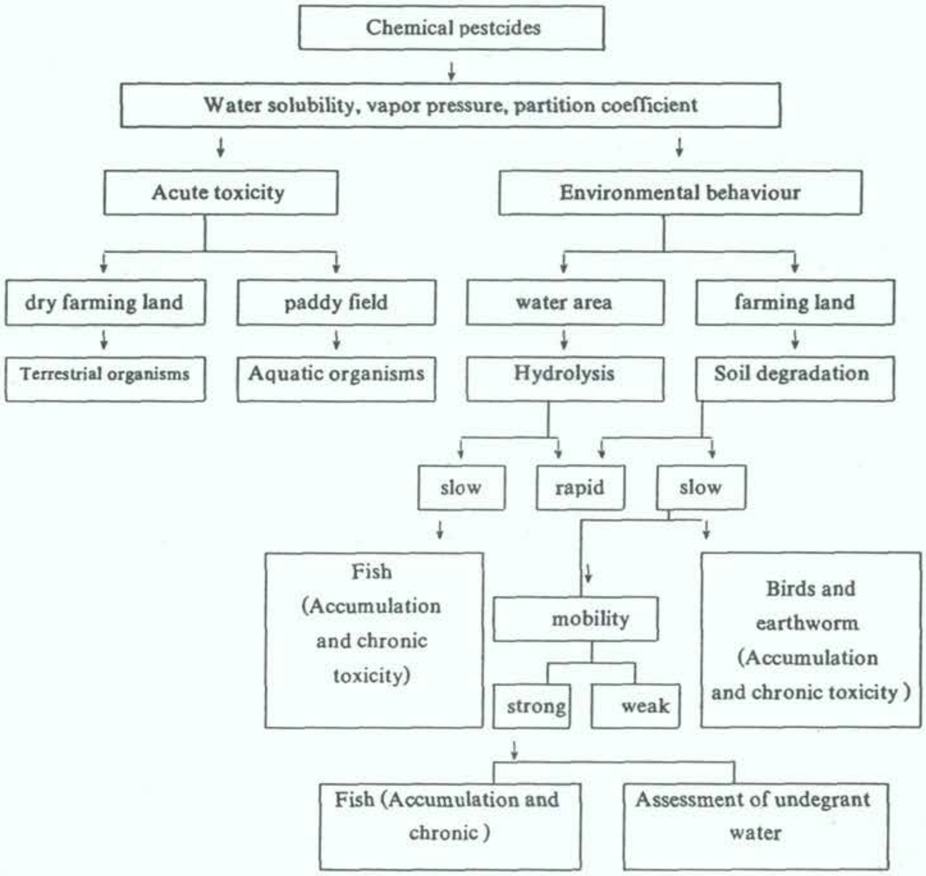

Fig. 1. Scheme for assessment of ecological toxicity.

Table 3

Toxicity for Daphnia carinate

Concentration (ppm)	Death Rate (%)	
	24h	48h
0	0	0
0.40	2	12
0.72	4	20
1.28	6	42
2.24	8	64
4.00	10	75
LC_{50}(ppm) 95% Confidence limit	>4.00	1.47

Table 4

Toxicity for Alga (Scenedesmus)

Concentration (ppm)	Death rate (%)				
	2d	3d	4d	5d	6d
0.44	12	15	10	6	5
0.67	26	29	26	19	20
1.00	57	50	47	44	40
1.50	83	71	65	62	59
2.25	100	86	78	64	62
3.38	100	100	100	86	92
EC_5(ppm)	0.89	1.00	1.10	1.32	1.34
95% Confidence limit	(0.80-0.99)	(0.88-1.13)	(0.79-1.25)	(1.16-1.51)	(1.18-1.52)

Table 5

Assessment of Toxicity for Four Species of Aquatic Organisms

A. The Criterion for toxicity assessment for fish and alga to chemical pesticides

	Lab Assessment (ppm)		Predicted Assessment of Field Toxicity (Coefficient of Application)	
	Fish LC_{50}(48h)	Alga EC_{50}(6d)	Fish	Alga
Highly toxic	<0.1	<0.3	>2000	>333
Medium toxic	0.1-1.0	0.3-3.0	200-2000	33.3-333
Low toxic	>1.0	>3.0	<200	<33.3

B. Assessment of Toxicity for Four Species of Aquatic Organisms**

	Lab Assessment		Previous Assessment of Field Toxicity	
	LC_{50}(48h)(ppm)	Toxicity	Coefficient of Application	Toxicity
Fish (Cyprinus Carpio)	0.43	Medium	87.21	Low
Tadpole (Ranalimnocharis)	0.33	Medium	113.64	Low
Daphnia Carinate	1.47	Low	25.51	Low
Alga (Scenedesmus)	1.34*	Medium	27.99	Low

* EC_{50}(6d) ** Use amounts in field : 562.5 g/hec

In comparison to the criterion of toxicity assessment of fish and alga to chemical pesticides, the toxicity of 2-ethyl-N(ethoxymethyl)-X-Chloroacetyl anilide to four species of aquatic organisms is relatively low.

3.2 Assessment of toxicity for terrestrial organisms

Table 6

Assessment of toxicity for a bird (coturnix coturix lime)

Oral (mg kg^{-1})	death rate (%) for > d
0	0
49	0
74	60
111	70
167	90
250	100
LD_{50}(mg kg^{-1}) 95% Confidence limit	83.7 (69.5-100.6)

The criteria for the toxicity assessment for birds to chemical pesticides are given in Table 7.

Table 7

Criteria for Toxicity Assessment of Birds

	LD_{50} (mg kg^{-1}) for > d
Highly toxic	<15
Medium toxic	15-150
Low toxic	>150

In comparison to the criterion of toxicity assessment for birds to chemical pesticides, the toxicity of 2-ethyl-N(ethoxymethyl)-X-Chloroacetyl anilide to Coturnix coturix lime is medium.

The assessment of toxicity for a bee is given in Table 8.

Table 8

Assessment of toxicity for bee (*Apis L.*)

Dermal toxicity (24h)		Oral toxicity (24h)	
μg/unit	Death rate (%)	ppm	Death rate (%)
acetone	0	0	0
4.4	0	2.1	15
10.9	16	10.7	6
27.2	6	53.3	4
68.0	8	266.7	11
170.0	26	1333.2	20
425.0	85	6666.7	51
		33333.3	66
		166666.7	85
LD_{50}(μg/unit) > 170		LC_{50}(ppm) > 6000	

The criterion for toxicity assessment of bees to chemical pesticides is given in Table 9.

Table 9

Criteria for Toxicity Assessment of Bees

	Dermal LC_{50}(μg/unit)
Highly toxic	0.001-1.99
Medium toxic	2.00-10.99
Low toxic	>11.0

In comparison to the criteria for toxicity assessment of bees to chemical pesticides, the toxicity of 2-ethyl-N(ethoxymethyl)-X-Chloroacetyl anilide to bee belongs to low toxic.

An assessment of the toxicity of silkworm (*Bomby x mori*) is given in Table 10.

Table 10

Assessment of the toxicity of silkworm (*Bomby x mori*)

		Death rate (%)	
		24h	48h
Oral (mg kg^{-1})	1106.8	8	7
	1549.5	2	83
	2169.2	42	92
	3036.9	42	88
	4251.7	83	92
	5952.4	88	
LC_{50}(mg kg^{-1}) (95% Confidence limit)		2872.4 (2714.8-3039.1)	1805.9 (1695.1-1924.0)
Dermal ($\mu g/cm^2$)	54.9	5	5
	76.9	3	3
	107.8	38	38
	149.9	90	90
	252.8	92	100
	353.9	90	100
LD_{50}(μg cm^{-2}) (95% Confidence limit)		111.3 (108.7-117.5)	113.0 (108.7-117.5)
Fumigation (ppm)	3125	0	0
	6250	552	52
	12500	100	100
LC_{50}(ppm) (95% Confidence limit)		>300	>3000

Table 11

Assessment of Toxicity for Earthworm (*Eisenia toefida*)

A. Parameters of tested soil

Soil type	pH	Organic matter (%)	CEC (mg/100g)	Texture (,0.01 mm%)
Blank earth	8.40	3.34	24.03	48.0
Rice Soil	6.50	2.04	17.36	34.2
Standard soil	7.00	2.51	5.21	

B. Toxicity for earthworm (*Eisenia toefida*)

Concentration ($mg\ kg^{-1}$)	Death rate (%) for > d			Death rate (%) for 14 d		
	Black earth	Rice soil	Standard soil	Black earth	Rice Soil	Standard Soil
0	0	0	0	0	0	0
33	0	0	0	0	0	0
50	10	10	10	10	10	10
75	30	40	40	40	50	50
112	60	70	70	70	80	70
169	70	90	80	80	90	90
253	100	100	100	100	100	100
LC_{50}($mg\ kg^{-1}$)	103.5	88.1	91.7	91.7	81.2	84.6
(95% Confidence Limit)	(83.5-119.2)	(75.2-103.2)	(76.5-108.8)	(76.5-108.8)	(69.4-106.8)	(72.0-100.6)

C. The criterion of toxicity assessment for earthworm to pesticides

Rank	Assessment of Lab LC_{10}($mg\ kg^{-1}$)	Predicted assessment of field toxicity (coefficient of application)
Highly toxic	<1.0	>50
Medium toxic	1.0-10.0	50-5
Low toxic	>10	<5

LC_{50} value for earthworm to 2-ethyl-N(ethoxymethyl)-X-chloroacetyl anilide is greater than 81 mg kg^{-1}. When the LC_{50} value for earthworm is compared with the criterion for toxicity assessment of earthworm to chemical pesticides, the toxicity for earthworm is considered to be very low.

III. Conclusions

The results of acute toxicity of aquatic animals, terrestrial organisms and soil animal to 2-ethyl-N(ethoxymethyl)-X-chloroacetyl anilide indicate that the toxicity of most organisms tested is low. Use of 2-ethyl-N(ethoxymethyl)-X-Chloroacetyl anilide as a herbicide in the field is relatively safe for living beings if the amounts used are controlled.

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Annex I

List of Banned and Severely Restricted Chemicals for Importation and Exportation

	Chemical name	CAS NO	Restricted level
1.	Mercury and it's compounds	7439-97-6	Banning
2.	Aldrin	309-00-2	Banning
3.	Dieldrin	60-57-1	Banning
4.	Endrin	72-20-8	Banning
5.	DDT	50-29-3	Banning
6.	HCH, mixed isomers	608-73-1	Banning
7.	Heptachlor	76-44-8	Banning
8.	Hexachlorobenzene	118-74-1	Banning
9.	Cyhexatin	13121-70-5	Banning
10.	EDB	106-93-4	Banning
11.	Fluoroacetamide	640-19-7	Banning
12.	2, 4, 5 - T	93-76-5	Banning
13.	DBCP	96-12-8	Banning
14.	Demeton	298-03-3	Banning
15.	Cyanide	57-12-5	Banning
16.	Chlordane	57-74-9	Banning
17.	PCBs and preparation with PCBs content higher than 0.01% by weight	1336-36-3	Severely restriction
18.	PBB		Severely restriction
19.	Tris (2, 3 - dibromopropyl) phosphate	126-72-1	Severely restriction
20.	Tris-aziriding-phosphinoxide	545-55-1	Severely restriction
21.	Crocidolite	12001-28-1	Severely restriction
22.	Acrylonitrile	107-13-1	Severely restriction
23.	Chlordimeform	6164-98-3	Severely restriction
24.	Chlorpicrin	76-06-2	Severely restriction
25.	Arsenic and its Compounds	7440-38-2	Severely restriction
26.	Pentachlorophenol	87-86-5	Severely restriction
27.	Dinoseb	88-85-7	Severely restriction

Annex II

List of Priority Control Chemicals in China (First Block)

	Chemical name	CAS NO
1.*	mercury and its compounds	7439-97-6
		107-27-7
		62-38-4
2.*	Dieldrin	60-57-1
3.*	Endrin	72-20-8
4.*	DDT	50-29-3
5.*	HCH, Mised isomers	608-73-1
6.*	Aldrin	309-00-2
7.*	Heptachlor	76-44-8
8.*	Hexachlorobenzene	118-74-1
9.*	Cyhexatin	13121-70-5
10.*	EDB	106-93-4
11.*	Fluoroacetamide	640-19-7
12.*	2, 3, 5-T	93-76-5
13.*	DBCP	96-12-8
14.*	Demeton	298-03-3
15.*	Cyanide	
16.**	Crocidolite	12001-28-4
17.	PCBS and preparations with PCBS contents higher than 0.01% by weight	1336-36-3
18.	PEB	59080-40-9
		27858-07-7
		13654-09-6
19.	Tris (2, 3-dibromorpropyl) phosphate	126-72-7
20.	Tris-aziridinyl-phosphinoxide	545-55-1
21.	Acrylonoitrile	107-13-1
22.	Chlordane	57-74-9
23.	Chlordimeform	6164-98-3
24.	Chlorpicrin	76-06-2
25.	Arsenic and its compounds	7440-38-2
26.	Pentachlorophenol	87-86-5
27.	Dinoseb	88-85-7
28.	Chloroethylene	75-01-4
29.	Formaldehyde	50-00-0
30.	Ethylene oxide	75-21-8
31.	Chloroform	67-66-3
32.	Phenol	708-95-2
33.	Carbon tetrachloride	56-23-5
34.	Sodiumnitrite	7632-00-0
35.	Tetrachloroethylene	127-18-4
36.	Asbestos	12001-29-5
37.	Trichlorethylene	79-01-6
38.	Trichloromethane	79-00-5
39.	Acrolein	107-02-8
40.	Toluene	108-88-3
41.	Lead and its compounds	7439-92-1
42.	Naphthalene	91-20-3
43.	Cadmium and its compounds	7440-43-9
44.	1, 2-Dichloroethane	107-06-2
45.	Dichloromethane	75-09-2
46.	Benzene	71-43-2

* Banning use in agriculture ** Banning use

PREVENTION AND MINIMIZATION OF HAZARDOUS WASTES

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I. Introduction

There is no doubt that hazardous waste prevention can reduce environmental risks more effectively than controls at the end of the pipe. Not only does prevention reduce risks more quickly and predictably, it has the distinct advantage of reducing total exposure of workers, air, surface water, and ultimately the land and groundwater to pollutants. The most certain means of hazardous waste prevention is through waste minimization. hazardous waste minimization is preferable to most hazardous waste management practices because it can land to lower direct costs and higher indirect benefits. (Wentz et al. 1985)

Hazardous waste minimization includes reduction of total volume or quantity as well as toxicity. But transfer of pollutants from one medium to another, for example, the removal of organics from wastewater using activated carbon, is not waste minimization.

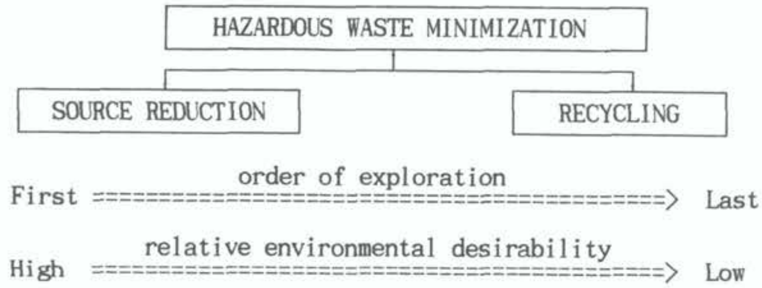

Figure 1. Hazardous Waste Minimization Definitions (from USEPA, 1988)

As shown in Figure 1, hazardous waste minimization is consisted of source reduction and recycling. Source reduction means any activity that reduces the generation of hazardous waste at the source, usually within a process, and recycling means use, reuse, and reclamation. Of the two approaches, source reduction is usually referable to recycling from an environmental perspective.

Source reduction and recycling each are comprised of a number of practices and approaches, so called, hazardous waste minimization techniques, which are illustrated in Figure 2.

Of course, hazardous waste minimization techniques are entirely different of different industries depending upon the particular waste streams being generated, the physical form in which they are generated, and the amount of waste being generated. Some examples of real world hazardous waste minimization in various industries are shown in Table 1. These examples illustrate the wide range of techniques and technologies considered to be hazardous waste minimization.

In this paper, hazardous waste minimization in some important industries of these industries will be discussed.

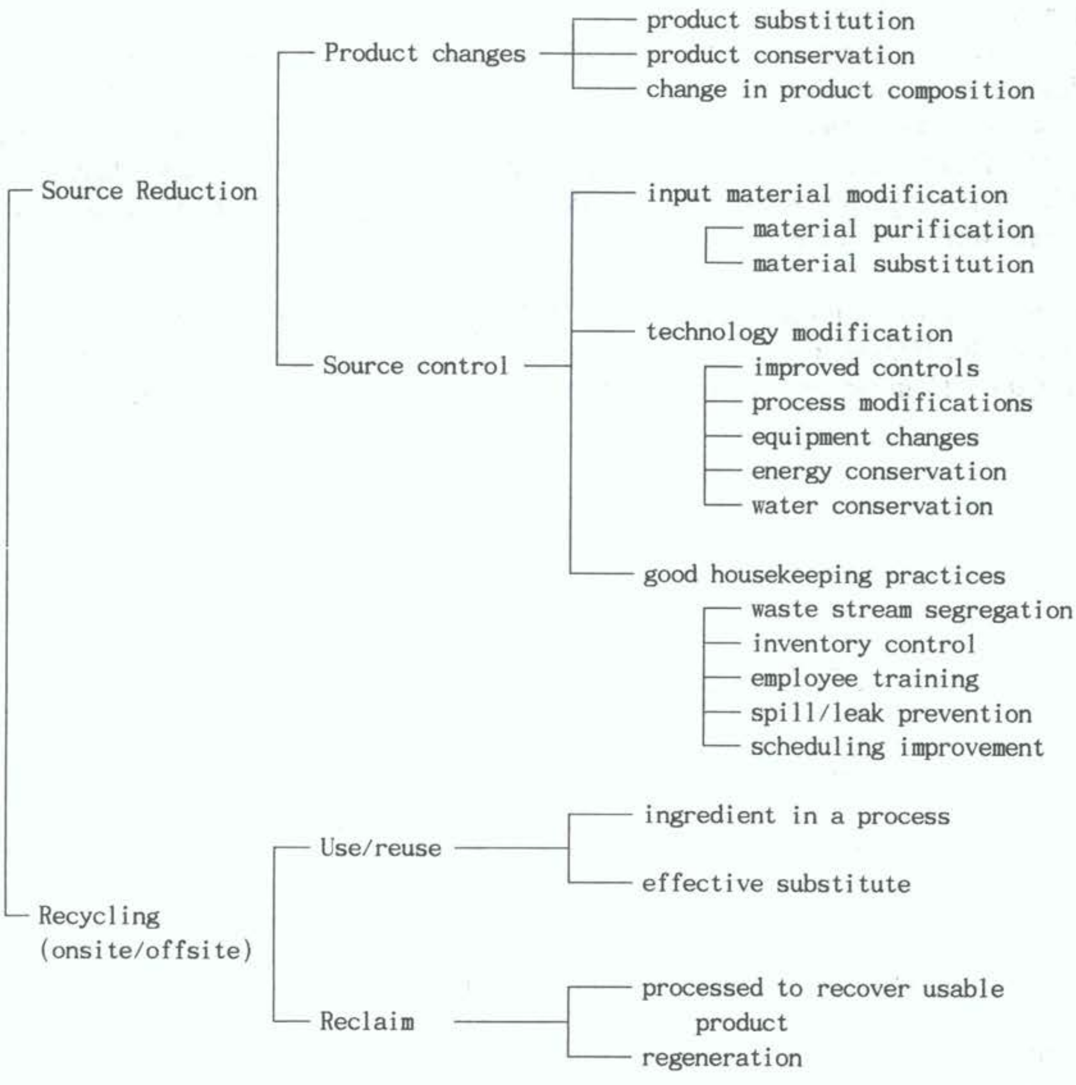

Figure 2. Hazardous Waste Minimization Techniques (From Wentz et al., 1985; USEPA, 1988).

Table 1

Examples of Hazardous Waste Minimization Techniques

(from Wentz et al., 1985)

Options	Industry	Techniques
Inventory management	Textiles	Review all chemical purchases
	Furniture	Purchase only exact amounts of coating required
	Diesel engines	Screen all products purchases
	Organic chemicals	Review new products before production
Material change	Printing	Substitute water-based for solvent-based ink
	Office furniture	Use Water-based paints in place of solvent-based paints
	Aerospace	Replace cyanide cadmium plating bath with non-cyanide bath
	Ink manufacture	Remove cadmium pigment from products
Production process modification	Chemical reaction	Optimize reaction variables/reactor design
		Optimize reactant addition method
		Eliminate use of toxic catalysts
	Surface Coating	Use airless air-assisted spray guns
		Use electrostatic spray coating system
		Control coating viscosity with heat unit
		Use high solids coatings
In-plant recycling	Metal fabricators	Recover synthetic cutting fluids using a centrifuge system
	Paint fabricating	Use distillation unit to recover cleaning solvents
	Printed circuit board	An electrolytic recovering system used to recover copper and tine/lead from process wastewater
	Power tools	Recover alkaline decreasing baths using ultrafiltration

II. Hazardous Waste Minimization Assessment

Figure 3 presents the recommended program for achieving successfully implemented waste minimization projects. As shown in this figure, the assessment phase can be divided into three major steps : assessment preparation (information gathering), assessment identifying and screening potential waste minimization options), and feasibility analysis (technical and economic evaluation of the options). Implementation of the recommended options follows the assessment. The waste minimization assessment program should be viewed as an ongoing program, rather than as a one-time effort.

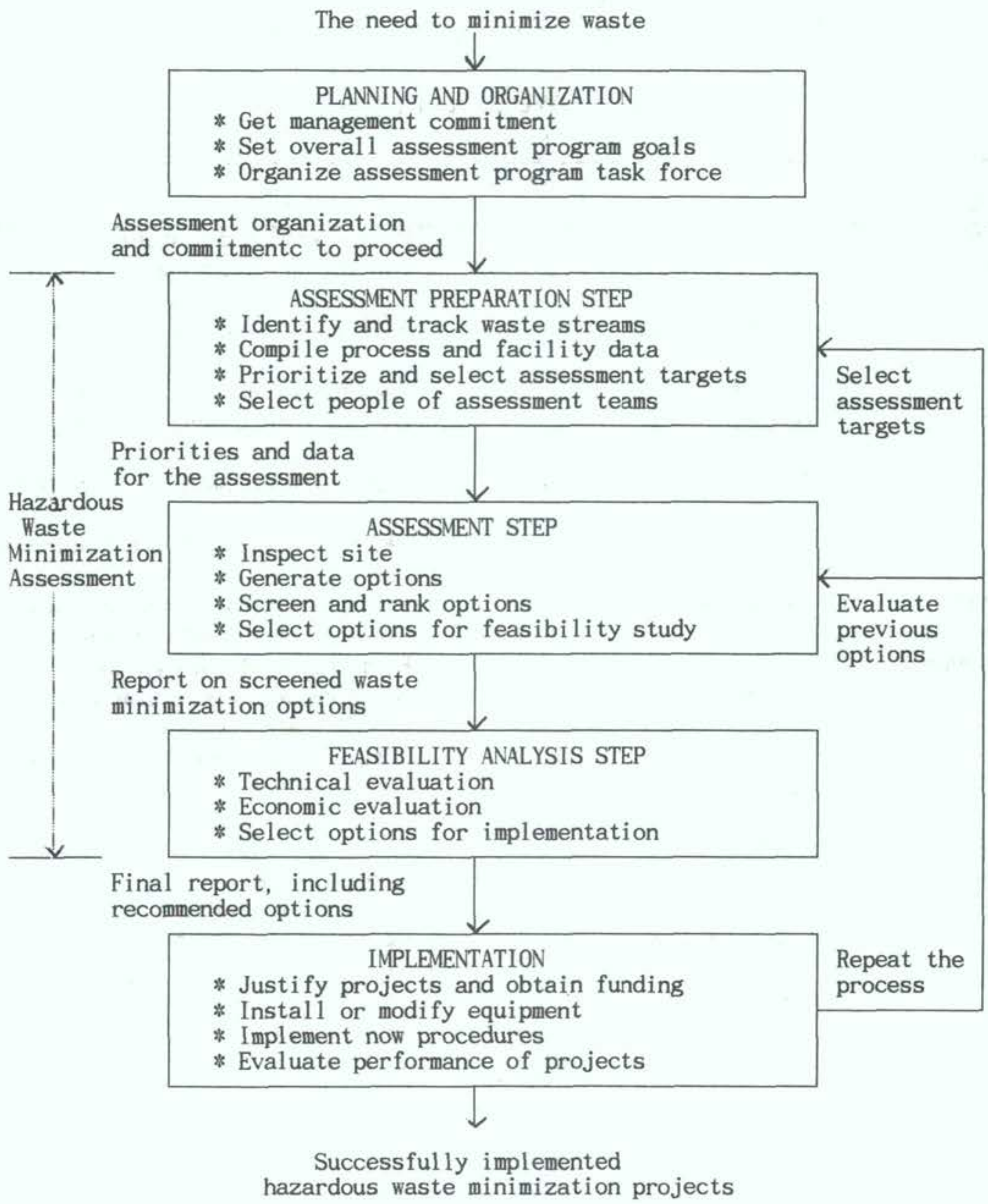

Figure 3. Hazardous Waste Minimization in Industries (from Drabkin, 1988).

III. Hazardous Wastes Minimization in Industries

1. Foundry Industry

1.1. Overview of Foundry Industry

All foundry operations produce castings by pouring molten metal into molds, often consisting of molding sand and core sand. Once the casting has hardened, it is separated from the molding and core materials in the shakeout process.

Overall materials balance for a foundry process is shown in Figure 4. Principal hazardous wastes from this process are calcium carbide desulfurization slag, melt materials which contain significant amounts of certain heavy metals, nonferrous alloy castings containing lead, such as certain brasses and bronzes, and strongly acidic and basic sludges from scrubbing process of off-gases from core-making process. Here, hazardous waste minimization is focused on two waste streams, calcium carbide desulfurization slag and melt emission control residuals.

Calcium carbide desulfurization slag is generated from the process to reduce the sulfur content of iron and may exhibit the characteristic of reactive. Melt emission control residuals contain lead, cadmium, and chromium and may be classified as hazardous due to EP toxicity.

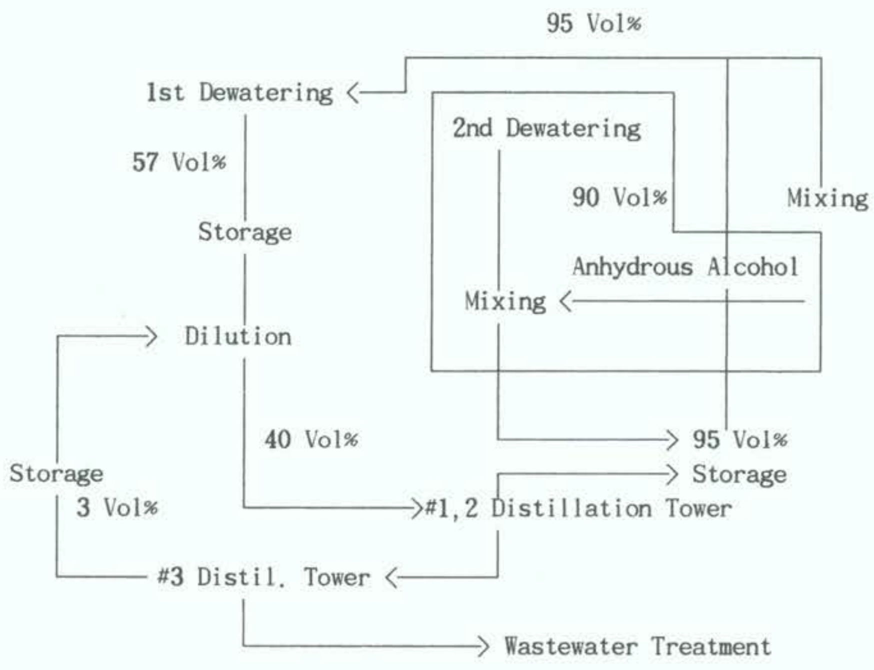

Figure 4. Foundry materials balance (from Oman, 1988).

1.2 Foundry Waste Minimization

Minimization techniques for these two wastes are in Table 2. Management options for minimization include altering product requirements and raw materials, recycle to the original process or other process, and improvement of process controls.

Table 2

Hazardous Waste Minimization Techniques of Foundry Industry

Waste Management Options	Minimization Techniques	
	calcium carbide desulfurization slag	melt emission control residuals
Reduce/alter product requirements	if a higher sulfur content in product is acceptable, --> a lower dose of Cac --> far less unspent CaC in the waste	Little usefulness in the minimization of waste generation
Alter raw materials	i) to substitute C_aC_2 with some other materials (C_aO, C_aF_2, etc.) ii) to alter the charge metal by purchasing only low-sulfur scrap	to use lower Pb and Cd containing materials
Improve process control	to control the process better in order to completely react the C_aC_2 with the sulfur in the metal	to switch to induction melting furnaces to melt grey iron --> elimination of the need for collecting emission over the melting operation --> elimination of air pollution control residuals
Recycle to the original manufacturing process	to recycle the slag containing from 10% to 50% metal into melting furnace	recharging of the emission control residuals to the melting operation
Recycle/Beneficially reuse in other processes	by blending C_aC_2 desulfurization slag with the melt emission control residuals (Pb, Cd) in proper dose, the mixture is often non-EP toxic	to reclaim the lead and cadmium
Treatment	i) a reactor system involving immersion of the slag in water ii) thermal destruction of the C_aC at 1500 F in rotary kiln iii) use of strong oxidizing agent (KM_n0_4, H_20_2)	i) precipitation ii) absorption iii) chemical reduction iv) pH control

2. Metal Finishing Industry

2.1. Metal Finishing Unit Processes

Common metal finishing unit processes are plating (electro, electrolysis, vapor & mechanical plating); descaling, decreasing, polishing & cleaning; machining; painting & coating; deformation & assembly; testing & calibration, etc. In almost of the cases, more than two of the processes are combined to complete a finishing process. Figure 5 shows an example.

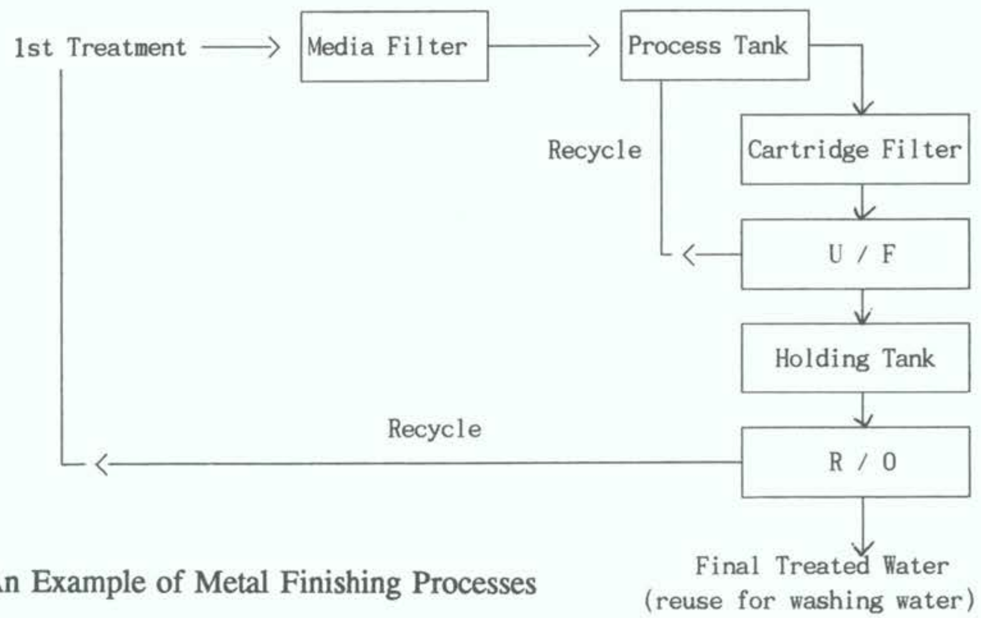

Figure 5 An Example of Metal Finishing Processes

Among them, electroplating has superior hazard potential due to high heavy metal and cyanide contents of process liquid, and extremely strong acids or alkalines.

2.2 Electroplating

1) Process Description

Electroplating is a sequence of bath and rinse. The materials t be coated will be the anode and the solved metals, brass, bronze, Cd Cr, Cu, Fe, Pb, Ni, Sn, Zn, Au, Ag, Pt, etc., are plated to the surface of them. Figure 6 shows general schematics of electroplating flow charts. The arrows indicate waste emission.

2) Pollution Sources and Pollutants Characteristics

The pollution source characterization is illustrated in Figure 7 and their details are the followings:

- proprietary solutions <-- detergent, accelerator
- cyanide concentrates (highly toxic)
- cyanide rinse water

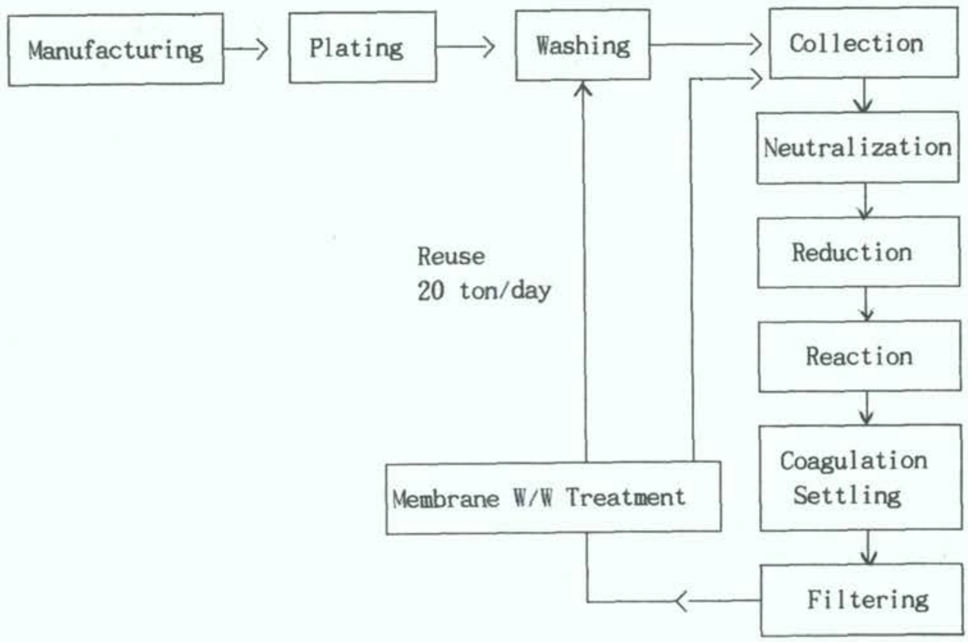

Figure 6 : Flow Chart for Some Common Plating Baths

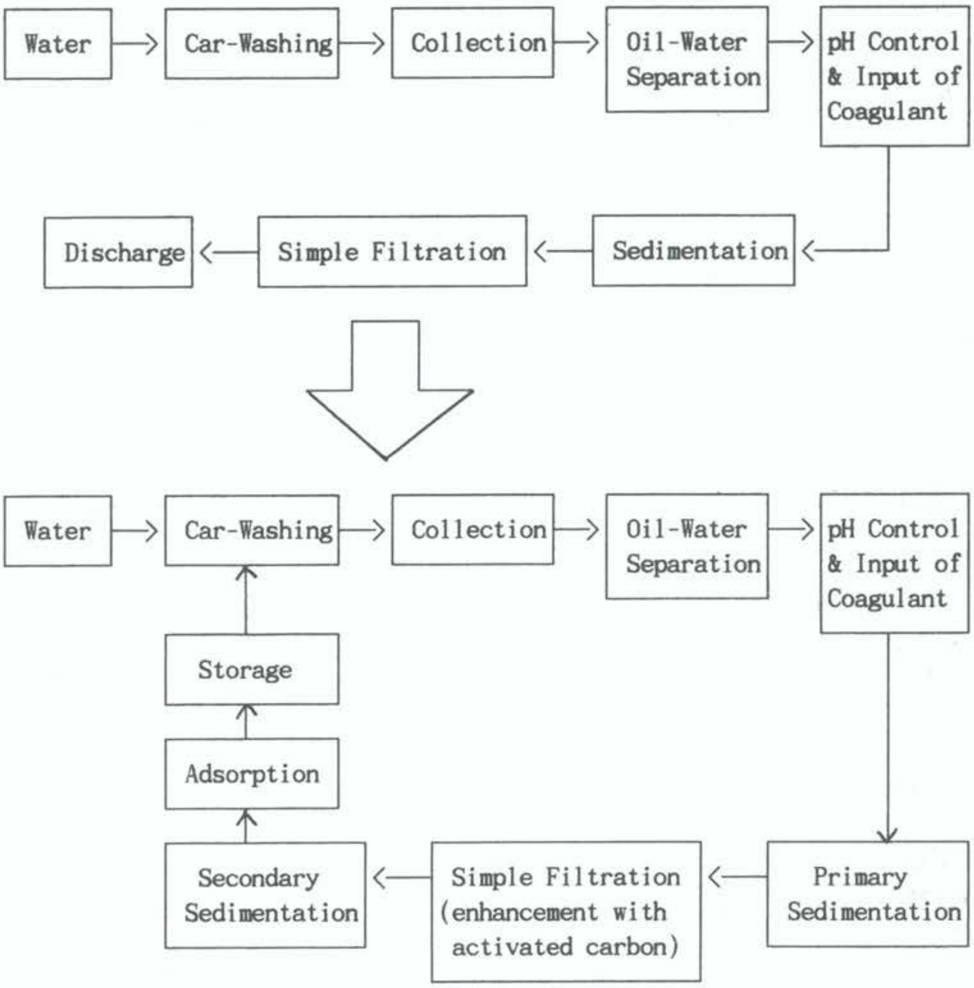

Figure 7 Sources of Contaminants (from USEPA), 1973).

- concentrated acids, pickling wastes <-- stripping, cleaning
- concentrated alkalies <-- alkaline washes (including soap, oil, SS)
- strong acid washes <-- acid dips, pickling solutions, strong acid processes
- chrome <-- plating washes
- others (metal compounds, oil, soap, SS, etc.)
- others (treatments are not needed) ; cooling water, etc.

The toxicities of wastes generated in electroplating facilities are depend on high concentrations of chemicals as acids, alkalies, cyanides, detergents, and several heavy metals with their compounds. When the factory has a treatment system, which generally is chemical precipitation of heavy metal ions, chemical sludge takes part in the toxicity. Non-toxic constituents like suspended solids are also produced.

3) Reduction of Contaminated Electroplating Wastewater

General waste reduction strategies in electroplating process are followings.

- water conservation
- rinse tank design
- flow control
- countercurrent rising
- drag-out reduction
- operational changes
- process bath substitution
- drag-put recovery
- management of drag-out

For an electroplating unit, metal-working liquids, including drag-outs and rinse, are the major hazardous waste, being the most important target of waste minimization of electroplating units.

The major fear of performing process modification is cost and harmful effects on product quality. In case of plating industry, cost reduction of metal recovery has been proved early, leaving the product quality the only concern in recommendation of waste minimization systems. Of course, however, the mentioned recycle/recovery systems are not of environmental concern but of strictly economic.

4) Metal-Working Fluid Reduction Techniques

Basic concept of waste minimization for electroplating units is the recycling of process liquids (metal-working liquids) associated with heavy metal recovery and reuse. By the reason that plating materials are usually precious metal, heavy metal recovery technology has been developed early and greatly improved to the current state of affluent experience and excellency.

The first of them exemplifies comparison of economy of systems with/without metal (nickel and chromic acid) recovery. The second example contains three medium nickel and chrome plating units, reporting that all of them require less than two years of payback period. Figure 8 and 9 show the schematics of applied systems.

The latter of the following examples illustrate the typical rinse recycling system now operated by Ching Ling Chang Enterprise Co., in Tiwan. They could achieve satisfactory level of pollutants, 0.05 ppm of Cr^{6+}, 0.36 ppm of Fe^{2+}, and Ni^{2+} is not detected, in waste liquids discharge.

The number outside boxes present the net saving of each process without considering the benefit of recovered nickel or chrome. The total amount of gaining by applying recovery systems will be raised with them. The unit used in Table 3 is NT$.

Table 3

Cost Comparison of Metal Plating Waste Minimization Action

(from Chang et al., 1992)

plant	item	chemical coagulation	recovery	amount saved
A	chemical addition	-118,170	-26,690	91,480
	sludge disposal	-115,020	-6,438	108,582
	recovery	-	+54,966	200,062
B	chemical addition	-85,200	-61,980	24,220
	sludge disposal	-12,120	-8,928	3,192
	recovery	-	20,406	33,325
C	chemical addition	-96,840	-28,010	68,830
	sludge disposal	-131,430	-3,023	128,406
	recovery	-	+54,612	197,236

Table 4

Payback Period

plant	first investment	amount saved (NT$/month)	payback period (months)
A	1,300,000	255,028	5.1 - 12.9
B	700,000	47,818	14.6 - 21.6
C	1,300,000	251,848	5.2 - 14.6

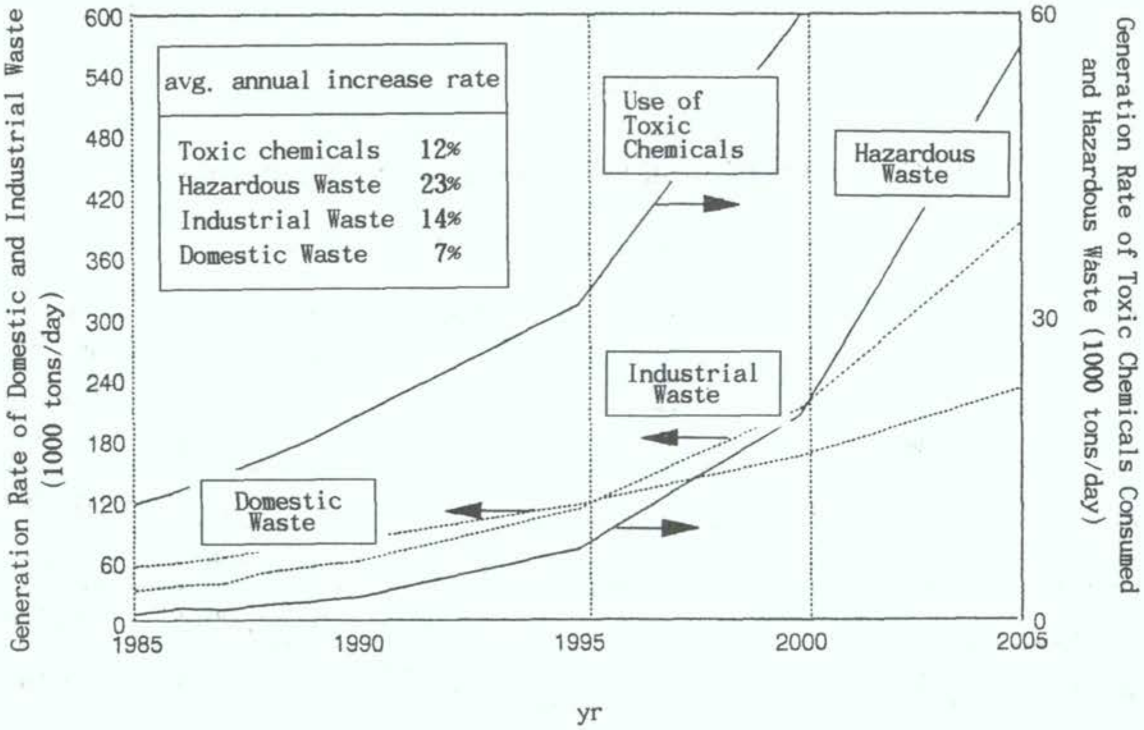

Figure 8 Nickel Plating Process with Recovery

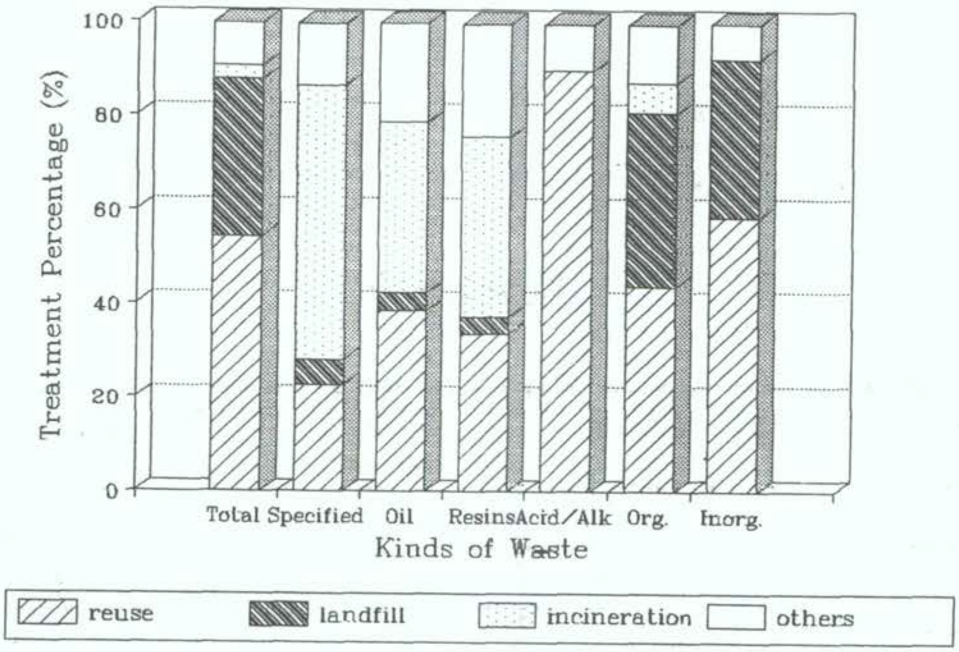

Figure 9 Chromic Acid Process with Recovery

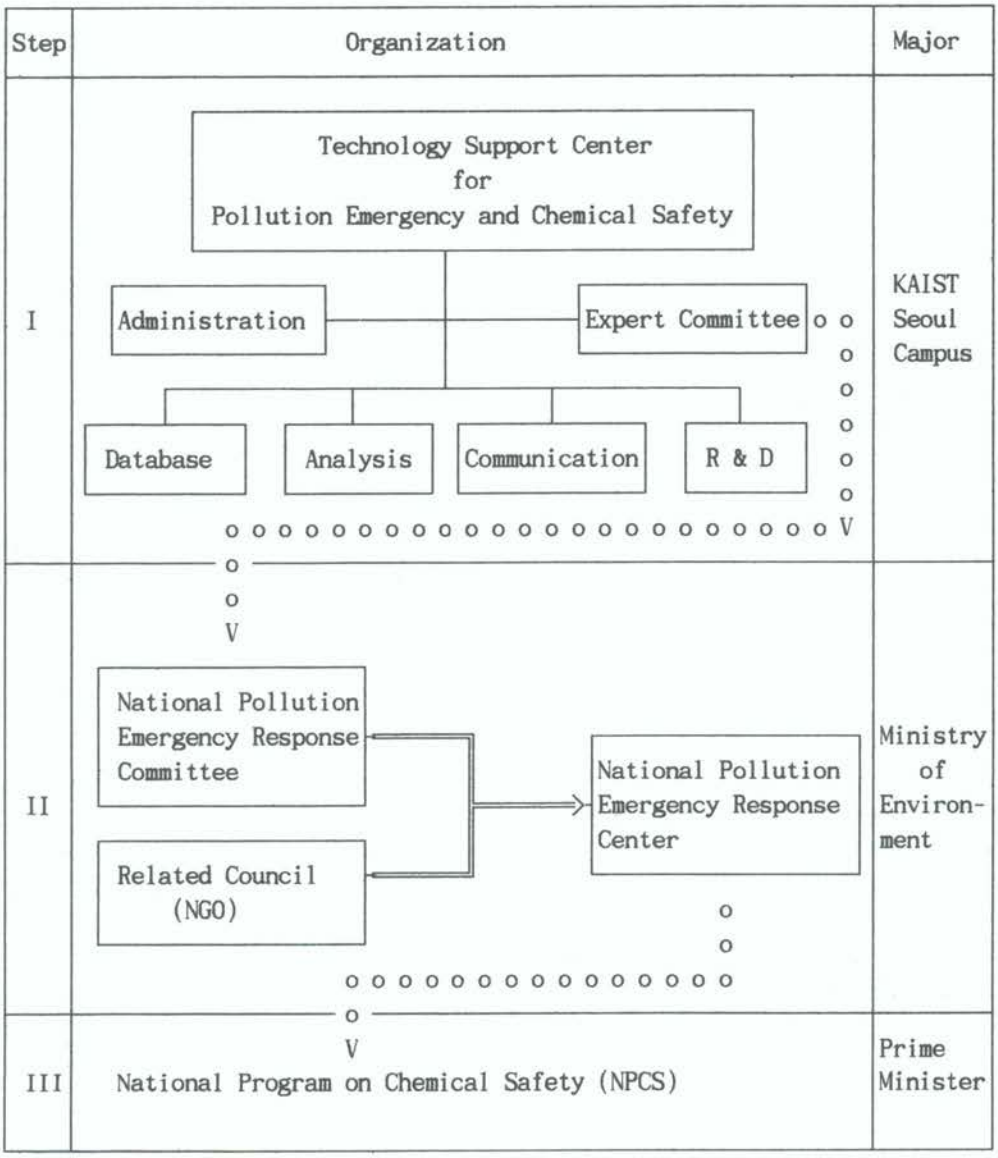

Figure 10 Conventional Rise System

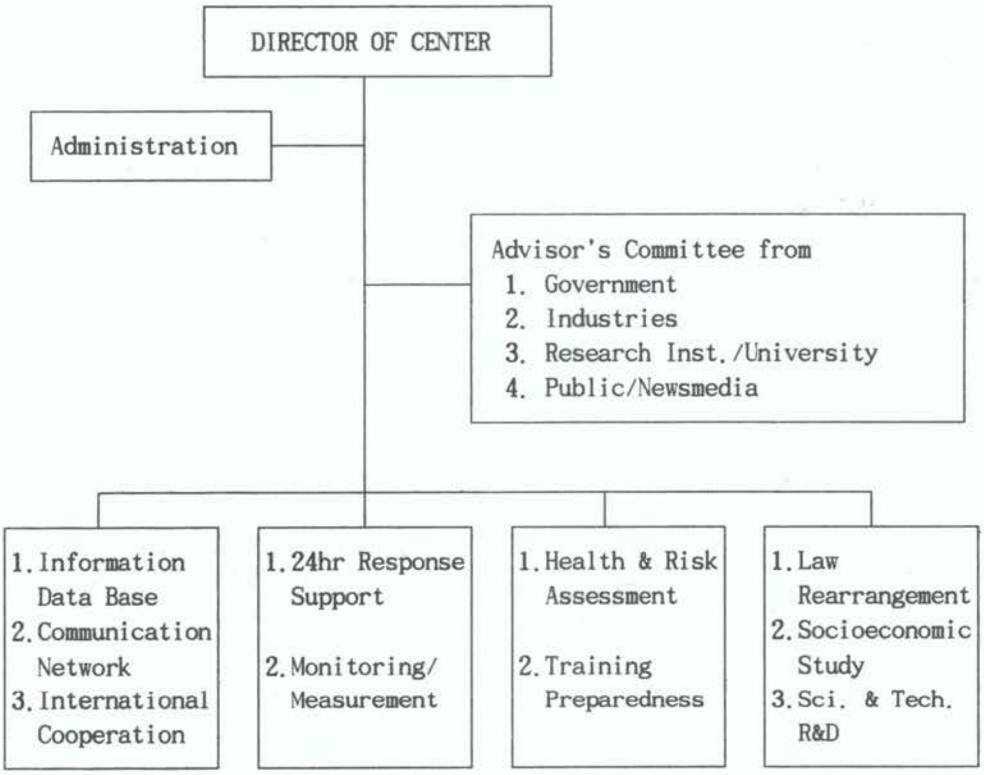

Figure 11 Reactive Recycled Rinse System

3) Automotive Repair Industry

3.1 Overview of Automotive Repair Industry

The automotive repair industry is composed of three primary segments. Figure 12 shows those segments which produce the significant solvent and aqueous hazardous liquid wastes and sludges required disposal as hazardous waste.

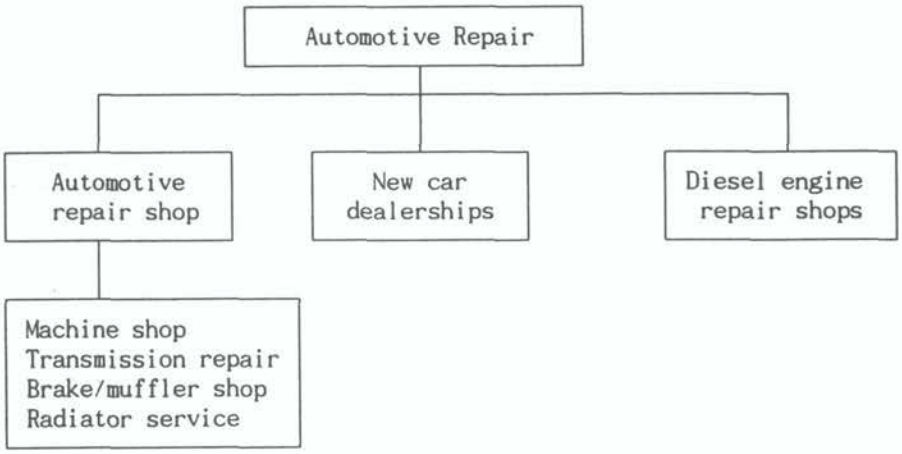

Figure 12 Segments of the Automotive Repair Industry Generating Significant Hazardous Wastes (from Toy, 1988; California Dept. of Health Services, 1987).

3.2 Waste Generation

The majority of waste produces are in the form o the followings;

1) Waste parts cleaning solutions and other miscellaneous detergent wastes
   - solvent cleaning solutions
   - aqueous detergent or caustic cleaning solutions
   - carburetor cleaner
   - aqueous floor cleaning detergents

2) Oil and grease removal wastes from engine cleaning
- hot tank sludges
- engine spray cleaning waste solids

3) Spent automotive fluids and batteries
- waste anti-freeze solution
- waste engine oil
- spent automotive transmission fluids
- spent automotive batteries, etc.

3.3 Waste Minimization (California Dept. of Health Services, 1988)

1) Source Reduction and Housekeeping

Significant quantities of waste generation can be avoided by the proper operation of existing equipments and good housekeeping efforts such as preventing spills and the proper location of service equipment to simplify operations.

2) On-site Solvent Recovery and Aqueous Waste Volume Reduction

Solvent reclamation equipment is becoming available for small scale on-site use.

4. Paint and Allied Products Industry

The paints and allied products industry consist of firms that manufacture a verity of materials. The products are used broadly. This section looks at the steps in the paint manufacture and identifies the wastes generated.

4.1 Paint Production Processes

The products are classified as solvent-based and water-based paints. The processes to produce these types of paints are generally similar. Figure 13 shows the steps in the paint manufacturing process.

4.2 Wastes from Paint Manufacturing

The predominant wastes from paint manufacturing facilities include the followings;

- Equipment cleaning wastes
- Waste rinsewater
  - waste solvent
  - paint sludge from cleaning operations
- Off-spec paint
- Obsolete paints and returned paints
- Empty raw material packages, bags, and containers
- Pigment dusts from air pollution control equipment
- Air emissions
- Paint filter bags and cartridges

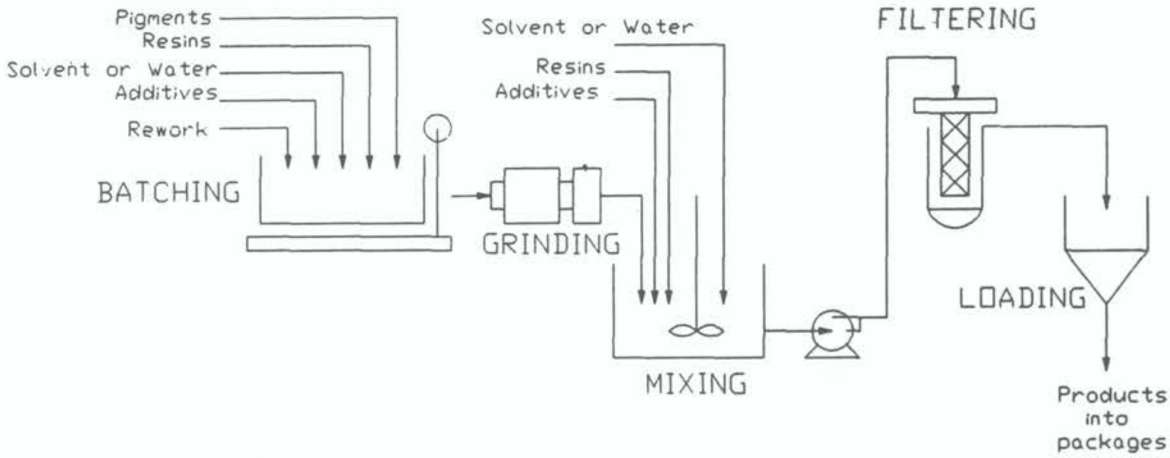

Figure 13 Steps in the Paint Manufacturing Process (from Lorton, 1988).

- Accidental spills and discharges, etc.

4.3 Waste Minimization

1) Minimizing Equipment Cleaning Wastes

- Source reduction of cleaning wastes ; Equipment cleaning wastes can be reduced by reducing the frequency of required cleaning or by reducing the amount of cleaning solvent or solution used for cleaning.

- Recycling and reuse of cleaning wastes ; Figure 14 is the process of cleaning system for solvent-based paints and Figure 15 is that for water-based paints.

2) Good Operating Practices to Minimize Other Wastes

Careful attention to production and maintenance operations will reduce waste generation resulting from spills or the production of off-spec paints.

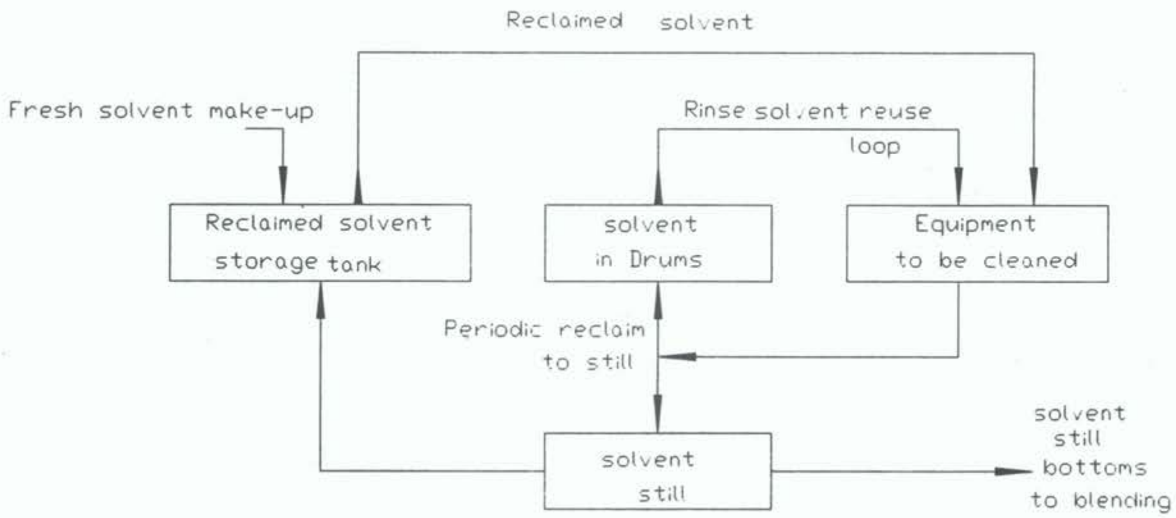

Figure 14 Recycling and Reusing Cleaning Solvent.

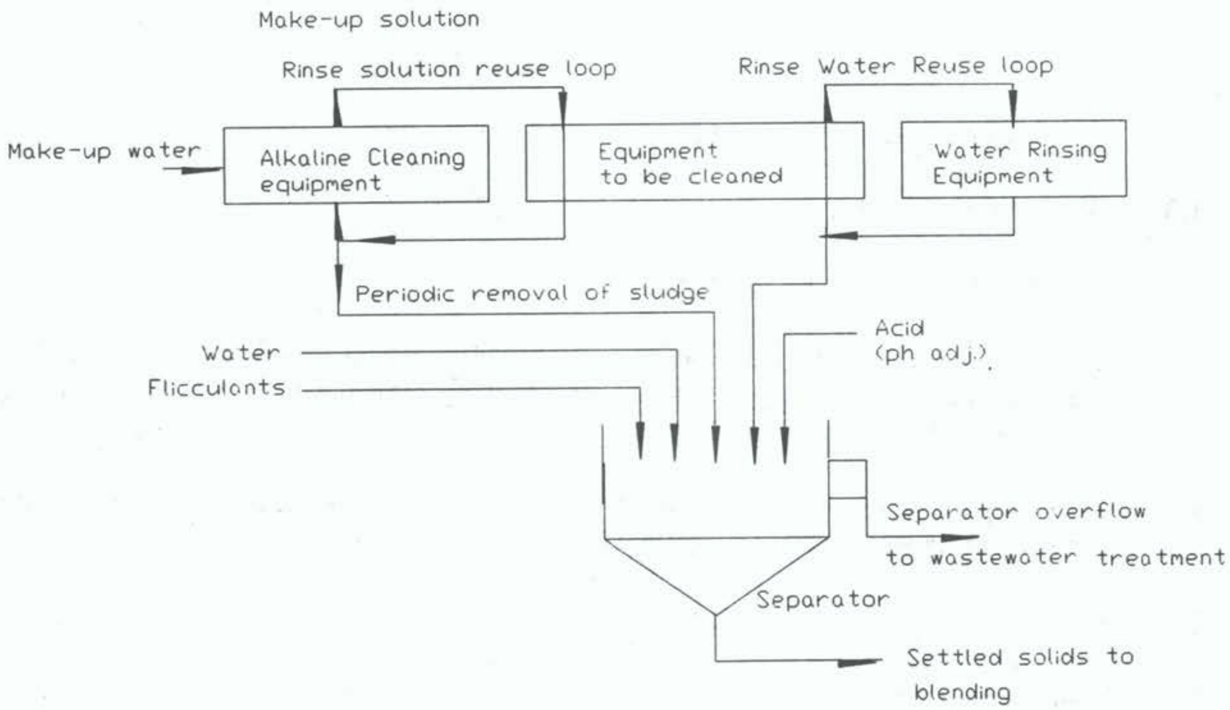

Figure 15 Recycling and Reusing Rinse Water and Alkaline Cleaning Solution.

3) Plant Automation

Plant automation reduce operational accidents and improve production efficiency.

4) Minimizing Empty Bag, Package, and Constrainer Wastes

- Input material substitution; The substitution of non-hazardous additives for hazardous ones is taking place to some extent in the industry.

5) Waste Paint Filters

- Wastes from spill cleanup

6) Trends in Product Substitution

- Pigment substitution; With the increasing regulation of lead compounds as toxic material, the market for lead-based paint is expected to continue to decrease.

7) Reducing Air Emissions

The use of solvents is generally decreasing in light of the air quality environmental regulations.

Waste minimization is making significant inroads into paint manufacturing plants. Since equipment cleaning operations are the largest source of waste in the industry, source reduction and recycling techniques will be important in the industry's effort to further reduce wastes. The increasing costs of waste treatment and disposal will make the companies continue to do efforts and developments to minimize waste.

5. Printed Circuit Board Facility

An aerospace manufacturer operates a prototype circuit board fabrication facility in New England. CH2M HILL was selected to design a waste treatment plant for this facility. Wastes to be treated in the facility consist mainly of continuous overflow rinses from scrubbing, cleaning, electrolysis plating of copper, electroplating of copper, photoresistance process, and etching.

To minimize hazardous waste, CH2M HILL recommended treating the combined rinsewater waste by chelating ion exchange. Chelating ion exchange resins, when operated at a pH of 4 to 5, are sufficiently selective for copper that the metal can be removed from the complexing agents, allowing the complexing agents to pass through to the effluent.

Regeneration of the ion exchange resin with sulfuric acid produces a mixture of sulfuric acid and copper sulfate, which is then electrowinned onto flat stainless steel plated, producing sheets of elemental copper that can be peeled off and sold as scrap. This process contrasts with conventional metal hydroxide precipitation, which produces a voluminous sludge requiring disposal as a listed hazardous waste.

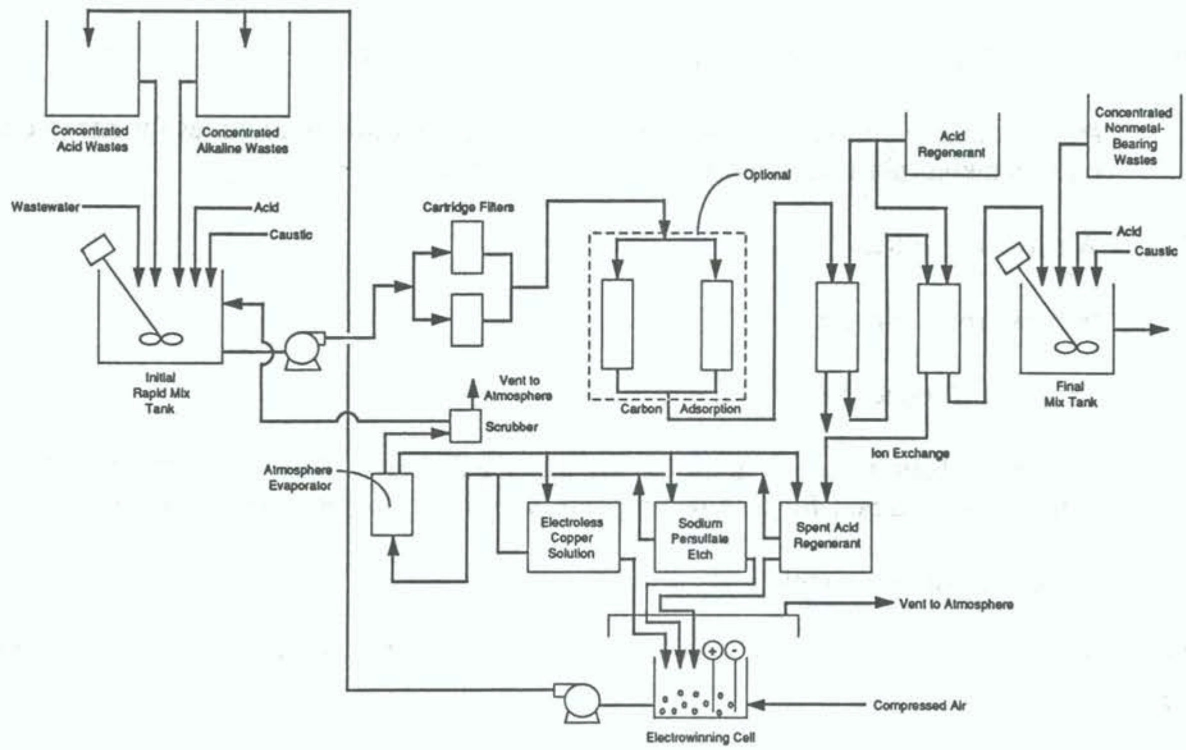

Figure 16 Circuit Board Waste Treatment Process Flow Diagram (from Higgins, 1989).

6. Integrated Water Management System

Because of the growing public concern for the quality of the environment and response to increasingly stringent environmental regulations, many chemical process industries (CPI) companies are actively seeking ways to minimize waste generation. In many cases they are working towards a goal of "Zero discharge."

"Zero discharge" is a term used to promote conservation of the quality of the environment. The followings are several real-world working definitions of zero discharge:

1) Zero discharge is the elimination of certain priority pollutants or toxic substances in the wastewater effluent from a facility.

2) Zero discharge means that no water effluent stream will be discharged from the processing site.

3) A somewhat looser definition incorporates parts of the first two definition. Here, zero discharge means that while wastewater volume discharge may not be small, it is relative safe. Some concentration of dissolved solids or salts may have occurred, but this amount is not harmful to the receiving waterway.

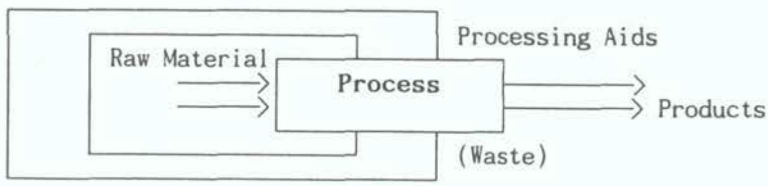

Figure 17 The Ideal Process for Zero Discharge (from Goldblaff et al., 1993).

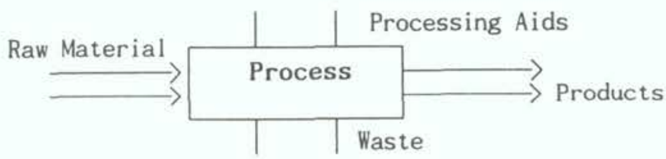

Fig. 18. The Real Processes

Figure 18 The Real Processes.

Table 5

Water Reuse Technologies Grouped According to Their Constituent Removal Capacities

(from Goldblaff et al., 1993)

Suspended Solids, Oil, Tar	Ammonia
Gravity Separation Coagulation, Flocculation, Clarification Flotation (Dissolved-Air or Induced-Air) Coalescing Filters Granular Media Filtration	Stream Stripping Biological Nitrification Ion Exchange Air Stripping Breakpoint Chlorination
Phenols	**Dissolved Organics**
Solvent Extraction Wet Air Oxidation Biological Oxidation, Aerobic Activated Carbon Chemical Oxidation	Biological Oxidation, Aerobic Biological Oxidation, Anaerobic Chemical Oxidation Activated Carbon Wet Air Oxidation Incineration
Cyanide/Thiocyanate	**Heavy Metals**
Steam Stripping Biological Oxidation Alkaline Chlorination Ion Exchange Chemical Precipitation	Chemical Precipitation Ion Exchange Activated Alumina Reverse Osmosis Electrodialysis
Desalination (TDS Removal)	**Sludge Handling/Disposal**
Mechanical Evaporation Evaporation Ponds Reverse Osmosis Electrodialysis Crystallization Spray Drying	Thickening Vacuum Drum Filters Filter Press Belt Filter Press Centrifuge Incineration Thermal Drying Solidification/Stabilization Landfill Disposal

7. Hydrocarbon Recovery Process (Styrene Waste Reduction : 70-85%)

During compounding of ABS resin (acrylonitrile-butadiene-styreneter polymer), hydrocarbon vapors are vented from ABS extruders and pelletizers. Some of the polymer is subjected to vacuum during compounding to volatilize water, residual monometer, and low molecular weight polymer from the ABS product. These constituents would be undesired impurities in the final product and are removed in order to meet or exceed the desired product properties and specifications.

The plant compounder vent waste collection system produces a styrene-rich hydrocarbon/water emulsion which contain approximately 15-30% hydrocarbon. This waste emulsion was formerly disposed of at an off-site hazardous waste facility at a significant cost.

But Bird Environmental found that with the proper ratio of reagent to emulsion and proper conditions of temperature, agitation, and reagent concentration, the emulsion could be made to separate into oil and water layers using a low-cost inorganic reagent.

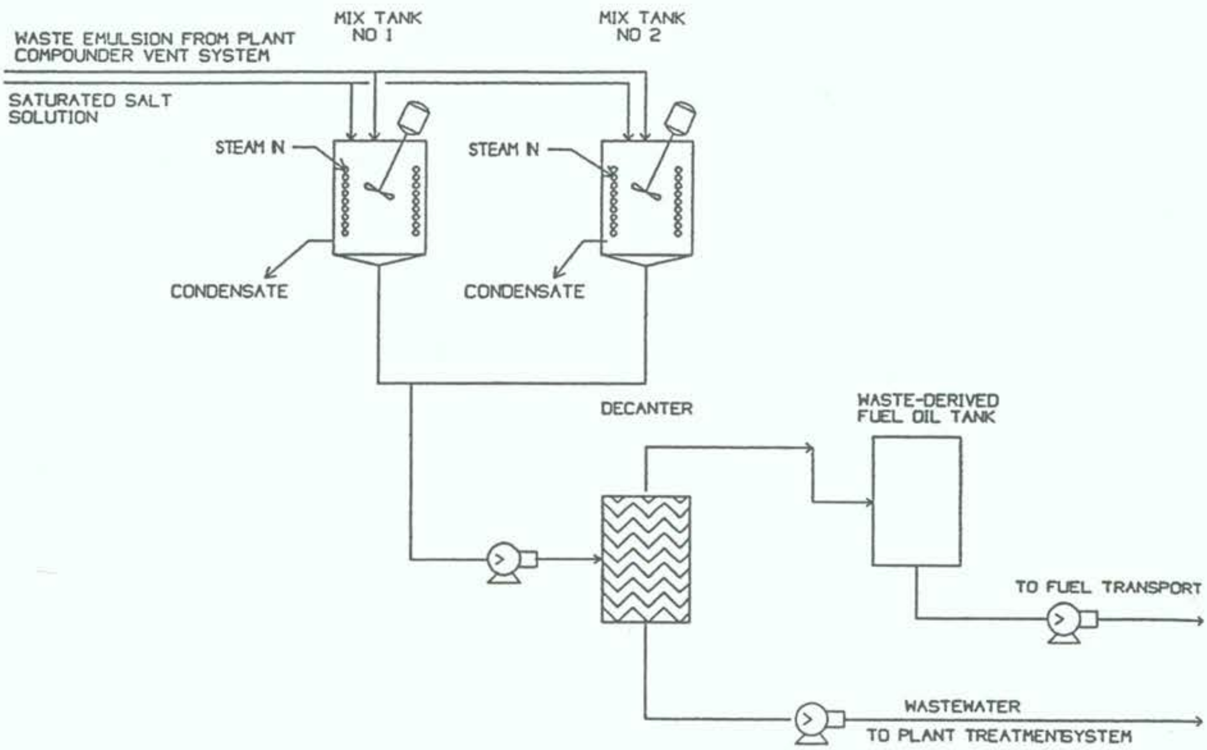

Figure 19 Conceptual process Flow Diagram (from Richards and Moller, 1993).

The demonstration unit has been operating successfully since June 1990. The system has consistently separated the waste emulsion, there-by reducing the annual waste generation by 70-85%. The system has provided valuable information on processing techniques, instrumentation performance, and materials of construction.

The oil product from the demonstration plant has a heating value greater than 18,000 BTU/lb and is utilized as a waste-derived fuel for a cement kiln. However, it is technically feasible to recover the styrene present in this stream for recycle to the polymerization process, and this approach could potentially be employed in the future. Wastewater from the demonstration plant decanter typically contains less than 200 mg/L styrene and is treated in the plant's wastewater treatment system. The 70-85% reduction in waste generation, coupled with the reduced disposal cost for waste-derived cement-kiln fuel, provides a dramatic reduction in the overall disposal cost. Thus, the present disposal cost for this waste stream is only 1.5 to 3% of the former disposal cost.

IV. Hazardous Waste Minimization in Korea

1. POSCO for Wastes Recycle and Reuse

1.1 Introduction to Pohang Iron & Steel Company (POSCO)

POSCO is the biggest integrated iron and steel mill in Korea producing 200 tons a year, being a model of environmental management.

1.2 Wastes and Byproducts Management in POSCO

In the beginning, this iron & steel complex organized a "TASK FORCE TEAM" first to deal with slags preferentially and set up "Department of Waste Resource Recovery". The organization has turned into "Department of Resource Recovery" and "Environmental Planing & Management Officer", which are running successfully today.

Table 6 shows the amount of production and recycle/reuse of wastes in two foundry facilities governed by POSCO.

According to it, about 80% of total amount of foundry wastes is re-utilized. The value includes the portion of them to be sold for reuse in other fields such as construction.

Table 6

Recycle & Reuse of Byproducts & Wastes in the First Half of 1992

item/unit	P'ohang Foundry			Kwangyang Foundry		
	Produced	recycle/reuse		Produced	recycle/reuse	
	ton	ton	%	ton	ton	%
blast furnace slag	1833.434	1833.434	100	1638.057	1638.057	100
steel-making slag	794.651	364.829	46	677.565	298.301	44
waste oil	448	120	27	882	372	42
dust	350.985	313.893	89	248.316	138.155	56
sludge	90.040	14.151	16	58.341	0	0
oxidized steel	6.136	6.136	100	8.322	8.322	100
tar sludge	6.548	6.548	100	4.248	4.248	100
ammonium sulfate	8.621	8.621	100			
light oil	33.249	33.249	100	28.678	28.678	100
coal tar	123.411	123.411	100	89.413	89.413	100
zinc dross	123	123	100	2.331	2.331	100
cold waste filters	120	0	0	96	0	0
cold waste scum	3.464	0	0	910	0	0
waste zinc anode	342	342	100	1.139	1.139	100
scale	106.977	101.977	100	87.934	87.934	100
cinder slag	1.542	1.311	85			
waste bricks	47.811	1.211	2	34.742	1.739	5
STS waste	83.381	21.873	26			
others	6.454	1.157	24	3.653	3.653	100
TOTAL	3497.738	2837.746	81	2884.627	2299.602	80

2. EPS Recycle in ANAM Industry

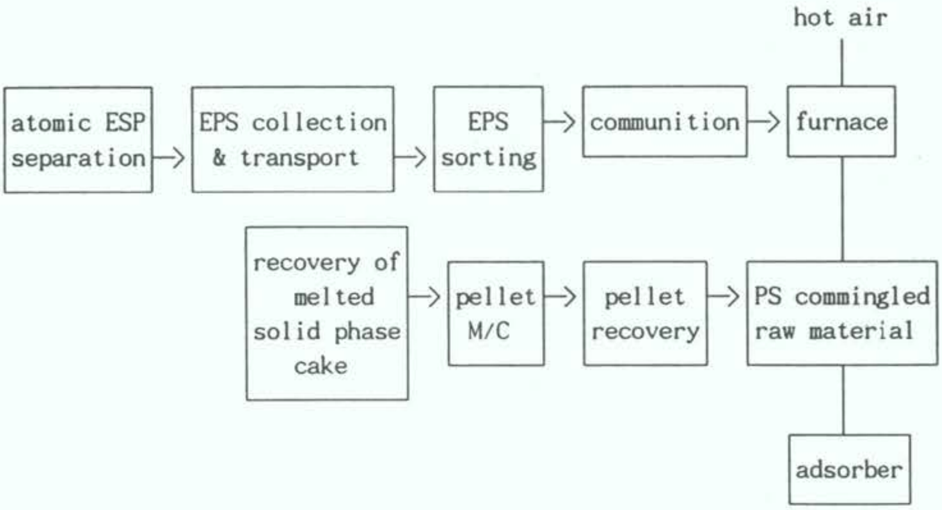

Figure 20 EPS Treatment Combined with Recovery.

V. Conclusions

Hazardous waste production is the inescapable result of manufacturing processes. Chemical processing, manufacturing, and fabrication operations are, by nature, imperfect. So, the proper goal is to minimize the burden industrial practices ultimately place on the environment. This is to be accomplished through implementation of an appropriate combination of source reduction, recycling, recovery, and treatment, with due consideration of economics and worldwide industrial competitiveness.

Hazardous Waste minimization is clearly an idea whose time has come in industrialized nations throughout the world. As more and more industries commit to utilizing waste minimization approaches to solving their environmental emission problems, there will certainly come the day when the problems created by hazardous and nonhazardous wastes will cease to be such a significant factor in the world's pollution problems.

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AGRICULTURAL PESTICIDES IN AQUATIC ECOSYSTEMS

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I. The Local Issue Relating to Agrochemicals

Experience in Thailand over time has been already well known and widely accepted among the public. The effect and impact of the use of agrochemicals, especially agricultural pesticides, could lead to undesirable consequences to the users and consumers, both directly and indirectly, as well as other ecological impacts due to residues in the agroecosystem, the environment and agricultural products.

II. The Objective of Lecture

The lecture is intended for tertiary level students, particularly those taking Environmental Science I and Aquatic Environmental Science. The objective is to develop an awareness among students of Environmental Science and Science education that will likely be of relevance during use, storage and disposal of pesticides.

III. Use of Agricultural Chemicals

With demand for increased production of higher quality foodstuffs, the need for pesticides has increased. The principle uses of pesticides is agriculture. Pesticides were regarded as wonder chemicals which increase crops yields, improve food quality and production, and control serious diseases, insect pests and weeds in crops. Pesticides include insecticides for insect control, acaricides for mite control, nematicides for the control of eelworms, rodenticides for rats and mice, fungicides for the control of plant diseases and herbicides for the control of weeds. The extent to which different types of pesticide are used varies with the differing agricultural conditions. In Thailand the climate conditions favour insect pests and the greatest amount of commercial pesticides used is insecticides. One of the most important uses of insecticides is in the field of public health and the prevention of deterioration of stored products. Herbicides are also used extensively in the control of aquatic weed growth in aquatic ecosystems.

IV. Do Pesticides Occur in the Aquatic Environment?

Agricultural chemicals have been found in the aquatic environment. They are sometimes there as a result of direct contamination due to careless handling (e.g. from disposal of pesticide containers in ditches), accidental spill or aerial overspray. They can reach water indirectly through volatilization and drift from application equipment on nearby treated fields, by run off in surface water from fields, or from vertical leaching in soil drainage systems to groundwater and transfer to river systems. Many of pesticides degrade rapidly and cannot be detected downstream from the point of application. Their impact on aquatic systems depends on many factors such as the amount and nature of the chemicals, its persistence, and its stability. Most important of all is the effect on aquatic organisms and the ability of the chemical to biomagnify or accumulate in the food chain.

V. The Proper Management of Pesticides.

Pesticide chemicals are more intensively and extensively evaluated for potential problems both before and after they are introduced into commerce than are other commercial chemicals. Appropriate non-chemical technology for agricultural workers is developed. The alternatives to chemical pest control which could be adapted and used by the farmers include: mechanical and physical controls, cultural control, biological control, microbial control, genetic control and legal control. When any of these control measures fails to achieve effective control, the integrated pest control and pest control using natural products will be adapted. The basic concept of the pest management is that when the chosen alternatives are used they will lead to satisfactory economic returns in terms of the cost/benefit ratio and should pose minimum risk to the environment.

VI. Regulations and Guidelines Based on Legislation

The group of pesticides with the most harmful environmental effects were the persistent organochlorine insecticides. DDT for instance, has been associated with fish kills, unacceptable residues and longevity in the environment and bioaccumulation in the food chain. DDT and other persistent organochlorines, such as aldrine and dieldrin were deregistered for agricultural uses. Non-persistent pesticides, synthetic pyrethroids, have been registered to replace DDT. The registrations may continue and farmers will be allowed to use the pyrethroids. In addition to assessing the aquatic impacts of new chemicals before registration, every effort is made to ensure that pesticides are being used safely. One of the most important directions is to raise awareness that pesticides must be used safely. Farmers and growers include home gardeners, householders and environmentally concerned persons should be provided advice regarding safe use and handling procedures. Provincial governments have active education programs often associated with careful practices based on responsible guidelines for product use. The Thai Department of Agriculture has produced a cautionary brochure about toxic effects of pesticides.

DOMESTIC HAZARDOUS WASTE MANAGEMENT

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I. Hazardous Waste

Hazardous waste means any hazardous substance or material which nobody requires or is disposed from some activities such as community, industry, agriculture, business places, including service industries. Waste which is toxic for humans, animals, plants or the environment can react very quickly or slowly.

Hazardous wastes are usually composed of ignitive substances, corrosive substances, readily reactive substances, explosive substances, toxic substances, radioactive substances and/or pathogenic waste.

II. Hazardous Solid Waste Category

Hazardous solid waste can have a reactive property, including the following:

1) Ignitability is an ignitive substance that can inflame if the quantity increases;

2) Reactivity or explosiveness is when a substance can react under suitable conditions; it may occur as an explosion;

3) Corrosivity is when the substance reacts with metal so the material equipment is damaged;

4) Toxicity is when the substance itself can ruin human life and the environment; that is a chemical substance or toxic substance because of radioactivity.;

5) Leachability is when the substance blends with water; an example is waste water from the solid waste of photograph shops containing developed-papers, films, etc.

6) Pathogenicity is pathogenic waste from clinics, hospital, pathogenic laboratories; mostly called "infectious"

III. Environmental Impact

As a consequence of the hazardous waste problem related to industrial development, water pollution has increased markedly. The problem begins with the chemical substance, which is used to increase production and productivity. This is a benefit to industry but the toxicity of the disposed material affects the environment.

In addition, infectious (pathogenic) waste from hospitals, if not disposed of or treated in the correct manner, will have negative impact on human health, animals and the environment. These effects are:

1) **Human Health Risks Related to Cancer**: through direct contact or by related means such as inhaling air pollutants (example Benzene, Formaldehyde) or by eating food or water which contain chemical substances such as residual insecticide;

2) **Non-Cancer Human Health Risks**: synthesized organic substances and heavy metals may cause disease such as Minamata or Itai-Itai or Arsenic disease;

3) **Adverse Ecological Effects**: the deterioration of environment quality can occur if there is inappropriate management of hazardous waste, such as contamination of the food chain by hazardous substances affecting heredity, etc.

4) **Public Welfare Effects**: may be related to fire, corrosion of material or the aesthetics of an area is decreased.

IV. Hazardous Waste Problems

Hazardous substances which are disposed of in the municipal disposal site are from a wide variety of sources. These include homes, factories and the residual materials including pathogenic waste from hospitals. These can damage human life. For example, near a mineral mine, the waste rock was spread. Arsenic washed away with the water passing through the waste. A well used by local people for drinking water became contaminated. For a long time (in 1987) the people in Ample Ronphibul, Nakorn Srithamarat province have had elevated arsenic levels in their bodies. It is called "Khai Dum".

In another event in Ample Muang, Rayong province (in 1982) the people drank water which had high lead levels. As a result 3 men died immediately. The cause was carelessness with hazardous substances. In addition, many provinces have developed heavy industry and light industry zones, with both generating hazardous wastes. The hazardous waste from the household is also toxicity such as that resulting from waste chemical substances. Some types of heavy metals accumulate in waste materials or the material ignites.

Mercury is usually used in industry; for example, those producing explosives, painting, used in agriculture such as anti-fungal pesticides. Dangerous for organs such as the kidney and intestine, with irritation, inflammation and possibly death. Causes Minamata disease, as in Japan. Sometimes mercury comes from waste water of industrial plants.

Lead is used in making batteries, paints, agricultural products such as insecticide ingredients and in gasoline. Toxic to human and cause of tiredness, headaches, insanity and ultimately death. Lead can be present in water, air and land, as a result of burning old batteries for obtaining lead by smelting or mixing in waste water that passes through solid waste heaps. Also occurs from burning of solid waste that has lead dispersed in it.

Manganese is used in torches, industry and agriculture. For example, some products of the fertilizer can cause paralysis of the body and have an effect of the respiratory system such as the lung and trachea and cause moodiness. Remnants from torches can mix in waste water or be burnt in solid waste heaps. This is especially a problem for villages downwind from a disposal area or where groundwater that people have always consumed is contaminated.

Cadmium compounds can be found in paint pigment factories and small battery factories. They also have widespread use in manufacturing electronic circuit boards. The people who drank water contaminated with cadmium will likely have Itai-Itai disease. This is a bone disease symptom.

PCB (Polychlorinated Biphenyls) are an important name in commerce, such as Arochlor. It is difficult to break PCBs by biological processes. Mostly used in the electronics and electrical industry in capacitors and transformers. PCBs injure the skin and has a reaction with enzymes in liver that affects reproduction in humans and animals.

Chemical substances that kill insects, mice etc are thrown away in solid waste heaps. These have an effect on humans and animals living nearby. Those chemicals contaminate the water or diffuse in air. They will be abundant in manufacturing areas or agricultural areas. Most of these chemicals are used in agriculture, industry and public health. Since 1978-1987 the importation of chemicals has grown systematically. One must consider the resulting quantities of those chemicals that will contaminate water, air and land or the general environment. Therefore, the use of these toxic chemicals is worrying. When the chemicals occur in solid waste heaps that lack the appropriate controls human and animal will be affected.

Solid waste from hospital is even more hazardous and of greater concern. From 1988 studies by Mahidol University in Thailand and the University of Hawaii in the U.S.A., it was discovered from diagnosis of 136 persons who worked at the "Oon-Nuch site" solid waste disposal plant 69 had AIDS infections and 26 had infective hepatitis. In addition, children and adults in slum settlements nearby had increased incidence of respiration problems, including children under 5 years of age with gnathostomiasis.

These figures show the danger of infectious waste which has not been disposed in an appropriate manner. For waste of such origin one should know the method of collection and disposal. Infectious waste from various hospitals in a big city can have an effect on the environment of the community, at least until there are complaints because the hospital lacks responsibility.

V. Domestic Hazardous Waste Management

(1) General method for managing hazardous waste

Managing hazardous wastes involves observing suitable controls. A cradle to grave approach is required, beginning with the solid waste that is produced and ending with final treatment. The sequence is waste generation, storage, collection, transportation, treatment, recycling and disposal, as shown in Figure 1.

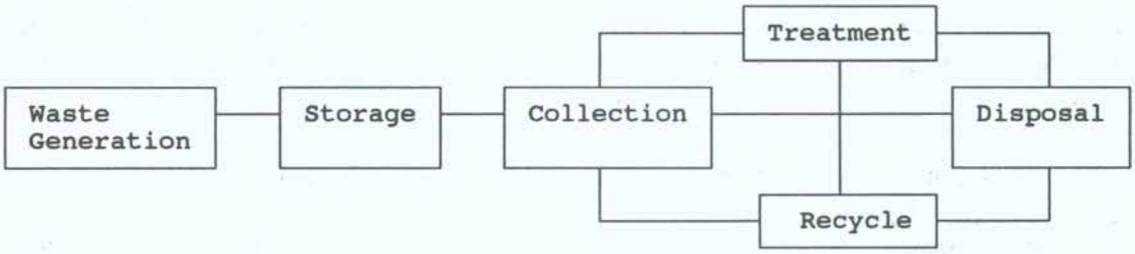

Fig. 1 Hazardous waste stage management.

(2) Management methods for hazardous waste of a specific type

As hazardous waste occurs in many areas of a community or municipality a management method should be developed which is specific to each hazardous category of waste. That is:

<u>Hazardous Waste from the Households in Community</u>.

The most hazardous waste is made up of fluorescent tubes that have mercury attached at the electrode, dry battery scraps which has a manganese component, insecticide can scraps and small batteries that have cadmium. The quantities may not be large when compared with other sources of hazardous waste. A method to manage such waste is:

-<u>Waste Generation</u>.

In general, there is only a small amount of hazardous waste from coming from households. The best estimates suggest the amount is approximately equal to 0.35 percent of all solid waste that comes from the community. In this way we can calculate tentative quantities of hazardous waste.

-<u>Storage</u>.

The municipality should require the separation of hazardous waste. Cooperation with inhabitants will lead to separation of specific solid waste in a given area. A garbage container covered with red colour could be used to leave fluorescent tubes, dry battery scraps, chemical can scraps, etc. The garbage container should have information to show that it is a container in which to keep hazardous waste. The container must be located in a suitable area and far away from houses in order to prevent chemical odours. The container must also be leak proof and not accessible to scavengers.

-Collection

The municipal garbage truck should have a special container to collect hazardous waste. Thus the hazardous waste is separated from other categories of waste or another special garbage truck can collect the waste everyday. The waste should not be left over night because of scavenging.

-Treatment

The municipality must deactivate chemicals, can scraps or insecticide by adding alkali solution, such as calcium carbonate ($CaCO_3$) or sodium hydroxide (NaOH) in order to lessen reaction potential. Other solid waste, such as fluorescent tubes or dry cell batteries, can be prepared for disposal.

-Disposal

This is the option for hazardous waste such as fluorescent tubes combined with mercury. The approach is to crush into a smaller size and mix with Sodium Sulfide (Na_2S) to form HgS, and then mix with cement to form a solid. Then bury. For dry cell batteries or cadmium use a solvent, such as calcium oxide or sodium hydroxide (NaOH); dry the sediment and then mix with cement in order to form a solid, then bury. Disposal of hazardous waste is a difficult process and not very acceptable to most municipalities. Hence the disposal should take place far away from the community, natural water areas, and underground water reserves and include appropriate environmental protection measures.

-Recycle

The best and most suitable method is for a municipality to try to make contact with manufacturers in order to try and recycle such items as fluorescent tubes. Some solid wastes that are hazardous have to be disposed of on an individual basis. For example, there is no technology to recycle manganese.

OPTIONS FOR THE MANAGEMENT OF HAZARDOUS WASTE IN HONG KONG

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Abstract

With the introduction of the Waste Disposal (Chemical Waste) (General) Regulation in Hong Kong, the disposal and management of chemical (hazardous) waste will be subject to stringent controls. Section 8 of the Chemical Waste Regulation stipulates that chemical waste must be disposed of at licensed or specified facilities approved by the Authority. The legislation also stipulates that any on-site and off-site treatment, reprocessing and recycling facility must be subject to the licensing control.

This paper provides an overview of the management options available for chemical waste in Hong Kong. Options to be discussed include waste minimization techniques which comprise waste reduction, waste separation and concentration, waste exchange, material recovery, product and process modification and good house keeping. Different physical and chemical treatment methods, especially waste stabilization/solidification will be discussed. The long term performance of the stabilized waste will be briefly reviewed. Since the final disposal method of chemical waste in Hong Kong will be landfilling, the science, practice and attenuation mechanisms of co-disposing chemical waste with municipal waste will be described.

I. Introduction

Hong Kong's manufacturing and service industries use large quantities of chemicals in their everyday activities. Many of the chemicals are toxic and hazardous in nature. The use of these chemicals invariably results in the generation of wastes in the form of residues, process wastes, unwanted by-products and off-specification products. These chemical wastes are normally concentrated in nature and contain the same toxic and hazardous properties as the raw chemicals. This paper provides an overview of the management options available for chemical waste in Hong Kong.

II. Chemical Waste Arisings

The most recent estimates of chemical waste arisings in Hong Kong is shown in Figure 1.

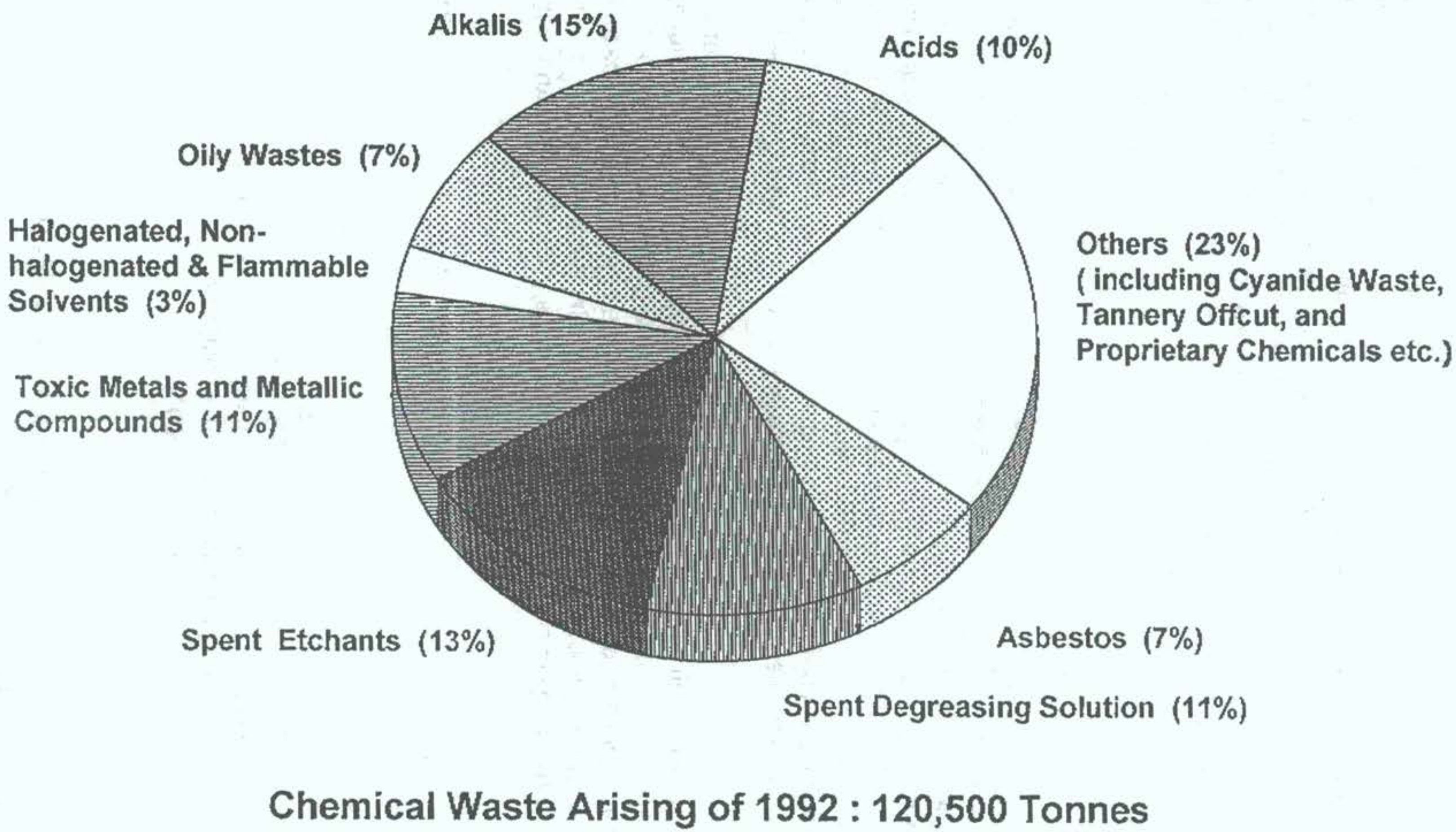

Fig. 1 Chemical waste arising distribution by waste streams (from Yang, 1992).

The data indicates that about 120,500 tonnes of chemical waste was generated in 1992. The major waste categories are acid wastes, alkali wastes, oily wastes, solvent wastes, spent etchants, spent degreasing solution and heavy metal wastes. The major chemical waste producers are the printed circuit board manufactures, the electroplaters and the basic metal industries.

III. Regulatory Controls of Chemical Waste

In order to tackle the problem of chemical waste, the Hong Kong Government's Environmental Protection Department (EPD) has established a scheme of legislative control on its management by the introduction of the Waste Disposal (Chemical Waste) Regulation (Laws of Hong Kong Chapter 354). The aim of the regulation is to impose a cradle to grave control on chemical waste from the point of its production to the point of final disposal. Key elements in the scheme of control include a definition of chemical waste; the registration of waste producer; a requirement for notification of particularly hazardous/difficult waste; requirements relating to packaging, storage and labelling of waste and a "trip ticket" system for tracking consignments of waste (Wong and Poon, 1991).

Regarding the disposal ("disposal" in the Regulation includes reprocessing, recycling and recovery activities) of chemical waste, Section 8 of the Chemical Waste Regulation stipulates that chemical waste must be disposed of at licensed or specified facilities approved by the Authority. The legislation also stipulates that any on-site and off-site treatment, reprocessing and recycling facility must be subject to the licensing control. The following guidance information has been issued by the controlling authority (i.e. Environmental Protection Department) to help waste producers to comply with the new regulatory controls:

i) A Guide to the Chemical Waste Control Scheme;

ii) A Guide to the Registration of Chemical Waste Producers; and

iii) Code of Practice of the Packaging, Labelling and Storage of Chemical Waste.

IV. Options for the Management of Chemical Waste

The options that are available for the management of chemical waste under the Chemical Waste Regulation include:

i) Waste minimization, including reduction of waste production, reuse of waste and recycle or reclaim useful materials from waste; and

ii) Waste management, including waste treatment and disposal.

V. Waste Minimization Techniques

There are a number of advantages in practicing waste minimization, including savings in raw materials and manufacturing costs, reduced potential hazards and liabilities due to waste handling, savings in treatment and disposal costs and improved image in the community and from employees by protecting the environment.

The general techniques that can be adopted for reducing, reusing and recycling chemical waste are illustrated in Figure 2.

Some of the techniques illustrated in Figure 2 would only require simple alterations to the management or work practice and can be accomplished without much cost and difficulties. A few techniques, for example, the replacement of hazardous by nonhazardous materials, may encounter opposition from industry in the fear that such actions may diminish product quality or entail higher costs of production. Some of the common barriers to an effective waste minimization programme are summarized in Table 1.

The best way to allay these concerns is to carry out small scale feasibility studies by setting up pilot scale demonstration plants. Since the Hong Kong industry is mostly made up of small scale businesses that lack the incentive to venture into new techniques and technologies, the government would probably need to take the lead to finance the development and/or evaluation of those waste minimization or recycling techniques that are applicable to the local industry.

Table 1

Barriers to an Effective Waste Minimization Programme

(from Anon., 1989)

Lack of awareness of the benefits of waste minimisation
Lack of technical skill
A "hand-off-the-process" attitude caused by fear of upsetting a products's quality
Organisation inertia, for example, an "if-it-isn't-broken-don't-fix-it" attitude
Internal politics of the organisation
An "it-can't-be-done" attitude as it is outside their range of experience

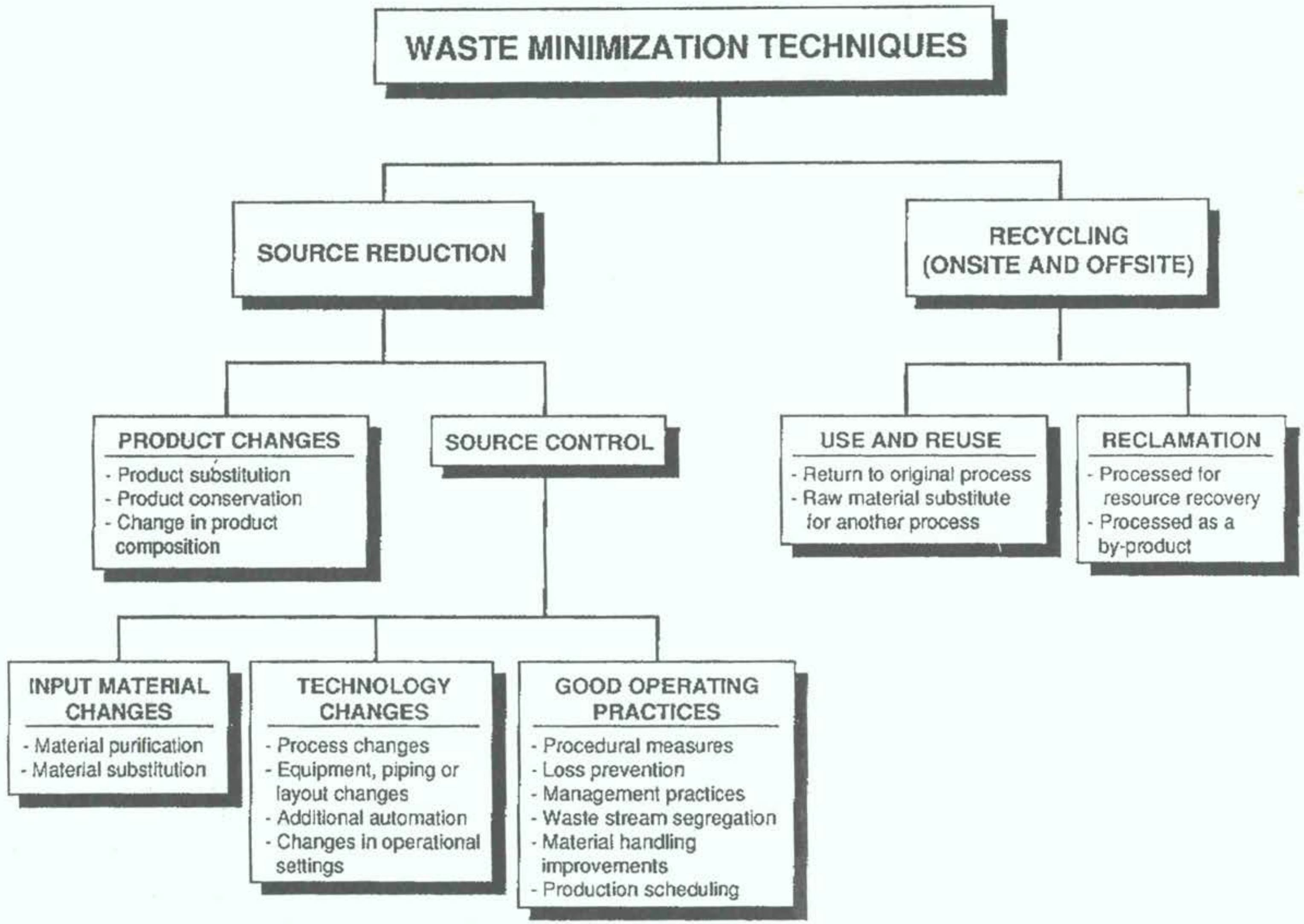

Fig. 2 Waste minimization techniques (from USEPA, 1988).

VI. Treatment and Disposal of Waste

If waste is inevitably produced, most chemical waste would need treatment before final disposal at landfills. A waste producer can either treat his/her waste in-house or arrange for treatment out-side his/her premises. All treatment operations (including recycling, reprocessing) are subjected to the licensing control of EPD. Generally the licensing conditions seek to control:

i) the site engineering works and infrastructure;

ii) the waste reception and categorization arrangement;

iii) the waste handling procedures, including the packaging and storage of wastes;

iv) the operation procedures of the treatment processes;

v) the provision of adequate site pollution control and monitoring equipment and facilities; and

vi) the liability responsibilities in case of accidents and emergencies.

There are a number of physical, chemical and biological processes available for the treatment of chemical waste. Table 2 summaries the applicability of some of these technologies for wastes generated by a few selected industrial processes.

The applicability of different treatment processes for the treatment of a certain waste type would depend on the physical and chemical properties of the waste and the regulatory requirements of the control authority (e.g. effluent discharge standards). Therefore a careful evaluation of the suitability of different processes should be carried out before any process is adopted.

VII. Chemical Stabilization/Solidification Processes

The increasingly likely prospect of more stringent controls on disposing hazardous waste in landfills necessitate the adoption of more advanced methods in the treatment of these wastes, prior to final disposal on land. Chemical stabilization/solidification (S/S) processes based on cement and other cementitious materials have been used as final treatment steps prior to land disposal of radioactive and chemically hazardous waste (USEPA, 1979; USEPA, 1981; Conner, 1990). These technologies are also playing an increasing important role for on-site or in-situ treatment and remediation of waste lagoons or contaminated soils (USEPA, 1990). The term "stabilization" refers to those aspects of the technology which results in rendering a waste less toxic through fixation of the contaminants that contain and/or by providing a stable chemical environment. "Solidification" relates to those operations which improve the physical and handling characteristics of the waste.

Table 2

Treatment Technology Matrix by Industry

(from Martin et al., 1987)

	Activated Carbon Adsorption	Chemical Oxidation	Chemical Precipitation	Chemical Reduction	Coagulation and Flocculation	Distillation	Electrodialysis	Evaporation	Filtration	Flotation	Flow Equalization	Ion Exchange	Neutralization	Oil Separation	Polymeric Adsorption	Reverse Osmosis	Screening	Sedimentation	Stripping	Solvent Extraction	Ultrafiltration
Inorganic chemicals manufacturing		#	#	#							#		#					#			
Iron and steel manufacturing					#								#	#				#	#		
Leather tanning and finishing	*	*			*				*								#				
Metal finishing		#	#	#				#		#		#		#							
Aluminum forming			#		#								#	#				#			
Battery manufacturing		*	#	#					#				#	#				#			
Pharmaceutical manufacturing					#						#		#					#			
Nonferrous metals manufacturing			#		#							*	#					#	#		
Organic chemicals manufacturing																					
Paint and ink formulation																		#			
Petroleum refining					#					#									#		
Pulp and paper mills	*				#										*		#	#			
Rubber processing					#					#	#			#				#			
Textile mills		#			#						#		#				#	#			
Timber products processing								#						#				#			

Many proprietary cement S/S processes, including cement/sodium silicate, lime/flyash and cement/flyash processes, have been developed. The basic principles of operation of these processes are broadly similar and reflect the basic requirement to effect hydration of the cementitious materials in the waste matrix to produce an acceptable stabilized/solidified product.

There are usually five basic steps involved in the S/S process:

i) analysis and assessment;

ii) pretreatment (optional);

iii) addition of stabilization materials;

iv) quality control, usually in the form of leaching and/or physical properties tests, of the end products; and

v) disposal of the solidified waste at landfills.

A schematic of the treatment process is shown in Figure 3. The S/S processes have been approved by the United States Environmental Protection Agency as the Best Demonstrated Available Technology for certain chemical waste streams (Conner, 1990).

The Hong Kong Environmental Protection Department has plans to phase out the direct disposal of liquid chemical waste in the landfills of Hong Kong. S/S processes would therefore have a role to play to stabilize/solidify chemical wastes before they are disposed of at landfills. In fact, the contractor of the Chemical Waste Treatment Centre is proposing to use the S/S process to solidify the treatment residues and incineration ash prior to landfill disposal (Chu, 1991).

It has been argued, however, that most S/S processes currently marketed do not approach the problem of the fundamental chemistry of the waste and stabilizing agents, but depend primarily on the isolation of the potentially harmful wastes in a coherent block of material to minimize leaching by physical means. The process design is mainly based on an empirical approach using trial and error methods of proportioning wastes to reagents levels. Whether a stabilized/solidified waste is acceptable for final disposal or otherwise depends purely on some short term criteria leaching and physical testing procedures which may or may not bear a relationship with the long term performance of the waste form. Although there are some published data on the leaching and physical properties of the solidified products, scientific interpretation of these data is not always possible because many of the results are based on non-standard testing methods obtained from samples with unidentified reagents/wastes levels.

In recent years, the stabilization/solidification process has attracted much attention in the science and engineering community. A number of researchers have used various techniques when studying the processes, including simple physical and chemical properties tests and complex microstructure examinations using different analytical tools and devices (Cote and Gillian, 1989; Gulf Coast Hazardous Research Centre, 1990; Poon et al., 1985; Poon and Perry, 1987). The challenge is to provide a scientific and technical understanding of the

Fig. 3 General inorganic S/S process procedure.

immobilization mechanism of the process. Also, it is imperative that the long term leaching mechanism of a solidified waste placed in a landfill environment be properly understood.

VIII. The Hong Kong Chemical Waste Treatment Facilities

The construction and operation of a centralized chemical waste treatment centre (CWTC) forms a part of the strategy for the management of chemical waste in Hong Kong. The centre and its associated collection facilities, commissioned in April 1993, are government owned and are providing the following services to the community (Boxall et al., 1992):

i) a high temperature incinerator for destruction of organic solvent compounds; the waste heat is recovered for reuse;

ii) oil/water separation and biological treatment systems of oil/water and other biological contaminated wastewater;

iii) a catalytic oxidation/evaporation system for wastewater treatment and water recovery;

iv) a stabilization/solidification system based on cementitious material for the treatment of incinerator ash and treatment residual prior to final landfill disposal;

v) a fleet of collection vehicles to collect wastes from waste generators' premises; and

vi) a barge for the collection of waste generated from marine vessels.

A process flow diagram of the various treatment processes of the (CWTC) is illustrated in Figure 4.

IX. Management of Residuals from the Treatment Processes

The treatment residual resulting from any treatment processes, e.g incineration ash and dewatered heavy metal sludge, would still require final disposal, often at a landfill environment. In Hong Kong, the landfill will be a co-disposal landfill where chemical waste will be deposited with municipal refuse.

Figure 5 illustrates the situation where a treated waste is deposited at a landfill. There are a number of factors affecting the release (leaching) of contaminants. These include:

i) the chemical speciation of the contaminants, for example, a metal sulphide or silicate would be much more insoluble than a metal hydroxide;

ii) the physical properties of the waste form; for example, a waste form that is monolithic or impermeable would subject to less attack by the percolating

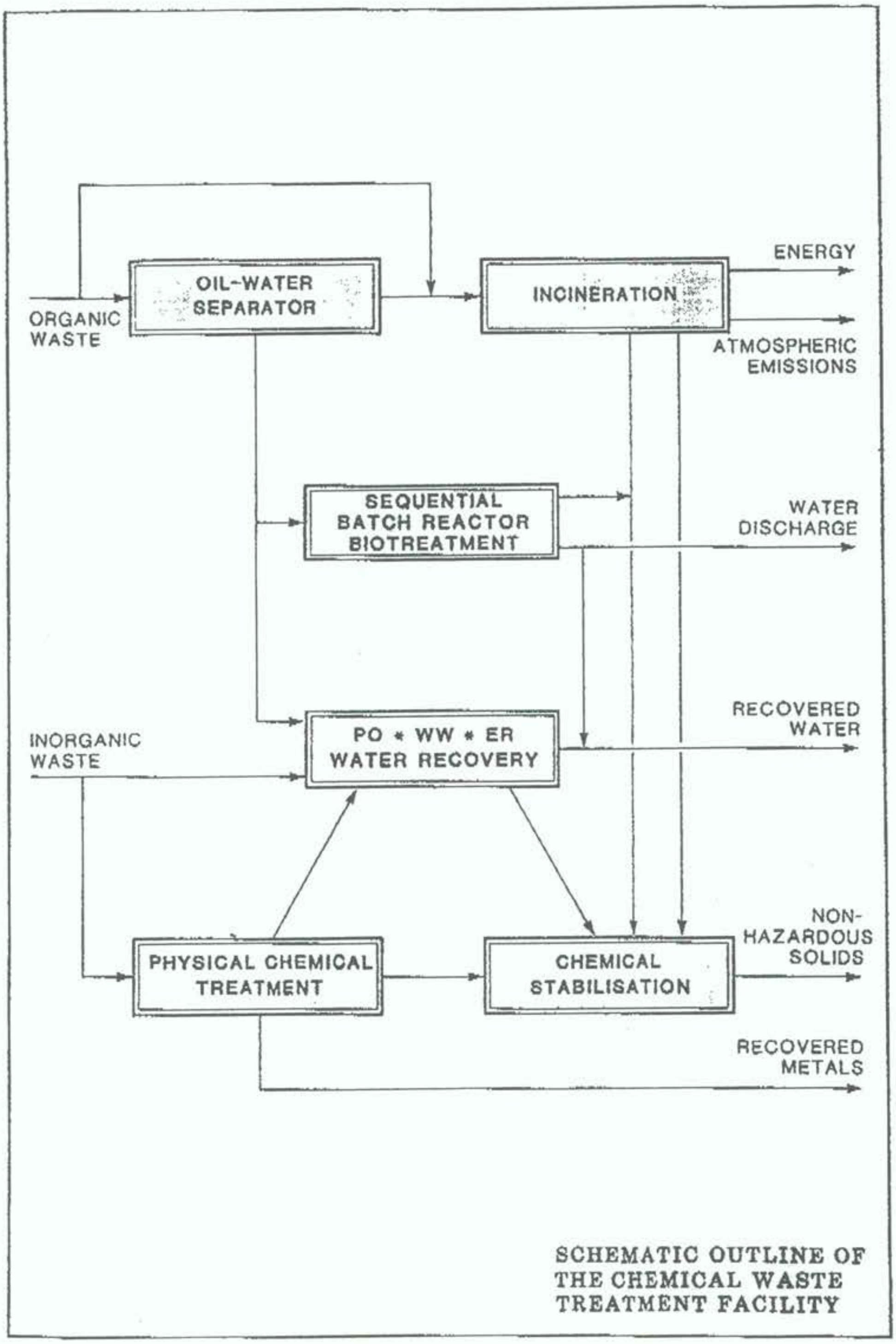

Fig. 4 Process flow diagram of the Hong Kong Chemical Waste Treatment Centre (from Enviropace Ltd., 1991).

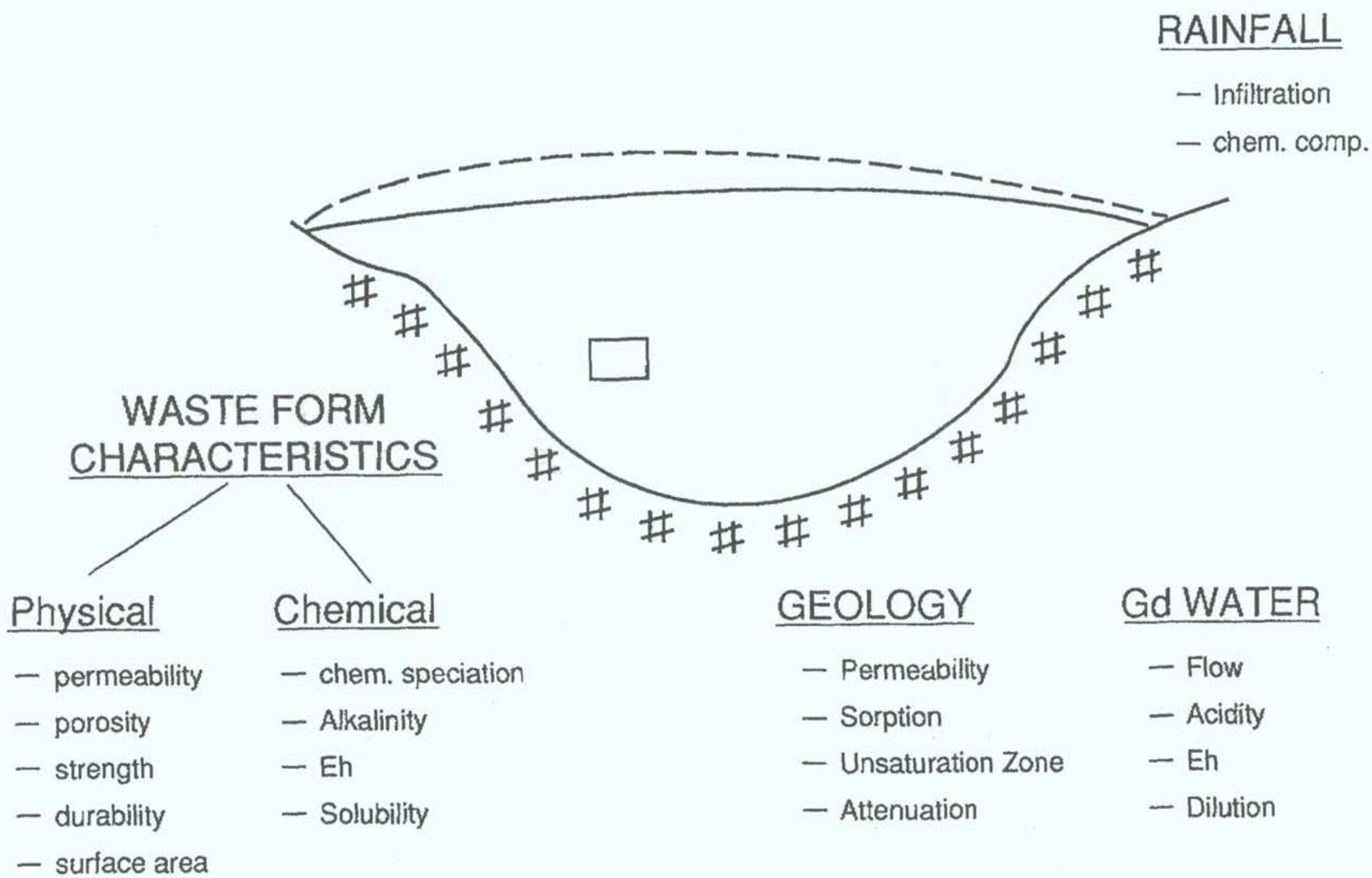

Fig. 5 Factors affecting leaching.

water than a porous waste form;

iii) the durability of the waste form under the landfill weathering conditions;

iv) the acidity and the redox potential of the leaching fluid; and

v) the amount of percolation or infiltration.

Research in the United Kingdom has demonstrated that the co-disposal of chemical waste at municipal landfills is one of the practical methods to dispose of some industry waste types, whereby the chemical constituents of the waste can be degraded to less toxic compounds or significantly attenuated or retained (Anon, 1989). This conclusion is based on the observed decomposition and attenuation capacities of municipal refuse for toxic chemicals. The identified decomposition and attenuation mechanisms include dilution and dispersion, precipitation, oxidation/reduction reaction, neutralization, ion-exchange, adsorption and absorption, and microbiological actions. A summary of the effect of the above mechanisms are presented in Table 3.

Table 3

Waste Decomposition and Attenuation Processes

(from Anon., 1989)

Process Type	Process Mechanism	Cause/Effect
<u>Physical</u>	Absorption	Liquid uptake by waste
	Dilution/dispersion	Leachate quality improve
	Waste compaction	Controls waste moisture content, liquid mobility, affects waste reactivity.
<u>Chemical</u>	Adsorption	Affects leachate quality Immodbilises ions from solution
	Precipitation	"
	Ion-exchange	"
	Oxidation/reduction	"
	Complexing	"
<u>Microbiological</u>	Aerobic decomposition	Degrades organic waste Raises temperatures
	Anaerobic decomposition	Degrades organic wastes and leachates. Produces landfill gas (high methane content).

Regarding the disposal of cement based stabilized/solidified waste, as in the case of the CWTC, although the mechanism of immobilization is not just purely an alkaline precipitation, the leaching of contaminants is highly dependent of the acid neutralizing capacity of the waste form. There have been attempts to predict the contaminants' release over time by diffusion and semi-empirical models. However, due to the complex chemistry and the lack of accurate thermal dynamic data of cement hydrates, little progress has been made. The Hong Kong Polytechnic is currently conducting a research project on correlating the long term release of contaminants with the change in microstructure of the waste form in order to further understand the leaching mechanism.

X. Conclusion

The various options for the management of chemical waste in Hong Kong that have been discussed in the paper is summarized in Figure 6. It is envisaged that government led efforts are required for the promotion of waste minimization (i.e. reduce, reuse, and recycle) options. Treatment of waste will be undertaken by the government owned centralized chemical waste treatment centre. More fundamental research on the behaviour of contaminants' release at a landfill environment will need to be evaluated in the tertiary institutions.

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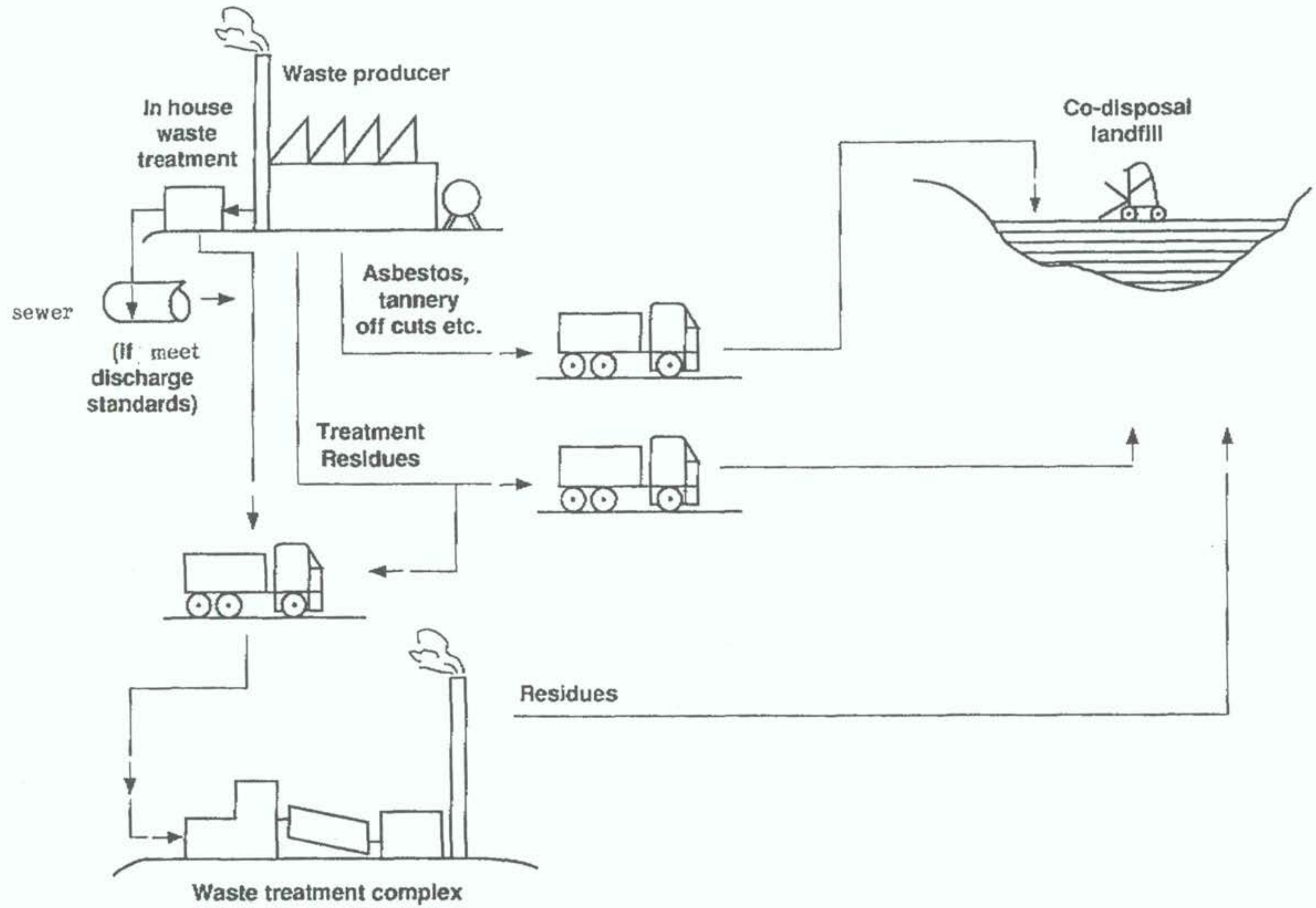

Fig. 6 Generalized view of waste disposal; options open to waste producers in Hong Kong.

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GUIDELINES FOR LECTURE ON SAFETY AND LOSS PREVENTION

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I. Country Overview

Malaysia is a South East Asia nation. It covers an area of about 330, 307 km^2, occupying the Peninsular Malaysia and the states of Sabah and Sarawak in the northwestern coastal area of Borneo Island. It has a population of 18.2 million and in 1991 the GNP is US$48,000,000. Primary exports are crude petroleum, timber and palm oil.

II. The Local Issue Related to Toxic Chemicals and Hazardous Wastes

Malaysia's rapid progress towards industrialization has associated with it increased levels of public exposure towards industrial accidents, particularly those dealing with toxic and hazardous materials. A recent tragedy involving an explosion in a local fireworks factory has revealed that existing safety standards are inadequate and enforcement is sorely lacking. The aftermath of the tragedy saw the Occupational Health and Safety Bill being drafted and a series of new legislative initiatives concerning management of toxic and hazardous wastes being passed.

Good management and legislation help improve the general attitude of an organization towards safety and reduce the likelihood of accidents. However, proper management and legislation may not be adequate to prevent the recurrence of the tragedy mentioned. Incorporation of established technologies for plant design can help eliminate accidents due to equipment failure, process deviations and in many cases, human error.

III. The Objective of this Lecture

This lecture is intended for tertiary level students, particularly those taking chemical and process safety engineering courses. The course requires the student to have an adequate background of core chemical engineering courses, including material balance, thermodynamics, reaction engineering, mass and heat transfer, unit operations design, and process control. This is equivalent to a minimum of three years undergraduate work in chemical engineering or related fields.

The objective of this course is to develop an understanding and expertise in the design of chemical plants to prevent and minimize hazards that may arise from the manufacture and storage hazardous chemicals, and from the disposal of related chemical wastes.

IV. The Lecture Presentation and Methodology

1. Title

Safety and Loss Prevention

Total Time : 1 hour

2. Hazardous Properties of Chemical Substances

An outline of the different categories and classifications of hazardous substances. For each category of hazardous substance, the appropriate quantitative measure(s) and it's basis are explained, giving specific examples on circulated handouts. Overhead transparencies are used for illustration.

Main Reference:

Sax, I.J. and Lewis, R.J. (1989), "Dangerous Properties of Industrial Materials", 7th Edition Vol. I, II and III, Van Nonstrand Reinhold, New York.

Time : 10 minutes

3. Hazard Identification and Assessment

The materials are organized as follows:

a. A review of the sources of hazards common in the chemical industries is presented along with the description of each phenomenon, whenever appropriate.

b. Description of a qualitative method employed to identify situations capable of producing loss, assessment of potential losses associated with these risks, and selection of measures to minimize these losses.

   The methodology is chosen from one of the following:

   i. Hazard and Operability Studies
   ii. Safety Audits
   iii. Checklists of Safety

   This descriptions is supported by a simple case study.

c. Description of a quantitative method employed to assess the potential hazards of a chemical plant.

The method is chosen from one of the following:

i. Fault Tree Analysis
ii. Hazard Indices such as Dow Fire and Explosion Index and Mond Index
iii Consequence Analysis

The same case study as employed in the qualitative analysis is used.

Video and slide presentations give a graphical description of the various sources of hazards. Overhead transparencies are used to describe the qualitative and quantitative methods employed during hazard identification. Contents of the transparencies are circulated.

Main Reference:

Lees, F.P. (1980), "Loss Prevention in the Process Industries", Vol. I and II, Butterworths, U.K.

Kletz, T.A. (1992), "Hazop and Hazan", 3rd Edn. Inst. Chem. Eng., Warwickshire, U.K.

Dow (1981) Fire and Explosion Index Hazard Classification Guide, AIChE, 5th Edition, New York 1981

Time : 15 minutes

4. Control of Hazards

Strategies for control of the possible hazards is outlined, based on the result from the previous hazard analysis case study. Emphasis is on *inherently safe design* to prevent the occurrence of any untoward incident. Specific examples on the design of storage tanks, reactors, and separators are cited.

The advantage of inherently safe features over engineered safety is illustrated using a case study involving the toxic release of methyl isocyanyte in Bhopal in 1984. The study illustrates how the tragedy can be avoided, or at worst the loss minimized by employing several inherently safe features on the process.

Colour slides and overhead transparencies are used to present this section.

Main Reference:

Marshall, V.C. (1987), "Major Chemical Hazards", Ellis Horwood, Chichester, 1987

Kletz, T.A, "Cheaper, Safer Plants", Inst. of Chem. Eng. Hazard Workshop, 2nd Edition, Rugby, 1984

Kletz, T.A, "Towards Intrinsically Safer Plants", The Institution of Chemical Engineers (Midlands Branch), Birmingham, Sept. 12-14, 1979, pp.4/1

Time : 10 minutes

5. Control of Process

The case study from hazard analysis is further extended to take into account automation to *prevent hazardous deviations in process variables*. The study includes provision of automatic control systems, interlocks, alarms, trips and sound operating practices and management.

Examples of possible hazardous deviations to the process are listed.

An additional case study extracted from the local newspaper involves the toxic release of SO_2 and SO_3 from a factory that produces bleaching earth. The study highlights the need for control automation to prevent hazardous release.

Colour slides are used to illustrate examples of control systems employed in practice.

Overhead transparencies give schematic representation of the features.

Main Reference:

Lees, F.P. (1980), "Loss Prevention in the Process Industries", Vol. I and II, Butterworths, U.K.

"Gas Leak: Factory to Submit Report" New Straits Times, October 20, 1992

Time : 10 minutes

6. Limitations of the Loss

This section focuses on the design features that minimize the damage and injury caused if an accident does occur. This takes into account the plant layout, equipment layout, provision of fire-fighting equipment and emergency procedures.

Overhead transparencies are used for presentation.

Main Reference:

Lees, F.P. (1980), "Loss Prevention in the Process Industries", Vol. I and II, Butterworths, U.K.

Time : 10 minutes

7. Plant Visit

At least one visit is organized for the students during the semester. This gives the students an appreciation of the of the relevant safety control systems, the schedule of operations and emergency procedures, as employed in practice.

The visit normally covers companies involved with hazardous chemical operations.

A session for discussion with the plant manager takes place at the end of the meeting.

8. Conclusion

Summary and emphasis on the need for sound plant design technology to eliminate accidents in combination with legislative measures and good operating practices.

Time : 5 minutes

V. Course Evaluation

The following subjects are covered for the purpose of evaluation:

Laboratory participation
HAZOP project
Hazard Index project
Examination
Participation in Plant Visit and subsequent report writing

Evaluation is continuously done by way of the work, assignments, quizzes and exams. The wide range of topics covered enables the use of multichoice, structured and essay type questions.

CASE STUDY ON DETOXIFICATION OF ORGANIC MATERIALS: AN APPROACH TO THE PROSPECT OF APPLYING SONOCHEMISTRY (PHOTOCHEMISTRY)

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I. Introduction

China is a developing country with a population of 1.3 billion. Food is therefore an important commodity. In order to develop agriculture in China there are now about 200 manufacturers which produce various types of pesticides, such as insecticides (amounting to 77.4%), bactericides (7.9%), herbicides (7.6%) and plant growth promoters (0.46%).

In China, the organic chlorine pesticides, such as BHC (666), DDT, and the agents of mercury or arsenic make up 80% of total pesticides produced in China.

In 1986 China's Chemical Engineering Ministry carried out an inquiry into contamination resulting from 53 pesticide manufacturers. In the waste water to be discharged the chemical oxygen demand (COD) was about 30,436 tonne day $^{-1}$; sulphur compounds were about 304.2 tonne day $^{-1}$. Currently most of the waste water is not treated. The rate of treatment is only 9.26%, and the ratio of achievement is lower yet. The waste water from processing is characterized by the following:

- The displacement of waste water is not too great, about 3 to 24 tonne per tonne of product. But the concentration of toxic materials is rather high - COD may be up to 5,000 to 80,000 mg L^{-1}.

- The components of waste water are typically complex and toxic. There are many pesticide intermediates, chemical compounds of phosphorus and sulphur, and salt. Some pesticides are aromatic, halogenate, aromatic hydrocarbon or organic phosphorus and sulphur compounds which are hardly degraded by means of biochemical methods.

In China, processing pesticide waste water relies mainly on biochemistry, just like other organic waste water. These methods have made appreciable achievements already, but have suffered many limitations, such as the greater area occupied by the processing units, severe environmental conditions, complex operations and effects of water quality. The methods are particularly ineffective for extremely toxic organic chemicals.

The so-called sonochemical reaction is carried out through a sono-cavitation process.

Following the collapse of the cavitation bubbles, high temperatures (above 5,000 K) and pressure (above 5×10^7 Pa) occur in a minimal space for an instant, so as to form "hot spots" and provide a new approach for a chemical reaction.

Chinese researchers (Fang Ruo and Li Huamao, 1992) have recently reached several conclusions about the theoretical and experimental studies of sonochemistry.

1. Toxicities and Structure Feature of Organic Chemicals

The organic chemicals which may be accumulated in organisms easily endanger the human race through various mechanisms.

1.1 Toxicities of organic chemicals

The mechanisms of toxic actions on organisms after entering a live body may be divided into two types:

1. The toxins are from the specific chemical structure of organic compounds such as organic phosphate, chlordane and parathion; their toxic actions correspond to the physiological actions from the substance. Each time the concentration of the organisms which enter the body exceeds the threshold, the inherent physiological actions begin to appear. If the amount of toxin entering the body increases further so as to reach the lethal dose, the normal metabolism of the live body is not sustained and the result is the person's demise. This toxicity is called "simple acute toxicity".

2. On entering organisms some organic substances become more reactive astable intermediate metabolites in the process of reacting with biological metabolic enzymes and are polarized.

   The metabolites covalently link up with the macro-molecular compounds in cells, such as protein and nucleic acid, and in this way their chemical properties are non-reversibly modified, causing cancerogenic, malformed and mutated effects.

   The other of the organic compounds may be changed into even more toxic compounds. An example is a compound of chlordane. Heptachlor in soil, plants and animals may be changed into heptachlor epoxide. It has a toxicity four times greater than heptachlor.

1.2 Structural characteristics of some toxic organic compounds

Relevant information may be found in "Toxicological Aspects of Environmental Pollutants - Organics", "Pollutant Chemistry of Toxic Organics" and Cheng Yuan-Kai and Tabg Shen, 1990.

1.2.1 Toxic organic compounds with epoxide as ultimate form

The polycyclic aromatic hydrocarbon, such as benzpyrene, dibenzanthracene, 3-methylcholanthrene, and the chemicals with benzene ring or some double bonds, such as benzene and halogeno-benzene, chlorethene and its derivatives, phenylethylene, acrylonitrile and aflatoxin, all belong to this kind of substance. These toxic chemicals are oxidized by the microsome cell pigment enzyme P-450 or P-488 to become corresponding epoxides whose epoxy group with intensive electrophilic reactivity may react with the remainder group in protein and the base in nucleic acid. These possess highly nucleophilic reactivity, to yield the covalent compounds which are highly mutagenic and carcinogenic.

The benzo (a) pyrene (Bap) is one of the most highly carcinogenic aromatic hydrocarbons which is so far best understood. Its ultimate form is Bap-7, 8-diol-9, 10-epoxides, with cis and trans-isomers, both of them are highly carcinogenic.

For the polycyclic aromatic hydrocarbon (PAH), the precondition of carcinogenicity is that the molecule must possess an unsubstituted angular-ring. Because the epoxy group of dihydrodiol must be formed in the angle-ring only, the carcinogenic activities can be given. Once there is a substituting group on the angle-ring, the epoxy group of dihydrodiol is hindered from forming, so that the carcinogenicity is weakened or disappears. Secondly, there must not be a substituting group in the peri-position neighboring on an unsubstituted angular-ring, otherwise the carcinogenicity is also weakened or disappears. The reason may be that the peri-substitution hinders the half-axial dihydrodiol from transforming into the corresponding epoxide of dihydrodiol. Thirdly, when the bay region has a methyl substitution, the carcinogenicity may clearly be increased. According to studies, unsubstituted PAH is a plane molecule, but when a methyl exists in the bay region, the steric hindrance may enable the plane to turn around. This un-planeness is known to be a primary reason for the increase of carcinogenicity.

1.2.2 The toxic organic compounds containing the N-nitroso group

N-nitroso group compounds possess high carcinogenicity and mutagenicity. They can be divided into two kinds, i.e. N-nitrasoamines and nitrosoamide. The former is formed by the reaction between a secondary amine, or a tertiary amine, or a quaternary ammonium salt possessing di-alkyl, or alkyl-aryl, or diaryl, respectively, and nitrous acid under acid conditions. The latter is the product which results from the reactions of nitrous acid with alkyl urea, or N-alkyl aminocarbamate, or N-alkyl amide, etc.

N-nitrosoamine itself does not mutate cells, but the hydroxy compounds produced by oxidizing the α-carbon of a nitrogen atom through P-450 release aldehyde to readily form N-nitroso N-monoalkylated amine, by isomerization ones are turned into alkyl azide hydroxide which can be dissolved to form alkyl carbonium ions. These can alkylate the macromolecules of the organism, such as protein and nucleic acid, by electrophilic attacking, with the result that the organism is cancered.

Dimethyl nitrisormine (DMNA) is the most highly carcinogenic. Dibutyl nitrisormine (DBNA) and its W-hydroxy compound: N-butyl N-hydroxybutyl nitrisoamine (NBBA) promote carcinogenesis for the bladder. The compound in which the butyl group of NBBA is replaced by methyl or ethyl group also has high carcinogenesis to the bladder.

Under the influence of physiological pH the N-nitrisoamide in vivo may be hydrolyzed immediately to yield the alkyl azide hydroxide, initiating carcinogenicity.

1.2.3 The toxic organic containing polychlorinated biphenyls (PCB)

The polychlorinated biphenyls (PCB) is the general name of biphenyls displaced by chlorine in varying degrees.

As a group, the PCBs possess excellent physico-chemical properties, so that they are used extensively in industry. Diffusing into environment, PCB has become a spectacular contaminant.

The different numbers or positions of the displaced chlorine in the PCBs which enter the organism decide the different metabolic pathways and the different toxicities.

According to research:

- the lower chloro-PCB with less than four chlorine atoms can be metabolized to monophenol; a part of them can be changed further to diphenol;
- the pentachlorinated or hexachlorinated PCB can be less rapidly oxidized to monophenol;
- perchloride PCB with more than seven chlor cannot be metabolized;
- the PCB with the same number of chlor whose ortho is undisplaced or displaced by chlor are more easily metabolized than others.

The research indicates that the PCBs which are easily metabolized also readily combine with the macromolecules of an organism, but the perchloride PCB, which can hardly be metabolized, shows very high toxicities.

II. The Principle of Sonochemistry

The cavitation phenomenon of liquid flowing at high speed in a tube was discovered by Reynolds in 1894. At the same time, Thornycroft and Barnaby studied the severe vibration occurring at a propeller. Rayleigh produced his famous academic thesis in 1917 (Rayleigh, 1917). Several phenomenon, such as erosion, vibration and noise, which had been induced by cavitation, now have widespread importance.

2.1 Ultrasonic cavitation and cavitation threshold

Ultrasonic cavitation means that under the action of ultrasonic waves, the micro-gasification in a liquid produce a series of dynamic processes such as radial pulsating, growing and collapsing.

So called instantaneous cavitation means that under greater sound intensities or lower frequencies, the bubbles exist for only one or at the most only a few periods of wave. In reaction to the negative pressure, the bubbles expand quickly. Then in response to the positive pressure they collapse quickly. After collapsing many micro-bubbles will be formed to make new cavitation nuclei. Some bubbles dissolve in the liquid because of their radii is excessively small, i.e. the surface tension is very great. In the time during which the bubble exists there is not the mass migration of gas through the bubble wall, but rather at the surface of the wall. This may result in the liquid evaporating and the vapor condenses.

The high temperature and great pressure which has been produced as the cavitation bubbles collapse make the molecules of the material split apart into free-radicals. For example, water molecules can be split apart into hydrion (•H) and hydroxl (•OH). The most important property of the free-radical is its chemical reactivity. Through a chemical reaction it may take the shape of a static molecule and give out light. It is the free-radical which forms the basis of sonochemical reactions.

How does one study the relationship between the ultrasonic irradiation dose (irradiant time and intensity) and the output of free-radicals in water?

The fluorophotometer is a tool to study the free-radical by sound.

- Principle

Paraphenylene diformic acid (TA) is not fluorochrome. Provided the TA solution is irradiated with appropriate ultrasonic waves the water molecule will split apart into free radicals of •H and •OH. Both the ion of the TA radical and hydroxyl •OH are compounded to form the ion of the hydroxy paraphenylene diformic acid radical (HTA).

III. The Applied Prospect of Sonochemistry

According to the research of China's Chemical Engineering Ministry in 1986, the waste water discharged from 53 pesticide manufacturers possessed chemicals and discharge mass was as shown in Table 1.

3.1 Immediate degradation of organic toxic by ultrasonic ware

According to "Treatment and Uses of Phenolic Waste Water" the phenolic solution is to be processed in an ultrasonic field for 2 hours. It will be oxidized to form hydroxglic intermedium, guinone, fatty acid and CO_2. The effect of degradation does not relate to pH, if pH is in the range of 3 to 9.

3.2 Quicken the hyrolization of organic toxic with sonochemical methods

According to the "Treatment of Chemical Engineering Waste Water" the hyrolization of organic toxic compounds is a preferred process over that of biochemical treatment to reduce the content of COD and increase the biochemical possibilities, so that, decreasing the toxicity of the waste water will not make the micro organisms into toxins. In most conditions the organic phosphorus pesticide may be hydrolyzed. The reaction ratio is related to pH.

Table 1

Discharge and Components of Brief Organic Phosphorus Pesticides

(From: "Treatment of Engineering Waste Water", 1991)

product and name of waste water	discharge (tonne per tonne of product)	composition of waste water		
		COD	total organic phosphorus	other contaminants
dipteryx component waste water	27.8	25,000 to 230,000		NaCl 50,000 dipteryx 10,000
dichlorvas component water	4 to 5	40,000 to 50,000	4,000 to 5,000	
rogor mother liquor washing water	3	1,174	5.5	methanol 1,377
Sulphate, phosphate waste water	1.6	1390	44	NH_4Cl 16.67% coarse grease 5.93%
Malathion, and component washing water	3 to 4	5,000 to 95,000	15,000 to 50,000	methanol alcohol
parathion component washing water	3.8 to 24	8,000 to 21,000	244 to 1,400	3,000 to 20,000 NaCl 5,000 to 15,000
methyl parathion methyl chloride and condensation waste water	9 to 12	25,000 to 80,000	5,000 to 6,000	paranitrophenol sodium 2,000 to 12,000 NaCl 11 to 12%
methylamine phosphate methyl chloride, ammoniation waste water	17.3	75,000	4,600	paranitro-phenol sodium NH_3-N 68,000

- altaline hydrolysis

The organic phosphorus will split open P-O(s) or (s) O-X bonds in hydrolysis process, and form non-toxic or less-toxic dissolvent products. For example, the dichlorvas may be hydrolyzed to dimethyl phosphate of sodium and dichloro acetaldehyde. Both are non-toxic. Again, Malathion can be hydrolyzed to dimethyl disulfo-phosphate and dimethyl fumaric ester. The former can be degraded into other non-toxic compounds; the latter is non-toxic for insects and fish.

- acid hydrolysis

  By adjusting the pH to 4, the waste water of methyl parathion can be acid hydrolyzed to make organic phosphate into the inorganic phosphate. The latter will be precipitated under alkaline condition. Because of the hydrolysis of ultrasonic waves, in both of the above hydrolytic reactions there are many free-radicals of H and OH, in anticipation of hastening the conversion process to form non-toxic compounds from organic phosphorus and sulphate.

3.3 Degrading the organic toxic compounds with sonochemistry method instead of wet air oxidization (WAO)

According to the "Treatment of Chemical Engineering Waste Water" so-called wet air oxidation means that under temperatures of 200 to 300 C, keeping the pressure in the range of 29.4×10^6 to 1.67×10^7 Pa, the oxidation of organic/inorganic substances in waste water is carried out in liquidoid. At present, this is the most effective treatment for the organics. All over the world 200 units for WAO are already operating or are being built. By using catalysts in the WAO process some chloride for which biodegradation is powerless, such as PCB, DDT and pentachlorophenol, have been processed in USA. As a result, their toxicities may be reduced by not less than 99%. In Japan, the treatment of various waste waters which contain greater concentrations of the organics and ammonia, such as waste water from coal gas manufacturers, waste water resulting from the gasification of heavy oil, and petrochemical waste water, is economical and effective too.

The physical conditions of higher temperature and pressure resulting from the collapse of cavitation bubbles creates the required reaction conditions for the WAO. Meanwhile, under the influence of the ultrasonic wave, the water molecules split apart into free-radicals which will be helpful to speed up the WAT reaction too.

3.4 Degradation of high polymer with sonochemical methods

Numerous experiments (e.g. Mason and Lorimer, 1988; Schmid and Rommel, 1939; Schmid and Beuttenmuller, 1943; Schmid, 1940; Schmid, Paret and Pfleider, 1951) have shown that the cavitation effect can break down the molecular bonds of high organic polymers. This is helpful for the biodegradation of high organic polymers.

3.5 Degradation of organic metals with sonochemical methods

Generally organic metals are too toxic to biodegrade. Suslick et al. (1983) showed that as long as the ultrasonic cavitation is intensive enough, pentacarbonyl ferrite can be made into ferrite. Under the influence of ultrasonic waves the metal atoms in molecules of the organic metals can be "activated", so they split away with C bonds and form free-radicals. This creates the conditions for further physicochemical and biochemical processes.

IV. Conclusions

In order to degrade organic toxic with sonochemical methods, we have to study a number of key problems, such as :

- Study the interrelations between the toxicity of organics and their molecular structure:
  - analyze and sum up the regularities of typical organics;
  - under influence of sonochemical reaction, investigate the varied laws of the molecular structure of organics;
  - develop technical understanding and the basic approaches to make use of sonochemistry
- Study the sonochemical degradation mechanisms of typical organic toxic compounds:
  - the effect of physicochemical and acoustical parameters in liquid on the outcomes and the ratios of sonochemical reaction;
  - the interrelations between sonochemical reaction and the statistical characteristics of the sound field;
  - advance the technical needs about sonochemical reactors.
- Development of sound reactor:
  - sonochemical reactor that meets the needs of theoretical studies;
  - sonochemical reactor that meets the needs of engineering.
- Applied research of engineering with sonochemical reactions:
  - according to the actual needs and possibilities, select objectives;
  - depending on the components of waste water, develop single item analogous studies and comprehensive studies in the laboratory;
  - link up the formal and the latter technical sections of treatment of waste water;
  - make use of or develop catalysts, coagulants and auxiliaries to meet the needs of typical waste water;
  - develop the technical process of typical waste water treatments and advanced technical designs.

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MINIMIZATION AND TREATMENT OF HAZARDOUS WASTES IN METAL FINISHING WASTEWATER

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I. Introduction

The metal finishing industry as a group is often a major contributor to hazardous waste in many countries. In managing wastes from metal finishing industries many aspects come into play. This paper brings together the various aspects (pollution, legal, minimization technology, treatment technology, etc.) involved in managing metal finishing wastewater (MFWW) containing hazardous pollutants. A case study based on a completed project on minimization and treatment of MFWW from small and medium scale industries is used as an example. Small and medium scale industries are the most numerous in any country and they generally face such constraints as space, economy, technical facilities, and lack of trained staff in managing their wastes.

Management of wastewater should not be limited to only wastewater treatment at the end of the process. Equally, if not more important, is the minimization of wastewater volume and loading. Waste minimization is stressed here as the priority in managing wastes in a plant.

II. Pollution Problems and Wastewater Characteristics

The first step in managing a waste is to know the waste, especially with respect to its characteristics and its pollution potential. With respect to MFWW, heavy metals and toxic compounds in the wastewater can cause irreversible damage to the environment if the wastewater is not sufficiently treated before discharge.

In a 1985 survey by the Department of Environment (DOETH, 1985), the total toxic and hazardous wastes generated the states of Peninsular Malaysia amounted to 220,000 m^3 per annum. Of these, the metal finishing industry contributed the largest percentage of total waste (approximately 43.8%). The contributions of toxic wastes by various industries are shown in Table 1.

A survey conducted by the Department of Environment (DOE) Malaysia (DOETH, 1985) revealed that over 57% of both acidic and alkaline wastewaters and sludges containing toxic heavy metals are generated by the small and medium scale metal finishing industries.

Table 3

Raw Materials Used in electroplating Processes at 42 Facilities in Klang Valley Area

	Process	Raw Materials
1.	Pretreatment	Soda ash, Caustic Soda flake, hydrochloric
2.	Nickel Plating	Nickel chloride, nickel sulphate, boric acid, brightener, sulphuric acid, nickel anode, nickel square, nickel carbonate, nickel crown, nickstar New 35.
3.	Brass plating	Copper sulphate, Tosa Emery Powder 120, nitric acid, brass salt, brass anode, ammonium chloride, caustic soda, detergent, lead bar, cleaner, lacquer, hydrochloric acid.
4.	Chrome plating	Chromic acid, chrome anode, chrome salt, sulphuric acid, catalyst.
5.	Copper plating	Copper sulphate, copper anode, caustic soda/flake, soap powder/wetting agent, copper cyanide, chromic acid, sulphuric acid, sodium cyanide, canning brightener, metabisulphate, hydrogen peroxide.
6.	Zinc plating	Zinc oxide, zinc brite AP, zinc purifier No. 1, zinc anode, sodium cyanide, Asahi Zinkel Z-60R, zinc powder, nitric acid, sodium hydroxide, lacquer, stripper.
7.	Silver plating	Potassium silver cyanide, silver anode, caustic soda, silver cyanide, nitric acid, hydrochloric acid, degreaser, brighter.
8.	Tin plating	Stannous sulphate, tin anode, hydrochloric acid, detergent, degreaser.
9.	Painting	Ion phosphate, paint, tinner, derusting acids.
10.	Anodizing	Dyestoff, caustic soda, hydrochloric acid, sulfuric acid, nickel square, oxalic acid, phosohoric acid, sodium nitrate, glucomate, colouring agent, aluminium extruded.
11.	Graveling	Photopolymer, alkaline.
12.	Galvanizing	Sodium orthosilicate, lime, hydrochloric acid, sulfuric acid, nickel square, oxalic acid, phosphoric acid, sodium nitrate, glucomate, colouring agent, aluminium extruded.
13.	Cooper coasting	
14.	Engraving	Nitric acid, sulphuric acid, Newfine sol, ferric chloride, N-butanol, polychloroethylene, alcohol, hydrochloric acid.

III. Environmental Regulations.

Understanding of pertaining environmental regulations is necessary as these and their enforcement would be the primary driving force for industries to manage their wastes. In Malaysia the main legislation for protection of the environment is enacted through provisions in the Environmental Quality Act (EQA) 1974. The regulations and orders enacted so far under the EQA 1974 which are relevant to metal finishing wastewater, are :

EQ (Sewage and Industrial Effluents) Regulations, 1979, or EQ (SIE) R, 1979.

EQ (Schedules Wastes) Regulations, 1989, or EQ (SW) R, 1989.

EQ (Compounding of Offenses) Regulations, 1978 or EQ (CO) R, 1979.

EQ (Licensing) Regulation 1977 or EQ (L) R 1977.

Some local councils have also enacted, or are about to enact, local regulations requiring waste audits, recycling, etc. In setting up a plant that would generate scheduled waste, such as that containing heavy metals the environmental application procedure is as shown in Figure 1.

Under EQ (SIE) R 1979 discharged wastewater has to meet the Effluent Quality Standard A or B (see Table 4). If the plant is located upstream of a potable water intake point, the Standard A applies; otherwise Standard B applies.

These sets of uniform standards generally apply to both industrial and development projects throughout the country. However, the Environmental Quality Act, 1974 does provide legal provisions for project proponents to vary their effluents, provided that a license is obtained from the Director General of Environment. In granting such license, consideration will be given to factors such as technology availability and constraints and capacity of the water body to receive additional pollution load. It must also be shown that contravention of the acceptable conditions will not cause hazards to public health, safety, or welfare, or to animals, birds, wild life, fish or aquatic life, or to plants or to adversely affect the beneficial uses of the environment.

To minimize unnecessary pollution control costs, project proponents are advised to avoid siting effluent generating plants in areas subject to Standard A.

With regards to the schedules (toxic and hazardous) waste regulations, a summary of the EQ (SW) R 1989 is given below :

1. Under the regulations, 107 categories of waste have been classified as scheduled wastes. Waste generators should first of all determine whether their wastes are scheduled wastes. New generators of scheduled wastes are required to notify the Department of Environment within one month from the date of generation of wastes.

2. Scheduled wastes can be stored, recovered and treated within the premises of the waste generators. Such activities do not require licensing by Department of Environment. However, land farming, incineration, disposal and off-site facilities for recovery, storage and treatment can only be carried out at prescribed premises licensed by Department of Environment.

3. Waste generators have to keep an up-to-date inventory of scheduled waste generated, treated and disposed off. Proper labelling, containers and storage areas as well as prohibition of storage of incompatible waste are also required by law.

4. In the case of transporting the waste from the waste generator to the treatment and disposal facilities, the transporting of waste shall conform to the consignment note system, whereby the movement of waste is monitored until it reaches the approved destination. It is the responsibility of a waste generator to monitor and ensure that the waste transported from his/her factory reaches the approved destination. The waste generator is responsible to inform the transport contractor regarding the nature of the waste and what actions to be taken during accidents in order to minimize damage to human life and the environment. Scheduled waste transporters should also be licensed by the Department of Environment.

IV. Waste Minimization

Waste minimization reduces input of pollutants to the environment. This alone justifies the priority to be given to it in managing waste in a plant. Understanding of waste minimization procedures will show that it is actually part of plant improvement.

Minimization can be carried out on an existing plant or planned for at the design stage, Reduction of wastewater volume and loading will decrease wastewater treatment costs. Often valuable by-products are obtained in the process. As waste minimization ultimately leads to less wastage of raw materials and often generation of income generating resources, several companies which embarked on waste minimization have found the move to be profitable. Several examples of these are given by Frankel and Phongsphetraratana (1986). Waste minimisation may involve modification of process, recycling of water and improvement of "housekeeping" so as to lower the volume and concentration of the waste generated. In an existing process, the scope for process modification and water recycling may be limited; however, in a new plant, waste minimisation may be planned at the design stage. General guidelines in waste minimisation are given below.

(1) Designing for Minimum Waste at Source

In designing a new plant, waste minimisation may be approached by following these steps:

- Plant Assessment

This involves a preliminary study of the plant to define manufacturing processes and to identify and quantify all sources of toxic wastes and to indicate any obvious housekeeping changes or in-plant process, and layout changes which would minimize the levels of treatable wastes.

- Wastewater Management: Options and Strategies

The second phase of the study is to draw a conceptual plan which provides an outline of the various waste management strategies along with provisional capital and operating costs, including long-term cost benefits of each option. This provides a basis for system selection.

System Installation, Start-up and Operator Training

The final major phase involves the final design of the selected system, installation and commissioning. The commissioning of the new system may be phased with the decommissioning of an existing system.

(2) Waste Minimisation in an Existing Plant

Waste minimisation in an existing plant involves analysis and replanning of the water usage in the whole plant. The replanning may be via the following steps :

Register of water usages and wastewater discharges

(a) Identify all points of water usage and wastewater discharge lines. Water usage and wastewater discharge rates are then measured;

(b) Record daily water consumption and wastewater flow rates - including the diurnal variation thereof. Record the production activities that give rise to the flow variations. Relate the daily figures to commodity production rate (e.g. m^3 per tonne product plated);

(c) Draw up a water mass flow diagram for all processes - including floor washing where relevant. Ensure that a balance is achieved between the overall water intake and the individual water usage figures;

(d) Establish the quality of and daily variations of the various wastewaters; and

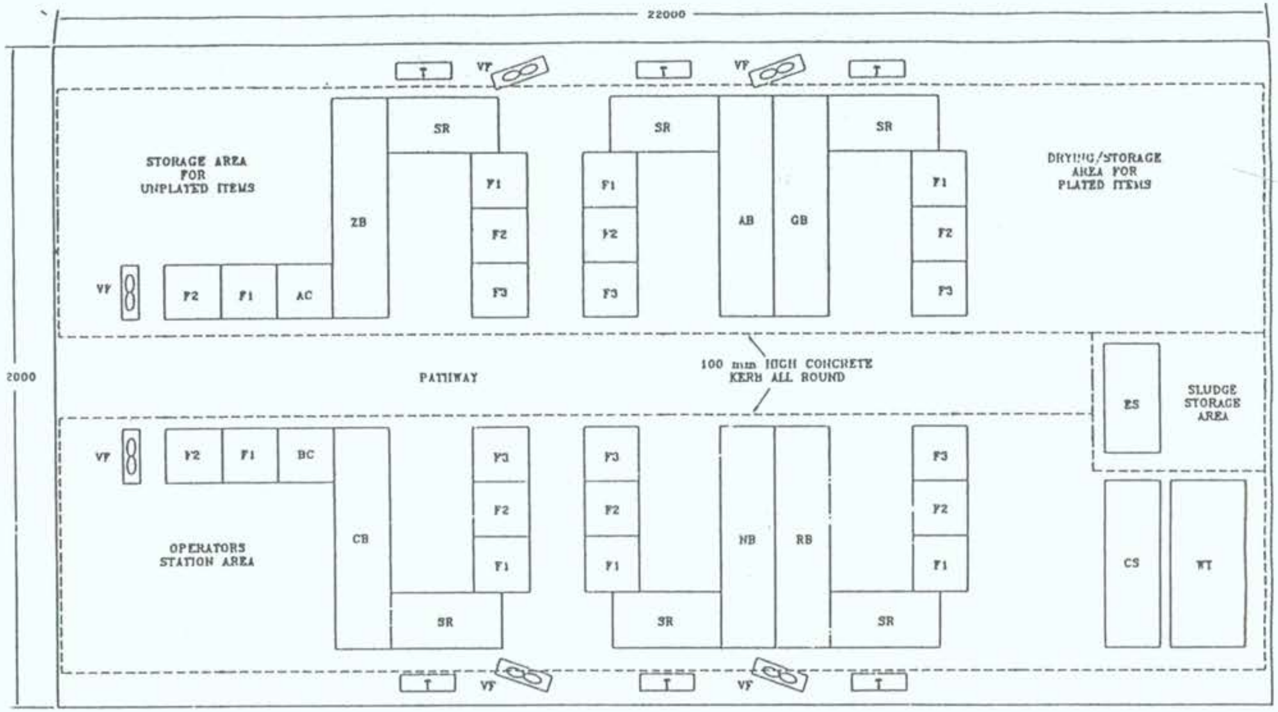
(e) Establish intake water quality criteria for each point of water use, clearly marking those uses requiring a potable quality water and those requiring an intermediate or non-potable quality so that water recycling and reuse may be considered.

Process Modification

(a) Carry out a thorough appraisal of the large water uses to ascertain the feasibility of modifying the process to reduce both water intake and waste discharged. Technical and economic feasibility study of the "cascade" use of water should be carried out. Factors to be considered include possible higher treatment costs but reduced disposal and intake water costs;

(b) Estimate the water consumption for "housekeeping"; and

(c) The modified processes should then be brought on stream and a further series of flows and analyses taken to confirm the original conclusions that prompted the change.



LIST OF SYMBOLS ITEMS					
SYM	ITEM	SYM	ITEM	SYM	ITEM
CB	COPPER BATH	F1	FIRST FLOWING RINSE BATH	AC	ALKALINE PRE-CLEANING BATH
ZB	ZINC BATH	F2	SECOND FLOWING RINSE BATH	BC	ACID PRE-CLEANING BATH
NB	NICKEL BATH	F3	THIRD FLOWING RINSE BATH	VF	VENTILATION FAN
AB	GOLD BATH	TR	TRANSFORMER/CONTROL PANEL		
RB	CHROMIUM BATH	WT	WATER TREATMENT PLANT		
GB	SILVER BATH	CS	COLLECTION SUMP		
SR	STILL RINSE BATH	ES	EMERGENCY STORAGE		

Fig. 2 Plant layout for waste water minimisation.

V. Treatment of Metal Finishing Wastewater

1. Characteristic of sustainable wastewater

Wastewater treatment should be closely inter-related with the production process; in fact it should be considered as an integral part of production. It is a serious mistake to compartmentalize wastewater treatment as a separate entity from the rest of the metal finishing processes. It is equally wrong to consider wastewater treatment as an unpleasant, additional burden to be tolerated reluctantly - hence warranting only a minimum of effort and attention. Failure in wastewater treatment should shut down production fully, as effectively as any other process catastrophe would.

Since the small and medium scale metal finishing industries generally lack space and skilled/knowledgeable operators, it is necessary for the design of the treatment plant to be inexpensive, compact, of easily understood technology, simple to operate and yet reliable. Thus, the characteristics of a good treatment plant would be :-

(1) Treatment matching the process. If process is subject to change or to expansion, then so is treatment and it must thus be adaptable.

(2) Simplicity in all aspects

(3) Design for the life of the facility served

(4) Centralized operations. Chemical handling, storage and feeding should not be scattered all over the place.

(5) Operator-level operation and maintenance. Any instrumentation or automation should not be too sophisticated, beyond the grasp of the operators.

The treatment technologies available for MFWW are either chemicophysical treatment or one of the bath salt recovery processes.

2. Chemicophysical treatment

The main objectives of chemical treatment of MFWW are to destroy or remove the cyanide and hexavalent chromium and to remove metals, usually via precipitation.

Removal of cyanide can be achieved via conversion of cyanide to cyanate at pH 9.0 or above, followed by decomposition of cyanate to N_2 and CO_2 at pH of 7.5 or below.

The oxidation of cyanide using sodium hypochlorite (NaOCI) and NaOH can be written as:

$$2NaCN + 5NaOCI + 2NaOH \quad \text{--->} \quad 2Na_2Co_3 + 5NaCI + N_2 + H_2O.$$

Otherwise ferrous sulphate ($FeSO_4$) can be used to complex cyanide at pH of about 9.5 :

Frankel R.J. and Phongsphetraratana A. (1989). *Effects of water reuse, recycling and resource recovery on food processing waste treatment in Thailand.* Wat. Sci. Tech. 18, 23-33.

Rakmi Abdul-Rahman, Hassan Basri, Salmijah Surif and Abu Bakar Mohamad (1991). *Waste reduction at source for small and medium scale electroplating plants.* Dept. of Environment, K. Lumpur.

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SIRIM (1973). *Report from Seminar on Wastewater Treatment for Electroplating Plants.* SIRIM, 2-4 Aug. 1973.

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TEACHING A TECHNOLOGY BASED ENVIRONMENTAL SCIENCES PROGRAMME

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I. Introduction

The course content of Environmental Science degrees varies widely and it is unwise to generalize. Two extremes that can be identified are the "natural" Environmental Science degree, which Is Biology/Geography based, and the technologically based course which deals essentially with people, industry and the environment. Most courses are, however, biased towards natural sciences and include topics such as Ecology, Physical, Human and Economic Geography. Applied Chemistry, Conservation, Resource Management and Planning. It is relatively rare for Chemistry to be a main subject area. When this occurs, courses cover areas such as environmental pollution, chemical analysis, biochemistry, water and waste water treatment, ecology and conservation.

The main career areas for Environmental Science graduates have been identified as conservation, planning, biological and chemical monitoring of pollution, waste disposal and environmental management. In the UK and Australia, a common criticism of many Environmental Science degrees is the lack of in-depth technical training owing to the wide range of subjects covered. For example, an Environmental graduate (especially those taking geographical options) may be able to write an essay on an environmental problem but lack the hands-on skill to execute anything more than superficial scientific investigations. This, coupled with the high expectations of many graduates to become involved in management and decision making, has lead to employment problems. Environmental Science graduates with a more technical bias generally fare better.

This paper outlines under-graduate environmental courses available at the Department of Applied Science, Papua New Guinea University of Technology (PNGUT). Waste and Hazardous Chemicals are stressed in Environmental Science while the Environmental Chemistry components show a technological bias. The proposed Post-Graduate Diploma in Environmental Technology programme is outlined at the end of this paper. Moreover, for the purpose of this workshop, an attempt has been made to list various teaching and learning aids used.

II. Bachelor of Science in Applied Chemistry

The BSc degree course in Applied Chemistry aims to provide an opportunity for a suitable training at degree level for students wishing to enter those industries and government services which employ graduate chemists in PNG. It provides a basis in the fundamental principles of chemistry and shows the wide application of these principles in diverse areas of chemistry. There is a strong emphasis on chemical analysis, as a major area of activity for chemists in PNG, but also deals with food technology, mineral technology, and such subjects as plastic manufacturing, brewing and forensic science.

The course is a modular, full-time course lasting for four years. The academic year is divided into two semesters and progression is normally dependent upon satisfactory completion of the work in the previous semester. The number of modules studied in each semester is variable, as is the amount of study in the modules, but the course usually involves approximately 24 contact hours per week.

The educational aims of the course are to enable a student, on graduation, to:

i) apply the fundamental principles of chemistry to the solution of problems in chemistry and applied chemistry;

ii) communicate the ideas and results of scientific investigations; and

iii) review critically reports of scientific investigations.

Thus the degree course is structured to produce, in essence, Analytical or Industrial Chemists, rather than an Environmental Technologist. It is therefore not surprising to find a lack of a range of environmental science topics, but courses are being reviewed to address this weakness.

III. Environmental Science Courses at the Department of Applied Science, PNGUT

The recent mushrooming of mining and forest industries in Papua New Guinea and the 1990 forced closure of the Bougainville Copper mine (the world's second largest open cut copper mine) by militant landowners, has aroused a new growth in environmental awareness. There is a large amount of environmental work currently being undertaken and currently extensive use is being made of foreign consultants for these activities within PNG. There is a clear need to develop local skills in primary environmental data collection, in data interpretation, analysis and synthesis, in resource protection, in monitoring and controls, in establishing and enforcing governmental policy and in assessing and planning developments.

In 1995 a Post-Graduate Diploma Programme in Environmental Technology will bring together existing environmental expertise and courses in various departments and should add substantially to what the department is currently able to offer. This programme is discussed under a separate heading below.

The existing environmental course at the PNGUT has a strong bias towards environmental analytical chemistry. Thus it has a technologically based trend rather than a "natural" environmental course.

Prior to entering their third year university studies, students would not have had any formal education in the environmental sciences. This position will gradually change as environmental literacy is refined at secondary schools. Earlier introduction to the environmental sciences will begin in 1995.

The key courses are: Environmental Science (CH362) and Environmental Chemistry (CH461), and Water Analysis (CH342), where field and laboratory measurements of common parameters in ground, surface, drinking and waste water and microbiological testing of water are forged. Trace metal speciation in natural waters and general trace analysis, sampling and sample preservation form a significant component of the fourth year course Topics in Advanced Chemistry (CH412). In addition, Civil Engineering run CE 421: Environmental Engineering (5 hours per week for one semester). This covers topics such as hydrology, meteorology, water and wastewater treatment, water supply, sewage disposal and refuse disposal.

IV. Teaching Aids in the Environmental Sciences

Audio-Visual

Apart from the traditional board and chalk teaching medium, overhead projection of lecture materials, tables, maps or diagrams play a supplementary role. The university has an Audio Visual Unit where a comprehensive collection of environmental topics are stored on VHS, Beta (PAL and NSTC) formatted video tapes. As no copy-right laws exist in the country, regular pre-arranged video recordings are undertaken for appropriate environmental subjects shown on television. The Australian Broadcasting Commission television station runs excellent educational programmes such as Quantum, A Question of Survival, and Open Learning and provides a core of video educational materials.

Slide albums with accompanying pre-recorded audio tapes on environmental subjects relevant to the South Pacific regions are produced by the South Pacific Regional Environmental Programme. They are made available to member countries at a modest price. These are specific to the region, and provide an increasing environmental awareness that students can identify with.

Computer Aids

Micro computers (IBM compatible 80286, 80386 and 80486's) are used extensively in the department to provide an introduction to computer hardware, operating systems and application software. A MacIntosh Classic II is used for specific purposes that PC software do not provide. Appropriate computer software for "Open Learning" can serve dual purposes of students-computer interaction, and enhancement of the learning process. Available software includes the ACOL (Analytical Chemistry by Open Learning) - marketed by the American Chemical Society. Demonstration packages have been on trial and the actual software are being purchased. Environmental related software are also being looked at - both for teaching and industrial application purposes.

Possible future learning/teaching computer based media may be looked at when the university fully links into e-mail communication through Internet (currently this service is being used sparingly at PNGUT). Programmes similar to "The Global Lab Project" (TERC, USA), which uses telecommunication learning, is particularly attractive, but may be very expensive. Computer-OHP projection pads will be available to the department, and remote controlled LCD projection will be used for overhead projections.

V. CH316 Environmental Sciences

Course Description

This course introduces third year students to the field of environmental chemistry. It provides students with an overview of the concepts and principles of Environmental Science. Issues of current global concern are exemplified with case studies. Tuition is 2 hours of lectures plus a 1 hour tutorial per week, for 8 weeks in the second semester. The other 8 weeks are taken out of campus in industrial training.

Objectives

On completion of this course, the student should be able to:

1) understand the makeup of the environment;
2) appreciate the impact of Man on the environment;
3) detail examples of terrestrial, aquatic and atmospheric pollution; and
4) illustrate the effects of pollution on biotic and abiotic components of the environment.

Syllabus

Introduction to Environmental Science. Description of the main environments - land, water, air. Ecological principles: concept of ecosystems, energy flow and trophic levels, species diversity. Nutrient cycling.

Human impact on the environment. Introduction to pollution and development of pollution problems. Renewable and non-renewable resources.

Ecotoxicology: toxic effects of pollutants at individual and population levels. Toxic testing sub-lethal effects, bioconcentration and food chain magnification.

Atmospheric pollution: structure of the earth's atmosphere. Sources of air pollution. Acid rain. Green house effect. Depletion of the ozone layer.

Aquatic pollution: heavy metals - sources, cycling and speciation. Eutrophication, sewage disposal and treatment.

Organic compounds: persistence. Plastics, hard and soft detergents, pesticides, PCB's.

Land pollution. Mining - dump leachates, microbiological activity, tailings, revegetation. Solid waste disposal and waste management. Nuclear energy and nuclear waste containment and disposal.

Case studies : Love Canal, Chernobyl Disaster, Captains Flat, Exon Valdez, Minamata and Itai-Itai diseases, the Kono waste dump, Agent Orange

Textbook

Laidler, G. Environmental Chemistry - an Australian Perspective, (Longman Cheshier, 1985)

Organization

The tuition of 16 hours lecture time for the semester is too short for the syllabus to be exhaustively taught. Tutorials have often had to be tailored to allow new materials to be introduced into tutorial sessions without totally curtailing free discussions on the week's lecture material. On occasions, tutorials are curtailed completely so that more lectures can be given.

Weekly assignments are chosen so that, while being relevant to the week's lectures, they contain questions on materials not covered in those lectures. This serves to encourage a student to do his/her own readings and note-taking, while at the same time covering portions of lecture materials time would not allow to cover. Case studies make up a good component of assignments.

Toxic Chemicals and Hazardous Waste take up about 60% of the total tuition. Topics fall under five general topics:

1) Intractable Wastes
   - nuclear reactor fuels and fission products
   - containment
   - incineration
   - secure landfills

2) Tractable Wastes
   - domestic wastes and sanitary landfills
   - treatment
   - recycling

3) Persistent Organics
   - soaps, oils
   - organochlorine pesticides
   - biological control and pheromones
   - plastics, poly vinylchlorides

4) Non Persistent Organics
   - biodegradability
   - organophosphorus pesticides

5) Heavy Metals
- industrial effluents
- mine tails, dump heap and leaching
- speciation, toxicity, and bioavailability

VI. CH461 Environmental Chemistry

Course Description

Material is presented to make the student aware of the techniques, methods, and relevant areas of knowledge required to design a sampling and analysis programme to meet specific objectives, and to be able to critically appraise results of such a programme.

This is a practical based course having at 7 hours per week practical session and 2 hours per week for lectures.

The course is aimed to present knowledge of how to perform practical environmental sample collection and analysis with particular reference to situations the student will encounter during employment in PNG.

Objectives

At the end of the course, a student should be able to:

1) have a comprehensive understanding of designing and implementing an environmental monitoring programme;

2) appreciate steps taken in preparing sample collection vessels, collection, storage, and treatment;

3) choose the most appropriate analytical technique in a given situation;

4) apply the chemical processes and interactions in aquatic and estuarine systems to interpret results;

5) appreciate the significance of reference samples;

6) perform analysis on soils, foliar, aquatic and marine water samples, using appropriate instrumental and classical techniques; and

7) understand and apply the PNG environmental legislation.

Syllabus

Design of measurement systems: planning defining objectives, location, time and sampling frequency, expression of analytical results.

Sampling problems and aims of sampling, procedures, preparation, transport, storage and stability.

Selection of analytical methods: chromatographic, electrochemical, spectroscopic, biological

Applications of analytical techniques to aquatic, soils and foliar samples.

Aquatic and Estuarine chemistry: chemical compositions of fresh and sea waters, thermodynamics and kinetics, precipitation and dissolution, buffering systems, redox reactions, estuarine mixing, dissolved and particular matter and interactions.

Textbook

Van Loon, J.C., Selected Methods of Trace Analysis: Biological and Environmental Samples (John Wiley and Sons, 1985).

References

Slumm W. and Morgan, J.J. Aquatic Chemistry: An Introduction Emphasising Chemical Equilibria in Natural Waters (John Wiley and Sons, 1981).

Forstner, U. and Wittman, G.W., Metal Pollution in the Environment, (Springer-Vering, 1979).

The Environmental Chemistry course is centered around designing, implementing and appraising an environmental monitoring programme. It is acknowledged that there is considerable material and topics to be covered during the course. However, a detailed and indepth knowledge of every aspect of the presented material is not the aim of the course. Due to limitations of time and resources, the course is biased toward practical aspects of elemental analysis using various atomic spectrophotometric techniques, which form a large percentage of employment opportunities for graduates. It is in this area of instrumental analysis that indepth knowledge is required to be demonstrated.

Of the remaining topics to be covered during the course, students are expected to show only an understanding and awareness of the concepts involved. This is based upon the realization that the majority of the information presented to students will not be required during employment. By being made aware of various topics and where relevant information can be obtained, the student can, if required at a later date, retrieve this information for utilization. This is designed to obviate the onerous task for the student of rote learning reams of text books which can defeat the learning process, as the underlying concepts are often not understood.

The monitoring programme involves sampling excursions for base line aquatic and biological (fish and benthic organisms) and sediments. As final year undergraduates, the students will be expected to demonstrate their gained knowledge. Detailed practical notes are not provided and students are expected to be able to extract relevant information from standard sources such as APHA/AWWA/WPCF Standard Methods for Examination of Water and Wastewater.

The laboratory practical sessions involve the analysis of collected samples as per the student designed monitoring programme for the environmental base-line study of Labu Lakes, Lae, PNG. The students are guided as the following instrumental techniques and analysis are performed:

1) Trace metal analysis (Cu, Cr, Zn, Cd, As)
   - Solvent pre-concentration graphite furnace AAS
   - Flame/furnace AAS of acid digested sediments, and biological tissues
   - Hydride generation AAS using flow injection analysis

2) General Analysis
   - Salinity titration
   - Organic carbon content, TSS
   - Chlorophyl content
   - Inorganic ions by ion chromatography, and ISE
   - Major cations (Na, K, Ca, Mg) by flame AAS

3) In-situ measurements
   - Dissolved oxygen
   - Temperature
   - Depth
   - pH
   - Conductivity

4) Soils Analysis
   - Cation Exchange Capacity and Exchangeable Cations
   - Phosphorus
   - Organic Carbon
   - Nitrogen

5) Foliar Analysis
   - Nitrogen
   - Phosphorus
   - Trace metals
   - Boron

VII. Post-Graduate Diploma in Environmental Technology

In 1995 a post-graduate diploma programme will be offered in order to supply a growing need for environment technologists in the country. While science and engineering students with first degrees would have had non-specific environmental training programmes within their fields, they can opt for this course, which is designed so as to produce technology based environmental graduates.

The course is still in the first stage of planning. The diploma course, based largely on existing subjects but with a core of new integrating subjects, will be the mode of delivery in the first instance. Subjects and candidates will be provided by six departments; Applied

Science, Civil Engineering, Mining Engineering, Forestry, Agriculture, and Surveying and Land Studies.

The course will be of 15 months duration (2 semesters lectures, 3 months work experience, 3 months common project and related lectures). The suggested possible content will consist of four modular components:

a) Integrating Module: compulsory for all students
b) In-Depth Module: consisting of one specialized environmental subject at honours level.
c) Broadening Module: set of subjects from existing undergraduate programmes.
d) Work experience (3 months vocational)

Possible Integrating Module Subjects are:

Year 1: Perspectives on Environmental Problems
Environmental Administration Policy and Law
Environmental Impact Assessment (Project)
Introduction to Social Science

Year 2: Major Group Project and Report with lectures as appropriate.

Possible Broadening Module Subjects:

<u>Applied Sciences</u>
Water Analysis
Environmental Sciences
Environmental Chemistry

<u>Civil Engineering</u>
Waste disposal
Sanitation Engineering
Hazardous Wastes

<u>Mining Engineering</u>
Mineral Exploitation
Mine Waste Management

<u>Forestry</u>
Forest Soils or Soil Science
Photogrammetry or other API/mapping
Foundation of Forest
Wildlife Management
Forest Ecology

Agriculture

- Principles of Agriculture
- Rural Sociology
- Agricultural Microbiology
- Biology

Surveying and Land Studies

- Geographic Information System
- Land use surveys
- Mapping
- Remote sensing

TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT CASE STUDY FOR THE PHILIPPINES:

TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT FOR THE LAGUNA LAKE AREA

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I. Introduction

In this paper the case study deals with toxic chemicals and hazardous wastes and their influence on management options for the lake catchment. The material is presented as a series of boxes in order to facilitate presentation in education and training sessions.

TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT FOR LAGUNA LAKE

Location: The Laguna Lake Basin is situated on the lower portion of the island of Luzon in the Philippines. The basin is bounded on the north by the province of Bulacan and on the west by the provinces of Cavite and Batangas.

Basin Area: The basin has an influence area of 5,078 square kilometers. It covers the provinces of Laguna, Rizal and some municipalities of Bulacan, Batangas and Cavite.

Description: The Laguna de Bay is a shallow lake immediately inland from Metro Manila. It serves as a natural detention reservoir for discharges from the surrounding tributary streams namely, Pila-Sta. Cruz, San Juan, San Cristobal, Pagsanhan, and Romero-Sta. Maria Rivers. The lake's only outlet is via the Napindan Channel and Pasig River. The Napindan River normally flows from Laguna de Bay to Pasig, but it can and does flow in either direction, depending upon river and lake levels.

WATER SURFACE AREA

93,000 hectares

WATER QUALITY RELATED PROBLEMS

1. Those caused by natural factors which include:

   (a) watershed characteristics;
   (b) microbiological growth (nutrients);
   (c) saltwater intrusion; and
   (d) density (thermal) stratification.

2. Those caused by human factors which include:

   (a) pollution from point sources:
      - sewage discharges
      - industrial wastes
      - spills

   (b) pollution from nonpoint sources:
      - agricultural runoff
      - livestock
      - urban runoff
      - land development
      - erosion
      - atmospheric deposition
      - navigation activities

FACTORS AFFECTING LAKE STAGES

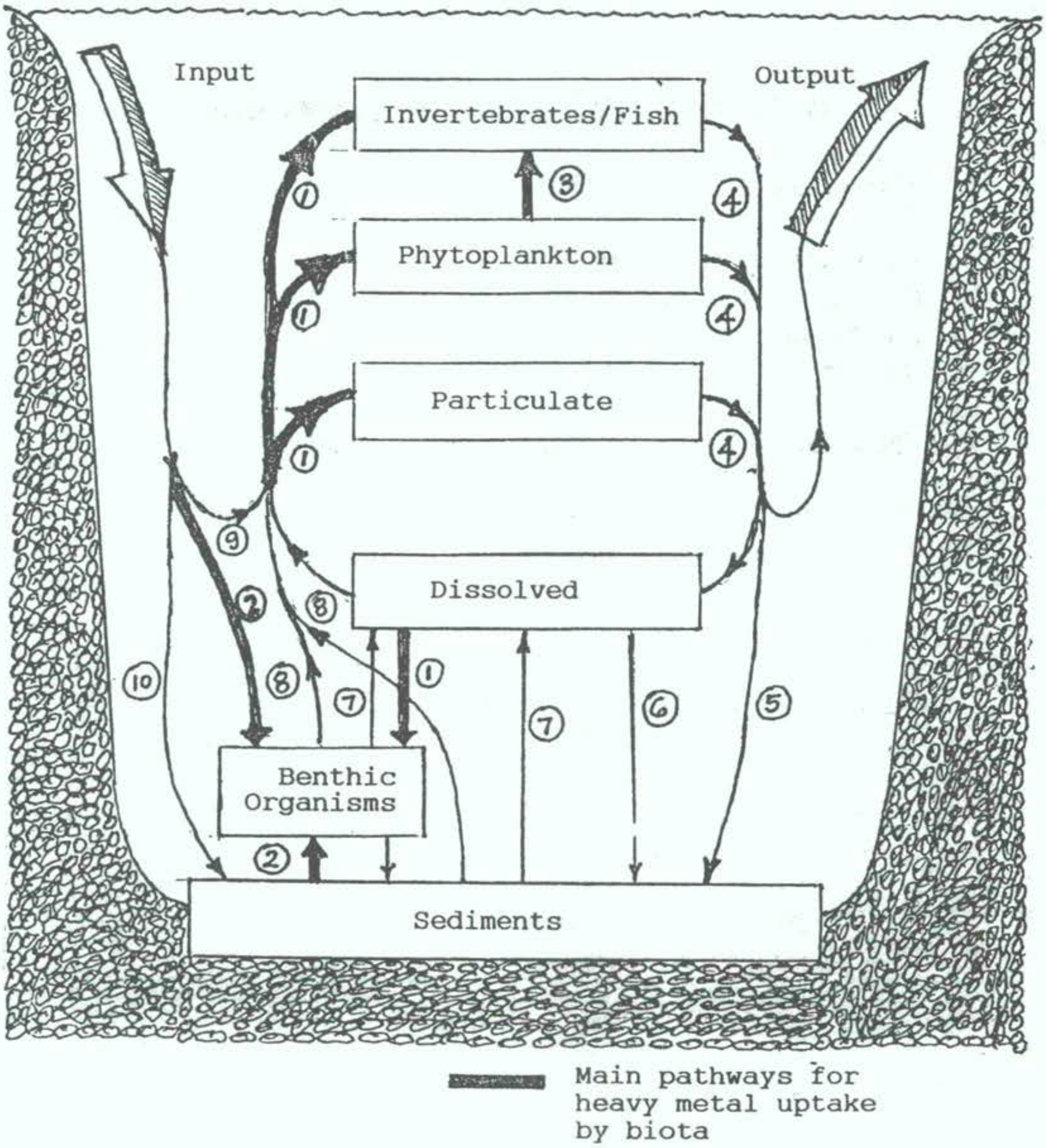
1. Seasonal variation in rainfall;

2. Yearly inflow of surface water;

3. The relation between the lake level and the tidal in Manila Bay; and

4. The annual evaporation from the lake.

A Simplified Biochemical Cycle for
Heavy Metals in an Aquatic System



Four compartments of the system:

1. the dissolved compartment - containing free metal ions and complexed and colloidally bound metal species.

2. the (abiotic) particulate compartment - consisting of both inorganic and organic particulates.

3. the (biotic) particulate compartment - consisting mainly of phytoplankton (and bacteria).

4. bottom sediments - the largest compartment of heavy metals in most aquatic systems.

DISTRIBUTION OF INDUSTRIES IN THE LAGUNA LAKE AREA, BY SUB-BASIN

INDUSTRIAL TYPE	SUB-BASIN																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	T
Piggery Farm		6		7	2	1	3					5		2	1	1	5	4	3	2		**42**
Chicken Farm	1	5	1	5	1	1	1			1		11	15	5	2		5					**54**
Duck Farm	8	1	1	1																15		**26**
Subdivision			2											1	1				1	1		**6**
Condominium																						
Hotel/Motel																						
Food	3	29	1	1	1				1			5	1	7	5	4	13	9	7	22	1	**110**
Distillery		1										1		1	1		1		2			**7**
Tobacco	3	3																		1		**7**
Beverage				1											3				1	1		**6**
Textile	8	39	8	1		1					1				5	5	8	2	4	28		**110**
Leather Mfg.	3	16									1				2	2		2	4	15		**45**
Wood	2	32	3	1								1		1	1			3	3	14		**61**
Paper/Pulp	4	6	1												2		1		2	6		**22**
Chem./Pharm.	8	22					1							1	9	3	4	2	9	21		**80**
Plastic	6	21	4				1								4	2	6	2	3	19		**68**
Non-metals	12	21	9	6		1		2			2	2		2	11		2	3	5	11		**89**
Metals	6	37		1										1	3	2	4	4	3	23		**84**
Electronics	7	13	3	1											1	3	1			19		**48**
Transport	3	10	2	1								1		1	3	1	1		1	11		**35**
Power																				1		**1**
School																						
Hospital																						
Memorial Park																	1	1				**2**
Dredging		1																				**1**
TOTAL	**74**	**263**	**35**	**26**	**4**	**4**	**6**	**2**	**1**	**1**	**4**	**26**	**16**	**22**	**54**	**23**	**52**	**32**	**48**	**210**	**1**	**904**
% of Total	**8**	**29**	**4**	**3**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**3**	**2**	**2**	**6**	**3**	**6**	**4**	**5**	**22**	**<1**	**100**

MANAGEMENT OPTIONS

A. Pollution Control Strategies

First Level of Control
- Modification of production process
- Changes in product design
- Recycling of materials

Second Level of Control
- Land-use adjustments
- Relocation of industrial activities

Third Level of Control
- Treatment and disposal
  - Incineration
  - Detoxication
  - Landfill Containment

B. Engineering Alternatives

Interceptors
- For whole region
- By sub-basin

Treatment Facilities
- Individual
- Centralized

C. Institutional Alternatives

- Functional organization with river basin coordination
- River-basin organization with functional coordination
- Facility management by the private sector

D. Time Frame Alternatives

- Short term
- Intermediate
- Long term

E. Facility-Site Alternatives

- By sub-basin
- Within the LLDA region
- Outside the LLDA region

Cadmium

Sources:	-	production of zinc with which cadmium is always associated
	-	processing plants
	-	landfill and incinerators
	-	phosphate fertilizers increase soil cadmium concentration
Pathways to humans:	-	ingestion of aquatic-based food chains (e.g., fish and shellfish)
	-	ingestion of crops planted in soils containing Cd
Effects to humans:	-	Cadmium poisoning
Biological effect:	-	No evidence of biomagnification.

A COMPARISON OF THREE TOXIC METALS: LEAD, MERCURY AND CADMIUM

Lead

Sources:
- automobile emissions
- leaded paints
- lead pipes
- smelters

Pathways to humans:
- water (from lead pipes)
- lead-contaminated foodstuff
- lead-contaminated dust

Effect on humans:
- Lead is an accumulative toxigen and brain damage to children is not reversible.

Biological Effect:
- No evidence of biomagnification. Importance of its chemical form to its toxicity: not Importance of its chemical form to its toxicity: Not as critical as it is for mercury.

Mercury

Sources:
- non-ferrous smelters
  chloro-alkali plants
  Hg-rich soils
  coal-fired generating plants
  Hg-dressed grains (e.g., with phenyl mercuric acetate which serves as fungicide)

Form of emission:
- Elemental vapour from burning of fossil fuels and from mining and smelting of non-ferrous metals. Hg is extremely volatile.

Pathway to humans:
- Ingestion of aquatic-based food chains (e.g., fish and shellfish)

Effect on humans:
- Methyl mercury poisoning

Biological effect:
- Biomagnified (i.e., it increases in concentration in organisms at increasingly higher (trophic) levels of the food chain)

Importance of its chemical form to its toxicity: Toxic in the form of methyl mercury and it is efficiently produced in aquatic ecosystems.

NEW ZEALAND CONTRIBUTION TO UNEP NETTLAP TCHW WORKSHOP

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I. Country Overview

New Zealand is a South Pacific nation occupying 268,676 square kilometres. It has a population of 3.3 million and in 1992 the GNP was $US41,000,000, 31% of which was contributed by industry. Primary activities are agriculture, forestry and fishing.

II. The Local Issue Relating to TCHW

Experience in New Zealand over time has illustrated that, despite the existence of local legislation for controlling the management of potentially toxic chemicals, there is a continuing necessity to maintain awareness in technologists of the need to adopt a life cycle or cradle to grave approach to the management of these materials.

III. The Objective of this Lecture

This lecture is intended for tertiary level students, particularly those taking engineering, science and technology courses. It does not, as a prerequisite, imply an advanced level of chemical knowledge. As such it can appropriately be included in general studies elements of all such courses.

The objective is to develop an awareness among students of the environmental hazards that may arise during the transport, manufacture, and storage of potentially hazardous chemicals and from the disposal of associated wastes, by the use of local case studies.

IV. The Lecture and Presentation Methodology

1. *Title*

The Management of Environmental Hazards from Potentially Toxic Chemicals and Hazardous Wastes.

Total Time: 1 hour.

2. *Hazardous Characteristics of Chemical Substances*

An outline of hazardous characteristics and classification systems, illustrating the UN system and giving specific examples, using overhead transparencies.

Main References:

UN (1989) Recommendations on the Transport of Dangerous Goods(ST/SG/AC.10/1 E/Rev6) UN New York.

Sax, I.J. and R.J. Lewis (1989): Dangerous Properties of Industrial Materials: 7th Edn., Vol. I, II, and III, Van Nostrand Reinhold, New York.

Time: 10 Minutes

3. *Transport of Hazardous Chemicals*

A review of local incidents arising from the transport of hazardous materials, the resulting health and environmental effects, and management implications. The principle example included is emergency which became known locally as the "Parnell Incident". It involved the mismanagement of tributylphosphorotrithioite during shipment from South America to Australia under the trade name of Merphos. This was in fact a chemical of relatively low toxicity but impurities such as butylmercaptan and dibutyldisulphide exhibit very low odour thresholds.

It also highlighted the need for preparedness at the local level for action to be taken in the event of chemical incidents.

This section involves the use of colour slides and overhead transparencies.

Main References:

Commission of Inquiry (1973): "The Report of the Commission of Inquiry into the Parnell Civil Defence Emergency." N.Z. Govt. Printer, Wellington.

UNEP (IEO) (1988):"Awareness and Preparedness for Emergencies at the Local Level", UNEP Nairobi.

SANZ (1988): "Code of Practice for the Transport of Hazardous Substances on Land", NZS533 (Amend 1), SANZ, Wellington.

Time: 10 minutes

4. *Incidents Arising from Chemical Manufacturing*

This section includes a review of incidents that have arisen in New Zealand involving chemical manufacturing processes. The principal example involves an incident arising during the manufacture of sulphuric acid using the contact process. It illustrates that such incidents can arise in processes which incorporate established technologies, simple chemistry and in which process control is highly automated.

Colour slides and overhead transparencies are used to present this section.

Main Reference:

Kletz, T. (1992) Hazop and Hazan 3rd Edn. Inst Chem Eng, Warwickshire,UK

Time: 10 minutes

5. *Incidents Arising from The Storage of Chemicals*

A case study is presented which describes the many issues that were highlighted when a local large chemical storage facility was destroyed by fire. There was a large range of chemicals involved including chlorinated pesticides and compressed chlorine gas. The study highlights the need for good management and accessible inventories with chemical storage.

Presentation is mainly by way of a short video made up of edited extracts of news items and subsequent interviews that appeared on local television programmes during the incident and over subsequent weeks.

Main References:

Commission for (1985): "The ICI Fire - A Report the Environment for the Minister for the Environment", MFE, Wellington

N.Z. Chem Ind.(1990): "Warning Signs for Council Premises Storing Hazardous Substances". NZCIC, Wellington

Time: 15 minutes

6. *The Proper Management of Hazardous Waste*

Presentation is made of another case study which involves the uncontrolled burial of chemical wastes arising from a process used for the manufacture of chlorinated phenoxy herbicides such as 2,4,5,T and 2,4,D. Leachate from the chemical dump was found to be contaminating the local sea shore. This dump was excavated and transported to a state of the art containment landfill in which facilities are provided for in situ decontamination over time.

Colour slides and overhead transparencies are used for presentation.

Main Reference:

Collier,P. et al (1989) "The Design and Construction of a Secure Landfill for Hazardous Wastes....New Plymouth", IPENZ Trans, 16, 1/CE.

Time: 10 minutes

7. *Conclusion*

Summary and emphasis on the need for a life cycle approach to the management of hazardous substances.

Time: 5 minutes

V. Evaluation

Subsequent tutorials, assignments and examination questions are used to evaluate the understanding that students obtain from this presentation. The topic covers a wide area and this allows a range of examination techniques such as oral, multichoice, short answer or essay type questions.

APPENDIX I

Workshop Programme

UNEP/NETTLAP
WORKSHOP FOR EDUCATORS COVERING TOXIC CHEMICALS AND HAZARDOUS WASTES

Bangkok - Thailand, 28-30 September 1993

PROGRAMME

DAY 1	**28 SEPTEMBER 1993**
08h30	Registration and Administration
09h00	Opening Remarks (Prof. John Hay, UNEP/ROAP/NETTLAP)
	Toxic Chemicals and Hazardous Wastes Network (Mr. Norman Thom, TCHW Coordinator)
09h45	Morning tea
10h00	Teaching and Training Related to TCHW (Dr. Visu Visvanathan, Asian Institute of Technology)
11h00	Curricula for Education in TCHW (Prof. Marino Mena, UOP)
12h00	Lunch
13h00	The London Guidelines and Prior Informed Consent (Mr. Ronald Macfarlane, UNITAR)
14h00	Awareness and Preparedness for Emergencies (APELL) (Prof. John Hay)
15h00	Afternoon tea
15h15	Transboundary Movements of Hazardous Wastes - the Basel Convention Classification Systems (Mr. Pierre Portas, UNEP/SBC)
16h15	Review of Resource Materials (All Participants)
17h00	Close

DAY 2 29 SEPTEMBER 1993

08h30	Computer Assisted Training - International Register for Potentially Toxic Chemicals (IRPTC) (Mr. Ronald Macfarlane, UNITAR)
09h30	Demonstration of International Cleaner Production Information Clearing House (ICPIC) (Mr. Mahesh Pradhan, UNEP/ROAP/NETTLAP)
10h30	Morning tea
10h45	Computer Assisted Learning/Simulation Packages (Dr. Visu Visvanathan, AIT)
12h00	Lunch
13h00	Country Case Studies - Session 1
	Prof. David Stokes - *"Environmental Teaching and Training"*
	Prof. Dr. Masamichi Tsuji - *"Environmental Education for Undergraduate Students."*
	Prof. Dr. Haryoto Kusnoputranto - *"Institutional Capacities in Hazardous Waste Management."*
	Dr. Philomena Gongaiya - *"Toxic Chemicals and Chemical Risk."*
15h00	Afternoon tea
15h15	Country Case Studies - Session 2
	Dr. Joo-Hwa Tay - *"Prevention and Minimization of Hazardous Wastes."*
	Prof. Dr. Ja-kong Koo - *"Prevention and Minimization of Hazardous Wastes."*
	Assoc. Prof. Dr. Tran Van Nhan - *"An Approach to Prevention and Minimization of Industrial Toxic and Hazardous Wastes in Vietnam."*

Continued........../

DAY 3 30 SEPTEMBER 1993

08h30	Country Case Studies - Session 3
	Prof. Cao Hongfa - *"Assessment of Ecological Toxicity of Chemical Substances."*
	Assoc. Prof. Premchit Tansatit - *"Agricultural Pesticides in Aquatic Ecosystems."*
	Prof. Thares Srisatit - *"Domestic Hazardous Waste Management."*
10h15	Morning tea
10h30	Country Case Studies - Session 4
	Dr. Chi Sun Poon - *"Management of Chemicals/Chemical Safety."*
	Mr. Zainuddin A. Manan - *"Management of Chemicals/Chemical Safety."*
	Prof. Liu Jinchun - *"Detoxification of Organic Materials."*
12h00	Lunch
13h00	Country Case Studies - Session 5
	Assoc. Prof. Dr. Rakmi Abdul Rahman - *"Minimization and Treatment of Hazardous Wastes in Metal Finishing Wastewater."*
	Dr. Michael Kiap - *"Teaching a Technology Based Environmental Sciences Programme."*
14h00	Review, Assessment and Recommendations (All Participants)
15h15	Afternoon tea
15h30	Future TCHW Network Activities (Mr. Norman Thom TCHW Coordinator)
16h00	Workshop Recommendations (Prof. John Hay, Network Coordinator)
16h30	Concluding Remarks (Dr. Reza Amini, UNEP/ROAP)

APPENDIX II

List of Participants & Resource Persons

NETTLAP
RESOURCES DEVELOPMENT WORKSHOP ON EDUCATION & TRAINING IN TOXIC CHEMICALS & HAZARDOUS WASTES

ROAP Meeting Room, 10 Floor, UN Bldg., Bangkok
September 28-30, 1993

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APPENDIX III

Workshop Evaluation

Each participant completed a formal evaluation of the workshop and submitted this during or immediately after the final session. The evaluation form is reproduced at the conclusion of this summary.

A preliminary analysis of the evaluations provided by the participants (see following page) reveals that the majority viewed the workshop as:

- VERY GOOD in satisfying the participants' personal needs for professional development
- VERY GOOD regarding the printed materials provided
- EXCELLENT with respect to organization and execution
- VERY GOOD regarding usefulness of information, methods and instructional tools
- EXCELLENT in terms of the likely usefulness of the printed and other materials for future professional activities
- VERY GOOD in terms of an overall evaluation of the workshop
- VERY GOOD to EXCELLENT regarding usefulness to a tertiary level educator
- VERY GOOD regarding the usefulness of the software and databases demonstrated in the workshop

Most participants considered the services and facilities for the workshop to be SATISFACTORY or VERY GOOD.

All but one participant said they would consider participating in a follow-up workshop. The same people also thought that the subject matter of the current workshop would be beneficial to other individuals in their institution or country.

The following topics were listed as "most interesting" by at least one participant -

Software packages for teaching and training (7)
Computer databases (6)
Teaching packages (4)
Basel Convention as presented by P. Portas (2)
Country case studies (e.g. Vietnam) (2)
Video tapes (2)
Computer assisted learning packages (2)
IRPTC presentation by R. McFarlane
Training methods
Coverage of TCHW topics in Engineering
Illustrative transparencies
Current regional issues
Identification of toxic chemicals and of hazardous wastes
Disposal techniques
Law and legislation

Somewhat less helpfully, one participant commented - "everything that was done in this workshop was interesting".

PARTICIPANT RESPONSES

NETTLAP Toxic Chemicals & Hazardous Wastes Training Workshop

	Excellent	Very Good	Good	Fair	N/A
1. Were the subjects dealt with in this workshop appropriate in satisfying your need for your own professional practice?	3	9	2	1	
2. Please rate the usefulness of the printed materials provided in the workshop	6	7	1	1	
3. Workshop organization and execution.	8	4	3		
4. Please rate the usefulness of the information, methods, and instructional tools presented in this workshop in relation to their applicability to activities in your country.	2	8	4	1	
5. Please evaluate the likely usefulness of the printed and other materials for your reference in future professional practice.	8	5	2		
6. Over all view and evaluation of the workshop.	4	8	1	1	1
7. Please rate the usefulness of the workshop to you as a tertiary level educator.	6	6	3		
8. Are the software packages and data bases demonstrated in the workshop likely to be of use to you?		13	2		

C. Would you consider participating in a follow-up workshop?

[14] Yes [1] Not sure

E. Do you think the subject matter of the current workshop would be beneficial to other individuals in your institution in your country?

[14] Yes [1] No

G. Services and Facilities	Very Good	Satisfactory	Fair	Poor	N/A
1. Arrangements for travel and arrival	7	6			1
2. Accommodations	7	5	1		1
3. Lecture facilities	8	6	1		
4. Resource materials/demonstrations	13	1	1		
5. Quality of catering/food etc.	11	4			
6. Assistance given by ROAP for general needs	14			1	

The following comments were offered when participants were asked to identify what was "least interesting" about the workshop content -

Tendency of participants to deviate from major objective of the country case studies
Simple explanation of the status of each country was below a tertiary level
Involvement in TCHW processing of each country was not clear, including the technical contents
Off topic presentations - e.g presentation of research findings instead of teaching methods

In all only three participants identified aspects of the course they found "least interesting".

The workshop resource persons considered that the workshop had fulfilled the immediate objectives, but noted the following:

- additional time should have been allocated to participant familiarization with software, databases and other educational and training aids
- additional time should have been allocated for discussion amongst participants and with resource persons
- participants should have been asked to ensure that they focus on education and training methods and resource materials, rather than spending time on description of national status or research studies

Overall Conclusions

- the workshop was a valuable learning and awareness raising experience for the 15 participants

- the workshop demonstrated that this approach to training meets an important regional need in an effective manner

- the workshop is an efficient mechanism for other agencies and organizations (e.g. UNEP/IRPTC, UNEP/SBC) to familiarize educators and trainers with their activities and products and to in turn transfer this awareness and understanding to key people in the public and private sectors

- the workshop is an effective means for identifying and developing materials and aids that can receive widespread distribution to tertiary institutions in the region

Workshop for Tertiary Level Education
Toxic Chemicals and Hazardous Wastes

WORKSHOP EVALUATION

Name of Participant : ____________________

A. Please mark the appropriate block to indicate your opinion with respect to each of the following items

	Excellent	Very Good	Good	Fair
1. Were the subjects dealt with in this workshop appropriate in satisfying your need for your own professional practice?				

Comments : ____________________

2. Please rate the printed materials provided in the workshop

Comments : ____________________

3. Workshop organization and execution.

Comments : ____________________

4. Please rate the usefulness of the information, methods, and instructional tools presented in this workshop in relation to their applicability to activities in your country.

Comments : ____________________

5. Please evaluate the likely usefulness of the printed and other materials for your reference in future professional practice.

Comments : ____________________

6. Over all view and evaluation of the workshop.

Comments : ____________________

	Excellent	Very Good	Good	Fair
7. Please rate the usefulness of the workshop to you as a tertiary level educator.				

Comments : ____________________

8. Are the software packages and data bases demonstrated in the workshop likely to be of use to you?

Very Useful	Possibly Useful	Not Useful

Comments : ______________________________

____

B. Which aspects or features of the workshop did you find the most interesting or useful, and why? Please comment on these aspects. In order to assist in formulating future workshop, please do not hesitate to mention any short comings. Your frankness will be appreciated.

Most Interesting	Least Interesting

C. Would you consider participating in a follow-up workshop?

☐ Yes ☐ No Perhaps, depending upon subject area ______________

D. What additional follow-up activities would you like to see ?

____

____

____

E. Do you think the subject matter of the current workshop would be beneficial to other individuals in your institution in your country?

☐ Yes ☐ No

F. With consideration to time constraints and the objectives of the workshop, what additional topics or presentation would you like to have included in the workshop.

i) ______________________________

ii) ______________________________

iii) ______________________________

G. Services and Facilities	Very Good	Satisfactory	Fair	Poor
1. Arrangements for travel and arrival				
2. Accommodations				
3. Lecture facilities				
4. Resource materials/demonstrations				
5. Quality of catering/food etc.				
6. Assistance give by ROAP for general needs				

7. Other (specific)

i) ____________________
ii) ____________________
iii) ____________________

H. Please write down your comments about the workshop considering your own background and needs

APPENDIX IV

Industrial and Hazardous Waste Management: Selected Bibliography

This bibliography was prepared and made available by Dr C. Visvanathan, Environmental Engineering Programme, School of Environment, Resources and Development, The Asian Institute of Technology, Bangkok, Thailand.

The first version of this selected bibliography was prepared with financial assistance from the French Agency for Energy and Environment (ADEME) in September, 1993. Information that can be used for updating the document is solicited from users.

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By ...., Kyu-Hong : Vigneswaran, S.
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Hazardous waste.
Refuse and disposal.
Recycling Waste, etc).

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HRUDEY, STEVE E.(1985).
Residues from Hazardous Waste Treatment.
s.n. s.l.1985. 7-12 P.
Hazardous waste treatment facilities.
Refuse and refuse disposal.

TD1040 G75
GRIFFIN, ROGER D.(1988).
Principles of Hazardous Materials Management.
Lewies Pub. Chelsea, Mich. 1988. 207 P.
Hazardous substances-united States-Management.
Hazardous substance-Health aspects- United States.

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FORESTER, WILLIAM S: SKINNER, JOHN H.(1988).
International Perspectives on Hazardous Waste Management:
Report from the International Solid Waste and Public Cleansing Association (ISWA) working Group on Hazardous Waste / Edited by William S; SKINNER, john H.
International Solid Waste and Public Cleaning Association. Working Group on Hazardous Wastes.
Academic Press, London. 1987. 289 P.
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WENTZ, CHARLES A. (1989).
Hazardous Waste Management.
McGraw-Hill Pub. New York. 1989. 461 P.
Hazardous wastes- Management.
Hazardous wastes- Law and Legislation - United States.

T55.3 H3 E86 v. 1
T55.3 H3 E86 v. 2
Extremely Hazardous Substances : Superfund Chemical Profiles / U.S. Environmental Protection Agency.
United States Environmental Protection Agency, Noyes Data Crop., Park Ridge, N. J., 1988, 2 v.
Hazardous substances - Handbook manual etc..

TD1020 H39
MALTEZOU SONIA P.; BISWAS ASIT K.; SUTTER HANS (1989).
Hazardous Waste Management : Selected papers from an International Expert Workshop convened by UNIDO Vienna, 22-26 June 1987 / Edited by Sonia p. Maltezou, Asit K. Biswas and Hans Sutter.
United Nations Industrial Development Organization, International Association of Clean Technology, Tycooly, New York, 1989, 344 P.
Hazardous wastes - Management - Congresses, Hazardous wastes - Developing Countries - Congresses.

TD195 H39 U5
Hazardous Waste Management.
United States, Environmental Protection Agency, U.S. EPA., Washington, 1991, 16 P.
Hazardous waste management industry.

MAJOR HAZARDOUS WASTES AND THEIR IMPACTS ON THE ENVIRONMENT

BOOKS:

C.E.P. CONSULTANTS (1984)
Environmental contamination - Int. Conf. London, July 1984.
Edinburgh, CEP Consultants, 1984, 834 P.
These proceedings are divided in 15 sessions which deal with: Environmental asbestos contamination - Agriculture, organic contaminants - Contaminants in drinking water - Land management, toxic wastes - Agriculture, inorganic contaminants (I) - Health effects - Land management, reclamation - Agriculture, inorganic contaminants (II) - Contaminants in river waters - Land management, mining wastes - Airborne contaminants (I) - Contaminants in the marine environment - Land management, soil science - Airborne contaminants (II), synfuels - Contaminants in wastewaters and sludges.

CHRISTENSEN H.E. (1976)
Registry of toxic effects of chemical substances - 1976 edition.
Springfield, NTIS, 1976, 1246 P.
The 1976 registry contains some 82,908 listings of chemical substances. Its purpose is to provide basic information on the known toxic and biological effects of chemical substances for use of employers, physicians, industrial hygienists, toxicologists, researchers, and in general, all concerned with safe handling of chemicals. The absence of a substance from the REGISTRY does not indicate that it is not toxic. Drugs or therapeutic chemicals in the REGISTRY have been included if they have been reported to produce a noxious effect.

CONCERN INC. (1985)
Pesticides a community action guide.
Washington, Concern Inc., 1985, 25 P.
This purpose of this booklet is to provide an introduction to the complex issues surrounding chemical pesticides and to encourage individuals and communities to take part in determining safe use and more effective regulation of pesticides. Community action is particularly important now that regulatory agencies are receiving little support and funding.

ENVIRONMENT CANADA (1984-1986)
Ammonium nitrate - Ammonium phosphates - Benzene - Calcium chloride - Calcium oxide and hydroxide - Chlorine - Ethylbenzene - Ethylene - Ethylene dichloride - Ferric chloride - Hydrogen fluoride and hydrofluoric acid - Hydrogen sulphide - Sulphur - Sulphur dioxide - Sulphuric acid and oleum - Toluene.
Ottawa, Environ. Can., 1984-1986, Mult. Pag.
The environmental and technical information for problem spills (Enviro TIPS) manuals were initiated in 1981 to provide comprehensive information on chemicals that are spilled frequently in Canada. The manuals are intended to be used by spill specialists for designing countermeasures for spills and to assess their effects on the environment. For each group of chemical/manual, the following aspects are covered: physical and chemical data, material handling and compatibility, contaminant transport, environmental data, human health, chemical compatibility, countermeasures, previous spill experience, and analytical methods.

EUROPEAN COMMUN. COM. (1978)
Product planning. The relationship between product characteristics and environmental impact.
London, Graham and Trotman, 1978, 311 P.
This publication is divided into two parts: Part I - Principles and issues cover the nature of product impact, factors influencing product impact, the evaluation of product charges, and action designed to limit or reduce the environmental impact of products; Part II - The practical application of product planning deals with the significance of product groups in the European Community, the environmental impact of products, changing product impact, and developing a policy towards product planning.

GOUCH M. (1978)
Dioxin: a critical review of its distribution, mechanism of action, impacts on human health, and the setting of acceptable exposure limits.
NCASI Tech. Bull., 1987, n° 524, 320 P.
The main body of the report first summarizes the physical/chemical properties of 2, 3, 7, 8 TCDD and then identifies sources in the environment. This is followed by identification of potential routes of exposure to dioxin. The subject of biological disposition and effects of dioxin in humans and animals as well as comparison between the two is given thorough coverage. The next chapter dealing with studies in humans exposed to dioxin is comprehensive and should be especially helpful in placing in perspective the epidemiological evidence regarding low level human exposure.

I.M.C.O., F.A.O., W.M.O., W.H.O., I.A.E.A., U.N., U.N.E.P. (1982)
Evaluation of the hazards of harmful substances carried by ships.
London, IMCO, 1982, Rep. Stud. n° 17, 110 P.
This report is being published almost ten years after work started on the assessment of the environmental hazards of substances carried by ships. This work was undertaken initially as preparatory work for the development of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73). The lists of hazard profiles included in this composite report are accurate as of late 1981.

KUGELMAN I.J. (1985)
Toxic and hazardous wastes - Proceedings of the Mid Atlantic industrial waste conference June 23-25, 1985.
Basel, Technomic, 1985, 602 P.
This practical book consists of forty-seven original reports on recent advances in industrial pollution-control methods. The papers, written by experts from universities and industry, describe proven and innovative means for managing industrial effluents and wastes. The information is based on specific cases of industrial waste treatment technologies used in plants in the Eastern United States. The book provides data on procedures for dealing with industrial, toxic and hazardous wastes. Topic areas include: biological treatment, pretreatment, physical-chemical treatment, groundwater, land applications and liners, resource recovery, hazardous waste, metals and industrial wastes, sludge management, and safety technology.

MANZO L., SABBIONI E. (1988)
Lead, chromium and thallium: toxicity, environmental and health impact and regulation. Conference Milan, 769/04/1986.
Sci. Total Environ., 1988, 71, n° 3, 350 P.

The goals of the Conference were: (a) to review the current status of knowledge and evaluate how much progress have been made in the different areas of biomedical research on lead, chromium and thallium, (b) to identify major points of scientific agreement among investigators in the field, (c) to identify the critical data gaps and the most relevant and productive areas for future research to fill those gaps.

MITRA S. (1986)
Mercury in the ecosystem - Its dispersion and pollution today.
Aedermannsdorf, Trans. Tech. Publ., 1986, 340 P.
This book provides a comprehensive treatise on the environmental dispersion of mercury forcefully emphasizes the importance of "mercury-consciousness" in the present-day world, where rapidly expanding metallurgical, chemical, and other industrial developments are causing widespread contamination of the atmosphere, soil, and water by this metal and its toxic organic derivatives. Concepts concerning the mechanism of mercury dispersion and methyl-mercury formation in the physico-biological ecosystem are discussed in detail and a substantial body of data on the degree and nature of the mercury contamination of various plants, fish, and land animals by industrial and urban effluents is presented. Various analytical methods for the estimation of mercury in inorganic and organic samples are presented. These serve as a ready guide to the selection of the correct method for analyzing environmental samples. This book will serve as a useful reference work in mercury-related studies.

MORRIS C.R., CABRAL J.R.P. (1986)
Hexachlorobenzene: proceedings of an international symposium, Lyon, 1985.
Lyon, Int. Agency Res. Cancer, 1986, 699 P.
This book provides an up-to-date evaluation of both known exposures and biological effects of HCB, and makes recommendations for future research. It is intended to provide guidance to scientists as well as information useful to regulatory agencies, national governments and international organizations.

O.E.C.D. (1986)
Fate of small quantities of hazardous waste.
Paris, OECD, 1986, 100 P.
There are three main sources of small quantities of potentially hazardous wastes (SOHW) namely consumers/householders, small business enterprises and certain agricultural activities. One chief difficulty in monitoring and controlling these SOHW is that they are disposed in a very diffuse manner, i.e., by many holders of such wastes, in an irregular fashion. A number of OECD Member countries have initiated efforts to obtain baseline data concerning SOHW (components, sources and estimated amounts, potential effects of improperly disposed SOHW, legislative and regulatory controls) and their fate. This report represents an attempt to provide these information. Some suggestions for approaches to reducing potential problems arising from SOHW are also tendered.

RANTANEN J.H., SILANO V., TARKOWSKI S., YRJANHEIKKI E. (1987)
PCBs, PCDDs and PCDFs: prevention and control of accidental and environmental exposures.
Copenhagen, WHO, 1987, 237 P.
The report reviews strategies and actions intended to: substitute PCBs where used at present; develop strategies for effective contingency planning systems to respond to possible emergencies through immediate and subsequent actions; evaluate the risk of accidents caused by installations and/or operations involving PCBs, PCDDs and PCDFs; assess needs for rehabilitation of contaminated facilities; implement rehabilitation of affected people, buildings and ecological systems; develop safety methods for decontamination and disposal of contaminated wastes. To be able to plan and carry out all these activities, one needs an adequate appreciation of the properties and features of PCBs, PCDDs and PCDFs, environmental pathways of exposure, analytical methods for different environmental matrices, and physical and chemical properties. This background information is provided in a summarized form in this volume.

RICHARDSON M.L. (1988)
Risk assessment of chemicals in the environment.
London, R. Soc. Chem., 1988, 589 P.
The book covers both chemical and radioactive risk assessment, predictive techniques, risk acceptance (including prediction and reality on isolated and global bases), approaches to the control of chemical disasters and much more... It is divided into four sections as follows: Introduction and Overview - Contribution of toxicology to risk assessment - Incidental Emissions - Air and Water - Intentional emissions. Also included is an extremely useful glossary of terms, useful addresses and a subject index.

SHIMMEL P. (1987)
The environmental impact of industrial activities - Int. Sem., London, 1987.
London, Ind. Environ. Associates, 1987, 62 P.
The eight papers range from the use of a fungus to biodegrade chlorinated organic wastes to reviews of national programmes for hazardous waste control. The paper describing the Netherlands Hazardous Waste Destruction Facility is interesting. The "Schweizerhalle" and its consequences presented by Salzmann, SANDOZ Ltd, is a concise factual account of what happened during and after the fire in Basel and how much damage was done to the Rhine. The article on modelling in estuaries can be taken as an indication of how much work must still be done before complicated systems can be modelled usefully. Hong Kong and the U.S. Air Force are the subjects of two papers on wastes. Only one paper is devoted to the accomplishments of a company designed to deal with wastes.

SODERGREEN A., WARTIOVAARA J. (1988)
Forest industry - Environmental effects - IAWPRC Symp., Tampere Univ. Technol., Finland, 1987.
Oxford, Pergamon Press, Water Sci. Technol., 1988, 20, n° 2, 212 P.
Several papers discussed the role of biological indicators in environmental investigations. Another important topic was the significance of halogenated organic compounds, both to human health and the environment. Other papers examined the accumulation of toxic or otherwise physiologically active compounds, and the changes in individuals and at population level.

SITTIG M. (1979)
Hazardous and toxic effects of industrial chemicals.
Park Ridge, Noyes Data Corporation, 1979, 166 P.
This handbook is intended to be a working guide for the industrial hygienist and other concerned persons. The publisher and the author regard the present volume as important in providing a speedy link between the researcher and those who must be generally informed about hazardous chemicals. The book consists of about 250 individual entries arranged alphabetically by the common name of each substance described.

U.N.E.P. (1983)
International register of potentially toxic chemicals.
Geneva, UNEP, 1983, 807 P.
This register file is concerned with national and international recommendations and legal mechanisms related to control of a substance in various media, such as air, water, drinking water, wastes, soil, sediments, animal and plant tissues, food and beverages, drugs, consumer goods (including cosmetics and toiletries), agriculture and animal husbandry. The information contained in this file enables rapid access to be regulatory control mechanisms of many nations and to international recommendations for safe handling and use of chemicals.

WAID J.S. (1986/87)
PCBs and the environment.
Boca Raton, CRC Press, 1986/87, 236 P. + 198 P. + 280 P.

WEBB K.B. (1984)
Dioxin: lessons from the Missouri experience - Proceedings of the second annual G.O. Broun, St. Louis, Missouri, 1983.
Bull. Environ. Contam. Toxicol., 1984, 33, n° 6, 630-734.
This document contains various papers attempting to trace the development of public health problems due to dioxin-contaminated oil, and identifying the lessons learned from the Missouri experience.

WORLD BANK (1978)
Environmental considerations for the industrial development sector.
Washington, World Bank, 1978, 138 P.
This book presents the following topics: sources and effects of industrial pollution governmental structures for environmental management, criteria and standards, sampling and analytical procedures, treatment technology, economic, sociological, planning and political aspects.

W.H.O. (1986)
Organophosphorus pesticides - An epidemiological study. Workshop, 24-26 September 1986.
Copenhagen, WHO, 1986, 145 P.
The purpose of the workshop was threefold: review and evaluate the performance and results of the pilot study of the core protocol and the cholinesterase (ChE) quality assurance programme; review and where necessary revise the epidemiological study protocol; examine the feasibility and implementation of the final study, together with its quality assurance programmes.

PAPERS:

ABRAHAM M. (1988)
The pesticide pestilence.
Ecoforum, 1988, 12, n° 5, 2 P.

CLARKE E.A., ANLIKER R. (1980)
Synthetic organic colorants.
Environ. Chem. Handb., 1980, 3, Part A., 181-215.
This document discusses various aspects of synthetic organic colorants, including chemistry and uses, production data, analytical methods, ecological aspects, toxicological aspects, and legislation.

ECONOMOPOULOS A.P. (1982)
Rapid waste inventories and their use in environmental planning.
Water Qual. Bull., 1982, 7, n° 2, 89-101 (4 P.).
The purpose of this paper is to suggest a fairly rapid method for the collection, processing and use of the necessary information for pollution control decisions.

EGBUNIWE N. (1982)
Characteristics and disposal problems of industrial wastes in Nigeria.
Water Qual. Bull., 1982, 7, n° 1, 17-42 (4 P.).

ELHASSAN B.M. (1982)
Environmental impact of industrial waste in Sudan.
Water Qual. Bull., 1982, 7, n° 1, 31-43 (2 P.).

KRAYBILL H.F. (1981)
Carcinogenesis of synthetic organic chemicals in drinking water.
JAWWA, 1981, 73, n° 7, 370-372.
This paper describes the cancer risks factors estimated for five organic contaminants. Five experimental approaches are recommended to elucidate the risk of cancer from organic biorefractories.

NAGAI K. (1978)
Environmental effects assessment.
Technocrat, 1978, 11, n° 7, 11-17.
This article discusses the environmental effects assessment which is expected to play a continuing important part in environmental policy of the future, aimed at providing a proper environment.

SAVAGE G.M., SHARPE H. (1987)
Assessment of non-regulated hazardous waste in the Seattle area.
Waste Manage. Res., 1987, 5, n° 2, 159-171.
The results of a quantitative study to assess the extent and degree of non-regulated hazardous waste present in municipal solid waste generated in King County Washington State, U.S.A., are reported. A major objective of the study was to ascertain the health and environmental impacts of non-regulated hazardous waste within the County's collection, transport, and disposal systems and to formulate policies for managing non-regulated hazardous waste within the context of the County's solid waste management master plan.

U.S. EPA (1975)
Hazardous substances - Designation, removability, harmful quantities, penalty rates.
Fed. Regist., 1975, 30, Part IV, 59960-60017.
This document discusses, among others, hazardous substances - Their designation, removability, harmful quantities and penalty rates.

X... (1988)
Major accident hazards of industrial activities.
Environ. Policy Law, 1988, 18, n° 4, 2 P.

X... (1988)
Technological accident.
Ind. Environ., 1988, 11, n° 3, 40 P.
This issue presents other points of view and elements which illustrate the technological accidents issue. We hope that this material will help create the necessary awareness and will thus contribute to the prevention of industrial accidents. In particular, case studies of implementation of Awareness and Preparedness for Emergencies at Local Level (APELL)-like processes will be presented in future issues.

POLLUTION CONTROL

TL214 P6 G6
GOLDBERG A.J. (1973).
A survey of Emissions and Control for Hazardous and other Pollutants.
Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, 1973, 168 P.
Motor vehicles, Pollution control devices, Air pollution.

T55.3 H3 N3 1972
Control of Hazardous Material Spills : Proceedings of the 1972 National Conference on Control of Hazardous Material spills/ held in March 21-23, 1973.
National Conference on Control of Hazardous Material spills, Houston, 1972, Environmental Protection Agency and University of Houston, Houston, 1972, 223 P.
Hazardous substances, Congresses.

TD427 H38 U5
U.S. COAST GUARD (1970).
Control of Hazardous polluting substances.
U.S. Coast Guard, 1970.

TD427 H38 H39 1970
HAZARDOUS POLLUTING SUBSTANCES SYMP., NEW ORLEANS, LA., (1970).
Abstract of Proceedings Hazardous polluting substances Symp..
U.S. Coast Guard, 1970.

T55.3 H A5
AMERICAN ASSOC. OF STATE HIGHWAY & TRANSPORTATION OFFICIALS, ADMINISTRA (1975).
A Guide for Control and Cleanup of Hazardous Materials.
Washington, 1975.

T55.3 H S95 1972 C.2
NOYES DATA CORPORATION (1972).
Progress in Hazardous Chemicals handling & disposal Vol. III.
Noyes Data Corp., 1972.

TD886 H47
HESKETH, HOWARD E; CROSS, FRANK L. (1989).
Odor Control : Including Hazardous/Toxic odors/ ... and Frank L. Cross.
Technomic Pub., Lancaster, Penn.,1989, 86 P.
Odor control.

TD811,5 N386 1981
LEHMAN; JOHN P., ed. (1983).
Hazardous Waste Disposal, Edited by John P. Lehman.
North Atlantic Treaty Organization, Committee on Challenges on Modern Society, NATO/CCMS Symposium on Hazardous Waste Disposal, Washington D.C., 1981, Plenum Press, New York, 1983, viii, 396 P.
NATO challenges of modern society, v. 4.,
Hazardous Wastes, Congresses, Hazardous Waste facilities.

TD897.5 S96 1982
SUBRAMANIAN S. K., ed. (1983).
Treatment and Disposal of Hazardous Wastes from Industry: Some experiences. Report of the symposium on Disposal & Recycling of Industrial Hazardous Wastes, Tokyo, Japan, 1982. Sponsored by the Asian Productivity Organization, Editor: S.K. Subramanian.
Asian Productivity Organization, Symposium on Disposal & Recycling of Industrial Hazardous Wastes, Tokyo

1982, Asian Productivity Organization, Tokyo, 1983, iv, 197 P.
Factory and trade wastes, Congresses.

TD223 G76
WOOD, ERIC F. (1984).
Groundwater Contamination from Hazardous Wastes, Princeton Water Resource Program, Department of Civil Engineering, Eric F. Wood ET AL.
Princeton University, Princeton Water Resource Program, Prentice-Hall, Englewood Cliffs, N.J., 1984, xii, 163 P.
Water Underground, Pollution, United States, Hazardous wastes, Environmental aspects, Hazardous waste sites.

BERKOWITZ, JOAN B. et al. (1978).
Unit Operations for treatment of Hazardous Industrial Wastes.
Noyes Data Corp., N.J., 1978, 920 P.

GC1080 U5 no. 48
Hazardous Waste Storage and Disposal in the South Pacific / prepared in co-operation with SPC/SPEC/ESCAP.
South Pacific Commission, South Pacific Bureau for Economic co-operation, United Nations Economic and Social commission for Asia and Pacific, Regional Seas Programme Activity Center, United Nations Environmental Programme, Regional Seas reports and studies; no. 48, Geneva, 1984, 29P.
Hazardous wastes, Waste disposal in the ocean, South Pacific.

TD811.5 H392
HIGHLAND JOSEPH H., ed. (1982).
Hazardous Waste Disposal : Assessing the problems / edited by Joseph H. Highland.
Ann Arbor Science Publishes, Ann Arbor, Mich., 1982, 332 P.
Hazardous wastes, Hazardous waste sites.

TD1032 S73
FREEMAN HARRY M. (1989).
Standard Handbook of Hazardous Waste Treatment and Disposal / Harry M. Freeman, editor.
McGraw-Hill Book Co., New York, 1989, 1 v. (various paging)
Hazardous wastes - Handbook, Manuals etc., Hazardous waste treatment facilities - Handbook, Manuals etc..

HAZARDOUS WASTE TREATMENT AND DISPOSAL

BOOKS:

BATSTONE R., SMITH J.E. WILSON D. (1989)
The safe disposal of hazardous wastes. The special needs and problems of developing countries.
Washington, World Bank, 1989, 400 P.
The health and environmental effects of hazardous wastes - Planning for hazardous waste management - Waste minimization. A key strategy in hazardous waste management - Infrastructure of hazardous waste management systems - Hazardous waste treatment technologies - Precipitation/flocculation - Sedimentation - Oily wastes - Chemical oxidation - Stabilization/solidification - Neutralization.

BERKOWITZ J.B. (1977)
Physical, chemical and biological treatment techniques for industrial wastes.
Springfield, NTIS, 1977, PB 275 054, 400 P.
This study examined 47 unit engineering processes for their applicability to the task of treating hazardous industrial wastes. Some of these unit processes are commonly used for industrial waste treatment while others require further R & D efforts they will become commercially attractive. Four (dialysis, electrophoresis, freeze drying and zone refining) were found not to be applicable to waste treatment. Part two of this report presents comprehensive description of each of the unit processes, including information on the basic principles, areas of application, economics, energy and environmental considerations, and an outlook for future use on industrial wastes. Thus, part two is in essence an up-to-date reference textbook on potential treatment processes.

BROWER G.R. (1984)
Removal of hazardous wastes in wastewater facilities: halogenated organics.
Alexandria, WPCF, 1984, 121 P.
The purpose of this manual is to expose design engineers to the special issues concerning organic compounds generically classified as refractory, that is, resistant to microbial degradation in the conventional process found in wastewater treatment and the natural environment. Although many materials could be classified as refractory, only chlorinated organic compounds have been included here to limit the scope of this manual to a manageable level of effort. The manual is designed to provide treatment information for municipal facilities of less than 2.2 to 4.4 m^3/s (50 to 100 mgd). Treatment processes are described in addition to their effectiveness for removing chlorinated organics, which reside within or use the receiving waters and are presently regarded as potentially hazardous to either man or the biota. The applicability of alternative technology is described. Chapters on safety precautions, sampling, and analysis also are included.

CAVASENO V. (1980)
Industrial wastewater and solid waste engineering.
New York, Chemical Eng., McGraw Hill, 1980, 405 P.
Industrial water pollution control: water-pollution instrumentation, primary treatment methods, secondary treatment methods, tertiary treatment methods - Industrial solid waste control: solid waste treatment methods - solid waste disposal methods.

CONWAY R.A., ROSS R.D. (1980
Handbook of industrial waste disposal.
New York, Van Nostrand Reinhold, 1980, 575 P.
Problem definition, regulations, and disposal approaches - Wastewater equalization, neutralization and clarification - Biological treatment of wastewater - Dewatering of excess biomass and other sludges - Activated carbon adsorption - Special separations and reactions - Ultimate disposal methods for wastewater, sludges and residues - Preparation, recovery, and reuse of solid waste - Incineration of solid waste - Pyrolysis and wet air oxidation of solid wastes - Land and ocean disposal of industrial wastes - Contract disposal of industrial wastes - Disposal of hazardous materials - Air pollution considerations in industrial plant organization, etc.

CURI K. (1979)
Treatment and disposal of liquid and solid industrial wastes.
Istanbul, Bogazici Univ., 1979, 969 P.
Advanced treatment - Use of soils as industrial waste treatment system - An investigation on water reuse in industries - Joint treatment of industrial wastes and domestic sewage - Wastewater treatment by using bamboo bladed rotors - The response of activated sludge to high salinity - Wastewater treatment via combined biological-physico-chemical techniques - Conditioning and disposal of industrial sludges - Anaerobic treatment of palm oil sludge - A study of some industrial solid wastes - Economics of treatment and disposal of industrial wastes - Costs and innovative solutions for industrial waste treatment - Anaerobic treatment of high strength industrial wastewaters, etc...

De RENZO D.J. (1978)
Unit operations for treatment of hazardous industrial wastes.
Park Ridge, Noyes Data Corporation, 1978, 926 P.
Treatment processes investigated - Selection of treatment processes for given waste streams - Waste treatment process summaries - Treatment techniques: adsorption, biological treatment, centrifugation, dialysis, distillation, precipitation, flocculation, sedimentation, flotation, hydrolysis, neutralization, chemical oxidation, ozonation, chemical reduction, etc...

De RENZO D.J. (1980)
Biodegradation techniques for industrial organic wastes.
Park Ridge, NDC, 1980, 368 P.
Literature review - Site studies - Sampling activities - Engineering and economic comparisons of identified biodegradation techniques.

De RENZO D.J. (1981)
Pollution control technology for industrial wastewater.
Park Ridge, NDC, 1981, 714 P.
Wastewater conditioning (preliminary treatment) - Primary wastewater treatment - Secondary wastewater treatment - Tertiary wastewater treatment - Sludge treatment - Disposal.

DYER J.C., VERNICK A.S., FEILER H.D. (1981)
Handbook of industrial wastes pretreatment.
New York, Garland STPM, 1981, 270 P.
Developing a local pretreatment program - Elements of a pretreatment program - Impact of industrial wastes on municipal wastewater treatment - Sludge disposal considerations - Industry's role in pretreatment - Case histories of industrial waste control programs - Etc...

JORGENSEN S.E. (1979)
Industrial waste water management.
Amsterdam, Elsevier, 1979, 394 P.
Treatment techniques: sedimentation, filtration, coagulation and flocculation, membrane separation processes, flotation, adsorption, ion exchange, chemical oxidation and reduction, disinfection, aeration and stripping, biological treatment processes - Treatment of sludge - Wastewater from: chemical and electrochemical metal-treatment processes, iron and steel industry and mining, non-ferrous metals industries, alkali industry, gas, coke and tar industry, manufacture of stone and glass wools, petroleum industry, pigment industry, textile industry, photochemical industry, tanning industry, plastics industry, foodstuffs industry, pulp, paper and wood industry, manufacture of soap and detergents and from laundries - Radioactive wastewater.

LA GREGA M., LONG D.A. (1984)
Toxic and hazardous waste. Proceedings of the Sixteenth Mid Atlantic industrial waste conference held at University Park, Pa., 1984.
Lancaster, Technomic Publ., 1984, 294 P.
The them of the Sixteenth Conference was: Focus on problem solving. Technical sessions included: Biological waste treatment - Waste incineration and energy recovery - Regulatory compliance - Recycle/reuse - Heavy

metals control - Physical-chemical processes - Sludge management - Hazardous waste site clean-up - Groundwater protection.

NEAL A.W. (1971)
Industrial waste. Its handling, disposal and reuse.
London, Business Books, 1971, 137 P.
This book sets out to present the practical aspect of industrial waste handling and disposal or re-use. Subjects include the reuse of waste, incineration, with notes on ash and its use; controlled tipping and composting; recovery; organic and vegetable wastes; liquid wastes; and contracting act.

NEMEROW N.L. (1978)
Industrial water pollution. Origins, characteristics and treatment.
Reading, Addison-Wesley, 1978, 752 P.
This book is divided into four sections: Section 1 contains basic facts which the industrial waste engineering needs to know: effect of wastes on the surrounding environment, how to calculate the final treatment required before disposal of wastes into a receiving stream, etc. Section 2 delves into the theories of wastes treatment, and talks about how wastes can be reduced by proper operation of manufacturing plants. It discusses not only removal of suspended and colloidal solids, but also the subjects of neutralization, equalization and proportioning, removal of inorganic dissolved salts, and private contract collection and treatment. Section 3 accentuates engineering practice, and presents concrete examples of problems and their solutions. Section 4 gives separate treatises on all the major liquid industrial wastes - subject which normally requires an entire book. All industries are classified into six categories: apparel, food processing, materials, chemicals, energy, and non-point practices.

OVERCASH M.R. (19860
Techniques for industrial pollution prevention - A compendium for hazardous and nonhazardous waste minimization.
Chelsea, Lewis Publ. INC, 1986, 220 P.
This book is a compendium of successful waste elimination schemes. The technologies described, along with the chapter outlining the overall approach to handling industrial wastes, are applicable to a variety of disciplines. Industrial personnel will find the process changes described herein helpful in the review of possible waste reduction alternatives. Though waste reduction is not always economically feasible, the proven processes described in this book will be very helpful in many cases.

REED S.C., CRITES R.W. (1984)
Handbook of land treatment systems for industrial and municipal wastes.
Park Ridge, Noyes Publications, 1984, 443 P.
It is the purpose of this book to present the criteria and procedures needed for the complete design of land treatment systems for municipal and industrial wastes. A considerable research effort has not only established the treatment capability and reliability of land treatment but also shown that the capital and operating costs and energy usage can be significantly less than for the more familiar mechanical systems. Many of the standard engineering design textbooks still mention land treatment only in passing, if at all. This book is intended to fill that gap.

SALTZBERG E.R., CUSHNIE G.C. (1985)
Centralized waste treatment on industrial wastewater.
Park Ridge, NDC, 1985, 419 P.
With the CWT approach, industrial firms send their wastes to a common processing plant. In the right situations and with the proper kind of inexpensive retrofitting, CWT can drastically reduce the cost of treating industrial wastewater because of economies of scale. CWT also has several environmental advantages: the facilities are operated by professional waste handlers, trained to treat and manage the waste business; CWT can dramatically increase the potential for recovery of chemicals, which not only reduces the firm's operating costs but also the burden of sludge handling and disposal; and under some CWT concepts firms can share other services to further reduce their operational costs.

SHUCKROW A.J., PAJAK A.P., TOUHILL C.J. (1982)
Hazardous waste leachate management manual.
Park Ridge, Noyes Data Corp., 1982, 386 P.
This book includes chapters on leachate generation and characteristics, hazardous waste leachate management options, leachate treatment technologies and process selection, monitoring and other important considerations: safety, contingency plans/emergency provisions, equipment redundancies/backup, personnel training...

SCHOLZE R.J. (1988)
Biotechnology for degradation of toxic chemicals in hazardous wastes.
Park Ridge, Noyes, 1988, 697 P.
Full-scale application of biotechnology for the treatment of municipal and industrial wastewaters has been practiced for many years. However, whether this technology can be employed for detoxification and destruction of hazardous chemicals in aqueous and solid media is not yet fully understood. Removal of toxic and refractory organics in wastewater, groundwater, and leachate may be more efficient as a result of combining biological treatment with other treatment technologies such as chemical and physical methods. Development of standard techniques for biotoxicity detection and toxicity reduction evaluation is essential and extremely important to both technical determination and decisions on the future policy for hazardous waste management. The various chapters in the book describe current research in biotechnology for degradation of toxic chemicals in hazardous wastes.

SHULTZ D., BLACK D. (1980)
Disposal of hazardous wastes.
Cincinnati, EPA, 1980, 600/9-80-010, 301 P.
These proceedings are intended to disseminate up-to-date information on extramural research projects dealing with the disposal of hazardous wastes. The papers in these proceedings are arranged as they were presented at the symposium. Each of the ten sessions includes papers dealing with major areas of interest for those involved in hazardous waste disposal technology. These proceedings will prove useful and beneficial to the scientific community as a current reference on the disposal of hazardous wastes.

WALTER J.K., WINT A. (1981)
Industrial effluent treatment. Water and solid wastes.
London, Appl. Sci., 1981, 356 P.
The first half of the book covers the legal constraints within which the process designer must work in United Kingdom. Chapters 2 and 3 discuss the approach taken by the water authorities in controlling discharges to sewers and watercourses, while details of the law and the penalties for non-compliance are discussed in the appendix. Chapter 4 considers the role of dissolved oxygen in a watercourse and how it is affected by discharges and chapter 5 covers the effects on aquatic life of various pollutants. Chapters 6, 7 and 8 discuss physical, chemical and biological processes for the treatment of effluents and they are followed by two case studies in Chapter 9. The final two chapters cover the problem of the disposal of toxic materials and the incineration and pyrolysis of wastes.

X... (1987)
Handbook for monitoring industrial wastewater.
Washington, EPA Technol. Transf., 1973, 185 P.
Philosophy of monitoring needs, planning, sampling, measuring, and analysis is presented for familiarization by industrial plant managers. A logical procedure is suggested and direction given for those responsible for industrial plant waste control programs. Automated sampling, measuring, and analytical devices are described and methods of use outlined. Manual procedures and non-automated methods are likewise presented. Use of the collected data is discussed. Special considerations for industrial-municipal joint treatment are briefly described.

X... (1979)
Selected biodegradation techniques for treatment and/or ultimate disposal of organic materials.
Cincinnati, EPA, 1979, 600/2-79-006, 377 P.
Design, performance, and economic comparisons of the biological treatment technologies are presented to assist waste managers and engineers in the selection of proper treatment methods. The treatment techniques studied

were activated sludge, series lagoons, deep shaft aeration, and pure oxygen biological systems.

PAPERS:

CARTWRIGHT K., GILKESON R.H., JOHNSON T.M. (1981)
Geological considerations in hazardous waste disposal.
J. Hydrol., 1981, 54, 357-369.
The geology and hydrogeology of a site must be carefully considered in planning the disposal of wastes and in assessing the potential problems that may result from some current regulatory criteria. An evaluation process is necessary that considers both the specific character of the wastes for disposal and the specific geologic conditions at the proposed disposal site.

COTE P.L., HAMILTON D.P. (1983)
Leachability comparison of four hazardous waste solidification processes.
Proc. 38th Ind. Waste Conf. Purdue Univ., 1983, 221-231.
A research program was developed at the Wastewater Technology Centre (WTC), Burlington, Ontario, to evaluate the main hazardous waste solidification technologies. The program is limited to the solidification of inorganic aqueous wastes (that may contain small fractions of organics) using inorganic additives. It features use of synthetic wastes to carefully control the experimental conditions, in-house solidification and testing, generation of cost data and use of leaching tests that allow the results to be interpreted based on mass transport theories. This paper presents the results of a leachability comparison of four generic processes applied to three synthetic wastes.

KASCHAK W.M., SPATARELLA J.J. (1984)
Case studies involving the treatment of hazardous substances under the superfund remedial action program.
Proc. 39th Ind. Waste Conf. Purdue Univ., 1984, 313-320.
This paper discusses the planning activities and engineering studies leading up to the selection of the treatment systems at Bridgeport Rental and Oil Services site in New Jersey and at Sylvester site in New Hampshire.

SCOTT P.D. (1980)
The treatment and disposal of toxic and hazardous waste.
In Proc. Conf. IWPC, Pretoria, 1980, 35 P.
This paper concentrates on domestic, trade, industrial and to a certain extent, chemical feedstock production wastes.

STOLZENBURG T.R., TICKANEN L.D., DUDZIK B.E., VONDRACEK J.E. (1985)
Analysis and treatment of reactive waste: a case study in the ductile iron foundry industry.
Proc. 40th Ind. Waste Conf. Purdue Univ., 1985, 133-140.
This paper discusses the analysis and treatment of calcium carbide desulfurization slag generated at ductile iron foundries.

WAGENER S., SCHINK B. (1987)
Anaerobic degradation of nonionic and anionic surfactants in enrichment cultures and fixed-bed reactors.
Water Res., 1987, 21, n° 5, 615-622.
The aim of the present study was to check the influence of nonionic and anionic surfactants on methanogenic digestion of complex organic matter, together with an assessment of their possible biodegradability. Also experiments on purification of wastewaters containing high loads of nonionic surfactants in a lab scale anaerobic fixed-bed reactor are reported.

PHYSICO-CHEMICAL TREATMENT

BOOKS:

CHEREMISINOFF P.N., ELLERBUSCH F. (1978)
Carbon adsorption handbook.
Ann Arbor Sci., 1978, 1054 P.
This definitive study focuses on the practical aspects of carbon adsorption use in air and water pollution control as well as manufacturing uses. Extensive use of case histories illustrates the many applications of carbon adsorption - especially in the pharmaceutical, meat packing, pulp and paper processing and petroleum industries, municipal and industrial water treatment.

CUSHNIE G.C. (1984)
Removal of metals from wastewaters - Neutralization and precipitation.
Park Ridge, NDC, 1984, Pollut. Technol. Rev. n° 107, 232 P.
This is a manual of design and operating procedures for the removal of metals from industrial wastewaters by neutralization and precipitation, plus methods for handling and disposal of residues from the treatment processes.

EILBECK W.J., MATTOCK G. (1987)
Chemical processes in wastewater treatment.
Chichester, Wiley/Ellis Horwood Ltd, 1987, 331 P.
This book fills a gap in the literature available to industrial wastewater treatment engineers and scientists, where the need is frequently felt for a comprehensive coverage of the chemical processes so widely used. There are essentially four sections, consisting of a review of the basic chemical engineering and control considerations necessary for chemical treatment plant design; and analysis of pH adjustment processes; chapters on oxidation, reduction and electrochemical processes, and a study of phase separations. Throughout, the text maintains a pattern of theoretical introductions followed by reviews of applications, with particular attention to practical aspects and current control techniques.

GROHMANN A., HAHN H.H., KLUTE R. (1985)
Chemical water and wastewater treatment.
Stuttgart, Gustav Fischer, 1985, 310 P.
This book (which is the result of a conference) presents both principles and applications of chemical treatment. Internationally renowned experts contribute on the physical and chemical aspects of the process, on engineering problems and on the economics of this concept of water and wastewater treatment. Case studies of specific solutions serve as illustrations.

HUMENICK M.J. (1977)
Water and wastewater treatment - Calculations for chemical and physical processes.
New York, Dekker, 1977, 236 P.
Equalization - Coagulation and flocculation - Chemical precipitation, water conditioning and softening - Gravity sedimentation thickening and flotation - Filtration - Activated carbon adsorption - Ion exchange - Chlorination and disinfection - Aeration - Physical data - Balancing redox equations - Computer programs.

KAKABADSE G. (1979)
Chemistry of effluent treatment.
London, Applied Sci. Publ., 1979, 158 P.
In-house treatment of effluent liquids versus combined treatment with sewage - Chemical versus biological effluent treatment - Tertiary treatment - Recent advances in chemical treatment - Processes for extracting metals from effluents - Basic parameters of analytical control (advances in on-line monitoring of chemical effluent treatment) - Automated instrumentation of effluent treatment - Electrochemical sensors (their scope and limitations) - The role of liquid chromatography in effluent control.

JOHNSTON H.K., LIM H.S. (s.d.)
Bibliography on the application of reverse osmosis to industrial and municipal wastewater.
Ottawa, Environ. Can., s.d., Res. Rep. n° 18, 117 P.
The references in this review (period 1968-1973) emphasize the employment of reverse osmosis in the treatment of municipal and industrial wastewater. The introductory portion of this report provides sufficient information on the mechanisms and applications of reverse osmosis to permit one to make a general assessment of its suitability. The physico-chemical nature of the reverse osmosis process as well as the membrane types available and their fabrication techniques are examined. An area of importance in the waste treatment field is membrane fouling and appropriate cleaning techniques are summarized for different types of surface inhibition.

PAWLOWSKI L. (1982)
Physicochemical methods for water and wastewater treatment.
Amsterdam, Elsevier, 1982, Studies Environ. Sci. 19, 399 P.
Stability of colloid types and optimal dosing in water flocculation - Economical comparison of BOD-removal from waste water by physicochemical flocculation, biological and combined treatment - Chemical method of destabilizing emulsions using polyelectrolytes - Removal of phenol from wastewater by recuperative mode parametric pumping - Boundary phenomena in rapid filtration on multi-media filters - Immobilized microorganisms in wastewater treatment - Virus inactivation and removal by physicochemical treatment processes - etc...

RICE R.G., BROWNING M.E. (1981)
Ozone treatment of industrial wastewater.
Park Ridge, NDC, 1981, Pollut. Technol. Rev. n° 84, 376 P.
Included in the book is an introductory chapter on oxidation processes, stressing chemical oxidation. A chapter on the fundamental principles of ozone technology describes the generation of ozone on a commercial scale, the various methods of contacting ozone with aqueous solutions and methods of analysis for ozone from the point of view of process controls. Next, industries are grouped into 20 categories which are discussed separately. Known uses of ozone for treating waters and wastewaters are described in each category. Finally, a chapter is included which describes the biological activated carbon (BAC) concept.

WEBER W. (1972)
Physicochemical processes for water quality control.
London, Wiley, 1972, 640 P.
Process dynamics, reactions, and reactors - Coagulation and flocculation - Sedimentation - Filtration - Adsorption - Ion exchange - Membrane processes - Chemical oxidation - Disinfection - Corrosion and corrosion control - Aeration and gas transfer - Sludge treatment.

PAPERS:

BETTLER C.R. (1977)
Lime neutralization of low-acidity wastewater.
Proc. 32nd Ind. Waste Conf. Purdue Univ., 1977, 830-837.
Du Pont has built a 43 million dollar wastewater treatment plant to treat the complex acidic wastewater from Chambers Works, a large diversified organic chemicals plant in Deepwater, New Jersey. Lime is used to neutralize 40 mgd of highly variable, weakly acidic wastewater containing 200 tons, as $CaCO_3$. A study was initiated to determine the most economical neutralizing agent to neutralize the 73,000 tons per year of this acid.

CLIFFORD D., SUBRAMONIAN S., SORG T.J. (1986)
Removing dissolved inorganic contaminants from water.
Environ. Sci. Technol., 1986, 20, n° 11, 1072-1080.
This article describes the physico-chemical treatment processes typically used to remove the more common inorganic contaminants from water and wastewater. These are precipitation, coprecipitation, adsorption, ion exchange, membrane separations by reverse osmosis and electrodialysis, and combinations of these processes. The general criteria for process selection are discussed, and the processes and their typical applications are

described. Distillation and evaporation are not covered, and oxidation-reduction reactions are mentioned only in connection, with other processes.

WEBER W.J., SMITH E.H. (1986)
Removing dissolved organic contaminants from waters.
Environ. Sci. Technol., 1986, 20, n° 10, 970-979.
The article discusses processes for the removal of dissolved organic contaminants from water, including surface and subsurface supplies of water intended for municipal or industrial uses as well as wastewaters requiring treatment prior to discharge. The article focuses on four areas of technology that appear to offer the greatest potential for general application in the water supply and waste treatment industry: a transformation process, chemical oxidation; a liquid-gas separation process, air stripping; two variants of a liquid-solid separation process, carbon adsorption and exchange adsorption; and two membrane separation processes, reverse osmosis and ultrafiltration.

CASE STUDIES
CHEMICAL INDUSTRY

Books:

ENVIRONMENT CANADA(1981)
Survey of polychlorinated biphenyis in industrial effluents in Canada.
Ottawa, Environ, Can., 1981, EPS -3-WP-81, 44 P
An industrial of PCB sampling program was carried out to investigate the degree and sources of PCB contamination from industrial activities, and to provide at least a preliminary data base for planning a more effective control strategy.

ERIKSON D.G. HOBBS F.D., IVINS O.D., KALCEVIC V., TROXLER W.L. (1981)
Fugitive emission sources and batch operation in synthetic organic chemical production.
Springfield, NTIS/EPA, 1981, PB 81-216 848 - 600/2 -81-083, 91 P.
This survey report was developed for the EPA for use in assessing the potential magnitude of fugitive volatile organic compound (VOC) emissions from agitator seals, cooling towers and batch operations in the production of 378 designated chemicals. The information presented in this report has been developed based on a review of the available open literature. Information on the type of operation, i.e., batch or continuous, and the quantity of specific fugitive source types associated with each process was evaluated and overall industry estimates were made.

HACKMAN E.E. (1978)
Toxic organic Chemicals: destruction and waste treatment.
Park Ridge, NDC, 1978, Pollut. Technol. Rev. n 40, 331 P
In this book are presented many practical approaches for waste treatment and separation of difficult-to-destroy organic chemicals with ample scientific and theoretical justification. Emphasis is directed toward those organic compounds which are considered the most toxic and refractory substances, but having many useful properties.

KNUTZEN J. (1983)
A review of the effects on aquatic ecosystems of acid iron waste from the production of titanium dioxide by the sulphate process.
Oslo, Norw, Inst, Water Res., 1983, 0.82012, 72 P
Damaging effects of acid iron waste to biota have been demonstrated in the vicinity of coastal and estuarine outfalls. The toxic properties have been confirmed in laboratory studies with algae, invertebrates and fish.

MUEHLBERG P.E. REDING J.T., SHEPHERD B.P., PARSONS T., WILKINS G.E.(1977)
Industrial process profiles for environmental use - Chapter 22 : The phosphate rock and basic fertilizers industry.
Cincinnati, EPA, 1977, 600/2-77-023v, 211 P
Process descriptions for phosphate rock processing, ammonia synthesis production of ammonium sulfate, ammonium nitrate and urea, production of pottassium nitrate and liquid chlorine, production of ammonium phosphates and nitric phosphate, production of mixed fertilizers, elemental phosphorus and furnace acid segment, productin of elemental phosphorus and furnace acid, production of sodium phosphates and calcium phosphates.

MULLER K.R. (1986)
Chemical waste - Handling and treatment.
Berlin, Springer - Verlag, 1986, 360 P.
This is the first work generated by an international group of renowned and recognized scientists. They present, in the form of handbook, recently acquired and ascertained knowledge and demonstrated techniques. It is the aim of this handbook to be helpful in solving future problems and to present enlightening discussions, thus helping to move chemical waste problems out of the tabloid headlines and practice into the scientific literature.

O'NEILL L.A. (1977)
Water economy in the paint industry
TEddington, Paint Res. Assoc., 1977, 36 P
The papers presented at a Technical Panel Meeting held by the Paint R.A. on 8th March 1977, are the following :water treatment, water recovery and recycling, and industrial policy for water conservation - A view point from the paint industry - Emulsion manufacturer's view point - Automotive paint user's view point - Methods of saving water.

SITTIG M. (1974)
Pollution control in the organic chemical industry
Park Ridge, NDC, 1974, Pollut. Technol. Rev. n 9, 314 P.
X... (1983)
Effluent treatment in the process - Fed. Eur. Genie Chim., Inst. Chem. Eng. R.Soc.
Chem., Conf., Loughborough, 1983.
Oxford, Pergamon Press, 1983, Symp. Ser. n 77, 360 P
The aim of this three day conference at Loughborough is to survey the field of effluent treatment as it affects several major industries at a time when the disposal of waste is having an increasing effect on costs in the processing industries. Technical and legislative aspects of treatment are considered.

HUDAK C.E., PARSONS T.B. (1977)
Industrial process profiles for environmental use : Chapter 12 - The explosives industry. Cincinnati, US EPA, 1977, 125 P
The explosives industry as a whole includes companies which manufacture organic nitration products and formulate mixtures of chemicals with explosive properties. Five nitration processes are described along with the process for production of nitric acid used in the nitration reactions. Six process flow charts and fifteen process description have been prepared to characterize the industry. Within each process description available data have been presented on input materials, operating parameters, utility requirements and waste streams.

JONES H.R. (1972)
Detergents and pollution. Problems and technological solutions
Park Ridge, Noyes Data Corp., 1972, 268 P.
This book reviews the pertinent literature and describes actual manufacturing processes germane to the soap and detergent industry, as the proper solutions begin to emerge through the ingenity of the inventive mind. One hundred and eighty-eight processes based largely on the U.S. patent literature are described in detail. Because of the actuality of the problem most patents are of very recent date, although some older, basic patents are described to completely round out the technological picture. This book serves a double purpose in that it supplies detailed technical information and can be used as a guide to the U.S. patent literature in this field. By, giving all the information that is significant and eliminating legalistic phraseology, this book presents an advanced technically oriented review of modern detergent manufacture.

KATARI V.S., DEVITT T.W., JEFCOAT I.A. (1977)
Industrial process profiles for environmental use: Chapter 26 - Titanium industry.
Cincinnati, EPA, 1977, 600/2-77/02"z, 64 P
This document describes the titanium industry, covering raw materials, products, companies and environment impact, and provides on industry analysis for 11 processes.

SITTIG. M. (1978)
Inorganic chemical industry, Processes, toxic effluents and pollution control.
Park Ridge, NDC, 1978, 361 P
The present book provides helpful directions for making inorganic chemicals. The arrangement is encyclopedic starting with alumina and ending with various zinc compounds. The process details provide a wide choice of raw materials due to a changing economy and partial cutoff of the customary supplies e.g., natural gas, which in inorganic processing is a most convenient source of hydrogen, carbon, carbon monoxide and carbon dioxide. Careful perusal of this book will reveal many alternate sources and energy-sparing processes.

THOMPSON C.M. (1977)
Industrial process profiles for environmental use: Chapter 13 - Plastizers industry.
Cincinnati, EPA, 1977, 600/2 - 77/023m, 84 P
The plasticizer industry includes manufactures who produce primary synthetic organic plasticizers. Plasticizers are materials which are added to organic polymers to facilitate processing, to modify the properties of the product, or both. In many cases, the distinction between plasticizers and other additives, such as extender oils, flame retardants, processing aids and lubricants are often blurred. Three process flow sheets and three process descriptions have been prepared to characterize the industry. Within each process description available data have been on input materials, operating parameters, utility requirements and waste streams.

PAPERS:

ANDERSON G.K. IBRAHIM A.B. (1978)
Treatment of high nitrate wastewaters by plastic media anaerobic filters with particular reference to latex processing.
Prog. Water Technol., 1978, n 5/6, 237- 253
This paper presents the results of research carried out by the Rubber Research Institute of Malaysia.

CHAE - SHIK (1982)
Chemical pollution in Korea - An experience of the developing countries.
J. Kor. Env. Preserv. Assoc., 1982, 3 n 1, 1-25.
This report summarizes the results of environmental surverys carried out in connection with chemical pollution in Korea since the latter of the 1960s.

CHEN Y.S.E., PELUSO R.A., MUREEBE A.K. (1984)
Mercury waste treatment.
In 57th Annu WPCF Conf., New Orleans, 1984, 242 - 256
The purpose of this paper is to study the characteristics and treatability of the inorganic and organic mercury-contaminated waters generated by a chemical company, to evaluate existing waste pretreatment facilities, and to design, conceptually, an efficient waste pretreatment system to reduce effluent mercury levels to within discharge limits.

ENGELHARDT H., HALTRICH W.G., WEISBRODT W. (1984)
Water quality management in the chemical industry - BASF's Ludwigshafen complex as an example - Investigations, design, operation.
Water Sci. Technol., 1984, 16, n 12, 583 - 608.

GURUNADHA RAO B.V.S., SASTRY C.A. (1982)
Low cost waste treatment methods for treatment pharmaceutical wastes.
In 8th WEDC Conf., Madras, 1982, 83 -86

HAMZA A. (1982)
Application of biofiltration to heavy Industrial wastes in Egypt.
Water Qual. Bull., 1982, 7, n 1, 13-42 (5P)

JUNKINS R. (1982)
Case history - Treatment of chemical plant wastewater.
Proc. 38th Ind. Waste Conf. Pardue Univ., 1983, 487-492
The plant studied produces polymers and numerous specialty products used in the adhesive paper, plant, and textile industries. The scope of the paper includes waste water characterization studies, treatability investigations, conceptual engineering design, and treatment plant operation.

KINCANNON D.F., ESFANDI A. (1980)
Performance comparison of activated sludge, PAC activated sludge, granular activated carbon and a resin column for removing priority pollutants from a pharmaceutical wastewater.
Proc. 35th Ind. Waste Conf. Purdue Univ., 1980, 476-483

LAWSON C.T. (1980)
Development of a biological denitrification process for a high-strength industrial waste.
Proc. 35th Ind Waste conf. Purdue Univ., 1980, 882-888.

LEIPZIG. N.A (1980)
Effectiveness of the powdered activated carbon/activated sludge system in removing ammonia from an organic chemical production wastewater.
Proc. 35th Ind. Waste Conf. Purdue Univ., 1980, 889-897.
Salsbury Laboratories (Salsbury) has presented the results of an investigation into the treatability of its chemical production wastewater. Products are specially organic chemicals and animal health products.

LEPROVOST M.I., CHALMER P.N. (1983)
Effects of trial disposal of acid-iron effluent from titanium dioxide production on the seafloor and epibenthic macroflora offshore from Koombana Bay, Western Australia.
Water Res., 1983, 17, n 10, 1309-1316

MARSTON K.R., WOODARD F.E (1984)
Treatment of high strength wastewater containing organic solvents.
Proc. 39th Ind. Waste Conf. Purdue Univ., 1984, 735-739
The purpose of this paper is to discuss the design and operation of the activated sludge system at the Millipore Corporation plant in Bedford, MA.

McLAUGHLIN H. (1980)
Wastewater treatment evaluation and redesign.
Proc. 35th Ind Waste Conf. Purdue Univ., 1980, 516-521
In 1979 Schenetady Chemicals, Inc. (SCI) initiated a program to review the operation of its wastewater treatment plant at Rotterdam Junction (RJ). This wastewater treatment review involved three phases : a) piloting of certain existing unit operations and proposed new treatment operations b)extended observation of current operations; and c) assembly of a new treatment train design.

NEWKIRK D.D., WARNER M.G., BARROS S. (1981)
Treatability studies on heavy metal removal in selected inorganic chemical industries.
Proc. 36th Ind. Waste Conf. Purdue Univ., 1981, 17-28.
Treatability studies were conducted by Jacobs Engineering Group Inc. (pasadena, California) to evaluate the effectiveness of untested treatment technologies on the removal of heavy metals for seven inorganic chemical manufaturing industries.

PODUSKA R.A. (1979)
Operation, control and dynamic modeling of the Tennessee Eastman Company industrial wastewater treatment system,
Proc. 34th Ind. Waste Conf. Purdue Univ., 1979. 167-183
This paper describes the operation and control techniques utilized in the treatment system that ate significant for maintaining effluent quality. A dynamic mathematical model also been developed for this treatment system and verified using operating results.

RABOSKY J.G., SCHULIGER W.G. (1982)
Water and wastewater survey for the Brazilian Merck, Sharp and Dohme chemical and pharmaceutical plant.
Proc. 37th Ind. Waste Conf. Purdue Univ., 1982, 259-270

REYNOLDS L.F., WILLIAMS B.R.H., HARRISON D.W. (1985)
The treatment and disposal of complex organic effluents.
Water Pollut. Control, 1985, 84, n 2, 251 - 261
This paper outlines the ICI approach, illustrates particular aspects by example, and assesses the implication of future legislative trends.

SHAUL G.M., BARNETT M.W., NEIHEISEL T.W., DOSTAL K.A. (1983)
Activated sludge with powdered activated carbon treatment of a dyes and pigments processing wastewater.
Proc. 38th Ind. Waste Conf. purdue Univ. 1983, 659 - 671.

SUBRAHMANYAM P.V.R., KHADAKKAR S.N., CHAKRABARTI T. (1982)
Wastewater treatment of a phtalate plasticizer, ethanolamine and morpholine manufacturing plant: a case study.
Proc. 37th Ind. Waste Conf. Purdue Univ. 1982, 13- 20
This investigation involved : (1) determination of flow and pollution loads contributed by wastewaters from each unit: (2) treatability studies on the wastewaters; and (3) bench -scale studies, the data from which are to be used for scaling up the treatment process.

WYKPISZ A.C. (1980)
Ultrafiltration system for latex paint wastewater treatment
Proc. 35th Ind. Waste Conf. Purdue Univ., 1980, 416-424
A Romicon ultrafiltration pilot system was chosen for testing at DeSato's Chicago Heights Plant to determine the feasibility of an ultrafiltration system for latex paint wastewater treatment.

ZAMELIN V.I. (1982)
Protecting surface waters against industrial emissions from chemical fiber plants.
Sov. J. Water Chem. Technol., 1982, 4, n 3, 77 -81.

TANNING INDUSTRY

Books:

BARBER L.K., RAMIREZ E.R., ZEMATTIS W.L. (1979)
Processing chrome tannery effluent to meet best available treatment standards.
Cincinnati,EPA, 1979, 600/2-79-110,162 P
To satisfu stream discharge requirements at it Winchester, N.H., chrome tan shearing tannery, the A.C. Lawrence Leather Co., Inc, selected primary and secondary systems. Primary clarification is accomplished by means of coagulation and flotation. The secondary biological section is a so-called CARROUSEL. This report presents these data and describes the design and operation of the system.

CARRE M.C., VULLIERMET A., VULLIERMET B (1983)
Tannery and the environment.
Lyon, CTC, 1983, 452 P
This book looks at the actual impact of tannery discharges of various pollution loadings on the natural environment and considers the following areas : Biodegradeability and biodegradation, ecotoxicity, nitrogenous pollution, bacterial pollution, carbonaceous pollution, water-soil interactions.

MASSELLI J.W., MASSELLI N.W., BURFORD M.G. (1958)
Tannery wastes -Pollution sources and methods of treatment.
Boston, New England Interstate Water Pollut. Control Comm., 1958, 41 P
The main effect of this report is to provide an insight into the processes and process chemicals used by the tanning industry and to determine the sources and nature of the major pollution loads from tannery wastes. The systems of tannery waste treatment are discussed and methods of planning and facilitating a tannery waste survey are outlined.

PARKER E. (1970)
Anaerobic - aerobic, lagoon treatment for vegetable tanning wastes.
Washington EPA, 1970, WPRCRS 12120 DIK, 83 P
A field demonstration lagoon was operated at Virginia Oak Tannery, Inc., Luray, Virginia to evaluate the effectiveness of an anaerobic-aerobic lagoon in treating spent vegetable tannins blended with batepool and soak wastewaters. More over a completely mixed aeration unit was used in the laboratory to study the biological degradation of spend vegetable tannins.

POLKOWSKI L.B., BOYLE W.C., CHRISTENSEN B.F. (1978)
Biological treatment, effluent reuse and sludge handling for the side-leather tanning industry.
Cincinnati, EPA, 1978, 600/2-78-013, 258 P
An evaluation of the treatability of unsegregated, unequalized and unneutralized wastewaters from a side-leather tanning industry is presented.

RADDING S.B., JONES J.L., MABEY W.R., LIU D.H., BOHONOS N. (1978)
Assessment of potential toxic releases from leather industry dyeing operations.
Cincinnati, EPA, 1978, 600/2-78-215m 70 P
From consideration of the physical and chemical properties of the dyes, biosorption (complexing with proteinaceous material) appears to be the most likely mechanism for removal of dyes in biological wastewater treatment systems.

SAYERS R.H., LANGLAIS R.J. (1977)
Removal and recovery of sulfide from tannery wastewater
Cincinnati, EPA, 1977, 600/2-77-031, 141 P
Recovery of sulfide from tannery waste was accomplished through acidification with sulfuric acid in a closed system and removing hydrogen sulfide formed by blowing with air. Sulfide was then absorbed in caustic solution

to produce re-usable sodium sulfide/sulfhydrate liquor for the tanning un-hairing process.

THACKSTON E.L. 1973)
Secondary waste treatment for a small diversified tannery.
Washington EPA, 1973, R2-73-209, 76 P
A modified completely mixed activated sludge plant was constructed, along with facilities to handle specific problem wastes at the Alidwell Lace Leather Co. of Auburn, Kentucky. After operating for a year, an EPA survey team conducted a study which is presented in this report.

X... (1977)
Environmental impacts and policies for the EEC tanning industry.
London, Graham and Trotman, 1977, 140 P.
This report covers : the exact nature of the pollution problem; the anti-pollution technologies presently available or under development; longer-term possibilities for new anti-pollution techniques, the relevant environmental legislation and norms, the economics of anti-pollution measures.

X... (1977)
Economic impact analysis of final pre-treatment standards on the leather tanning and finishing industry.
Washington, EPA, 1977, 440-2-77-003, 100P
This document estimates the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effects of alternative approaches in terms of product price increases, effect upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

PAPERS:

BAILEY D.G., TUNICK M.H., FRIEDMAN A.A. REST G.V. (1983)
Anaerobic treatment of tannery waste
Proc. 38th Ind. Waste Conf. Purdue Univ., 1983, 673-682
This paper describes the results of studies that were designed to evalulte : (1) anaerobic roughing treatment of tannery wastewaters: and (2) the amenability of resulting anaerobic effluents to subsequent aerobic polishing.

BISHOP P.L. (1978)
Physicochemical pretreatment of wastes from a secondary tannery.
Proc. 33 re Ind. Waste Conf. Purdue Univ., 1978, 64-72/

CHEDA P.V., MANDLEKAR U.V., HANDA B.K., KHANNA P. (1984)
Joint wastewater management for a cluster of tanneries at Kanpur.
Proc. 39th Ind. Waste Conf. Purdue Univ., 1984, 151-162.
The management scheme includes appropriate cost-effective pretreatment arrangements to preclude conditions leading to the formation of lime mortar in the conveyance system,optimal design of wastewater treatment system incorporating a carrousel oxidation ditch. Also included in the management scheme in the design of a chromium recovery system. The paper also presents detailed cost analysis along with the guidelines for the apportionment of annual financial burden to contributing tanneries based on "Polluter-pays" principle.

COLLIVIGNARELLI C. BARDUCCI G. (1984)
Waste recovery from the tanning industry.
Waste Manage. Res., 1984, 2, n 3, 265-278.
This paper illustrates the main recovery techniques concerning the by-products of the tanning industry, a sector which is particularly suitable for recovering the values in waste.

COOPER D.E., RANDS M.B., WOO C.P. (1975)
Sulfide reduction in fellmongery effluent by red sulfur bacteria.
JWPCF, 1975, n 8, 2088-2100
This paper describes how, in the difficult field of fellmongery waste treatment, red photosynthetic sulfur bacteria

have been shown to reduce significantly the total sulfide in a lagoon receiving settled fellmongery effluent.

DRIOLI E. (1980)
Membrane processes for pollution control and recovery of reagents in the tannery industry.
In "Clean Technol", The Hague, 1980, 829-836.
Pressure driven membrane processes have been used for separating and recovering chemical species from two of the most polluting streams: the dehairing and the degreasing wastewater discharge. Three years of continous operation confirm the possibilities of the ultrafiltration in the rationalization of the leather production system.

FORSTER H.W. (1975)
Dewatering of tannery sludge.
30th conf. Purdue Univ., 1975, 1082-1085
When the S.B Foote Company tannery in Redwing, Minnesota was confronted with the necessity of dewatering their sludges in 1966, various methods and systems were investigated. A review of the processes revealed the success of the C. Freudenberg Tannery at Schoenau, Germany. This tannery uses the "Pressure Filtration Process," resulting in higher cake solids concentration than experienced before and, in additon, produces a filtrate extremely low in suspended solids.

HAGGER M.J., ROETS S.D. (1980)
Physical-chemical treatment of combined tannery wastewater to achieve acceptance for discharge to municipal sewer.
In Proc. Conf. IWPC, Pretoria, 1980, 50 P.
The main objectives of this paper are : to determine the characteristics of the wastewater, to carry out in-house process modification and to determine the commercial practicability, of such changes, to suitable methods of effluent pre-treatment, to investigate the influence of discharging the tannery effluent into sewer.

KASHIWAYA M., YOSHIMOTO K. (1980)
Tannery wastewater treatment by oxygen activated sludge process.
JWPCF, 1980, 52, n 5, 999-1007.
The authors compare three systems : Unox, Marox and Ebara, and present the experimental results of pilot plants operations.

NEMEROW N.L., WARNE D., FALK F. (1978)
A new and effective solution for treatment of tannery wastewaters.
Proc. 33rd Ind. Waste Conf. Purdue Univ., 1978, 596-603
This paper discusses the solution adopted by the Moench Tanning Company, located in the Village of Gowanda, New York.

O'NEILL E.T., CASTRANTAS H.M., KEATING E. (1978)
Tannery waste streams meet effluent regulations using hydrogen peroxide
Proc. 33rd Ind. Waste Conf. Purdue Univ., 1978, 471-478
This paper discusses the case studies on the use of hydrogen peroxide for sulfide control at two leather companies.

PANZER C.C., KOMANOWSKY M., SENSKE G.E. (1980)
Improved performance in combined nitrification/denitrification.
Proc. 35th Ind. Waste. Cont. Purdue Univ., 1980, 105-113.
The purpose of this paper is to describe results of a research on combined nitrification dentrification by the Carrousel system.

PETRILLO G. (1984)
Filtration of tannery sludges following a chemical-biological treatment.
In Proc. "Environ. Manage. Dev. Ctris," Istanbul, 1984, 11P
This paper describes the treatment works adopted in Italy, by "Concei a Maffei" located at Montoro Superiore, Avellino.

SRINIVAS M., TEEKARAMAN G., AHMED N.F. (1984)
Groudwater pollution due to tannery effluents in North Arcot district Tamil Nadu.
In Proc. Conf. "Environ. Manage. Dev. Ctries," Istanbul, 1984, 11P
In this present paper, an attempt is made to assess the extent of damage caused by the effluents of tanneries to the groundwater resources and agriculture.

THACKSTON E.L. (1973)
Secondary treatment of waste from a alum tannery
Eng. Bull. Purdue Univ., 1973, n 142, 881-893
The Caldwell Lace Leather Company, of Auburn, Kentucky, is unusual, and possibly unique, in that all three major tanning process -chrome tanning, alum tanning and vegetable tanning- are carried out at the sme location. The characteristics of the different waste streams and the treatment methods were investigated. This paper reports the results of the research.

THORSTENSEN T.C., SHAH M. (1979)
Technical and economic aspects of tannery sludge as a fertilizer.
JALCA, 1979, 74, 14-23.
A technical and economic evaluation indicates that tannery sludge has definite value as a fertilizer based on its nutrient content. The presence of toxic chemicals may restrict its use to nonagricultural applications. Regulations regarding fertilizer marketing are reviewed.

VULLIERMET B. (1980)
Improvement of the mass and energy balances in the tanning industry
JALCA, 1980, 75, 232-275
After an introduction on the impact of the tanning industry on the natural environment (especially its toxic effect) this lecture discusses the interaction between the mass and energy balances in the industry and the conditions for improving them.

ELECTRO - CHEMICAL INDUSTRY

BOOKS:

CHERRY K.F. (1982)
Plating waste treatment.
Sevenoaks, Butterworth Group/Ann Arbor Sci. Publ., 1982, 333 P.
Each topic chosen for discussion in this book is designed to give an understanding of the practical applications of important concepts. Advantages and problems, from both the operational and economic perspective, are presented to assist in making a reasonable selection of a waste treatment or resource recovery system.

CUSHNIE G.C. (1985)
Electroplating wastewater pollution control technology.
Park Ridges, NDC, 1985, Pollut. Technol. Rev. n 115, 245 P
More than 27 pollution control technologies which have application to wastewaters generated by electroplating operations are presented in this practical and timely manual. Design and cost information are provided for these technologies. In addition, as section on in-plant process changes has been incorporated into the book.

E.P.A. (1985)
Environmental pollution control alternatives - Reducing water pollution control costs in the electroplating industry.
Washington, EPA, 1985, 625/5 - 85/016, 68 P.
This publication discusses the cost tradeoffs of wastewater reduction and materials recovery technologies for the electroplating industry in the context of the EPA regulations. Although it discusses sludge briefly, its primary focus is on wastewater treatment. It is designed for those who will be selecting an optimum control system for their operation.

SITTIG (1978)
Electroplating and related metal finishing.
Park Ridge, NDC, 1978, Pollut. Technol. Rev. n 46, 425 P
This book presents methods for advanced treatment and detoxification of fumes and wastewater with excellent recovery of metal values.

PAPERS

AJMAL M., NOMANI A.A., AHMAD A. (1984)
Acute toxicity of chrome electroplating wastes to microorganisms : adsorption of chromate and chromium (IV) on a mixture of clay and sand.
Water Air Soil Pollut., 1984, 23, n 2, 119-127
Chrome electroplating wastes were collected from two industrial sites and analyzed for color, turbidity, pH, alkalinity, sulfate, chloride, N-ammonia, N-nitrite, acid hydrolyzable P, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, chromate and chromium (IV). The effect of these wastes on saprophytic and nitrifying bacteria was studied with varying concentrations of the waste using sucrose substrate as a source of C chain for microorganisms. The use of clay sand mixtures as adsorbents for chromate and chromium (IV) was investigated.

ALDRICH J.R. (1984)
Effects of pH and proportioning of ferrous and sulfide reduction chemicals on electroplating waste treatment sludge production.
Proc. 39th Ind. Waste Conf., Purdue Univ., 1984, 99-112

EISENBERG T.N., BONNER W.P., CHUANG N.S.R., GUSS K.M. (1985)
An evaluation of vermiculite, ion filings, lime, sulfide, and lime sulfide in the treatment of plating rinsewaters.
Proc. 39th Ind. Waste Conf., Purdue Univ., 1985, 443-450

The purpose of this investigation was to compare the effectiveness of several treatment methods for the removal of Cr,Cu, Zn, and Ni from the discharge of a small plating company.

GABE D.R. (1988)
A positive approach to treatment effluent from electroplating processes.
In Proc. Conf., Loughborough, 1983, 291-303
The problems of treating metallurgical process effluent, arising primarily from electroplating plant, are discussed and related to their origins. Electroplating methods of recovering metal in a directly reusable form are discussed.

HUNTER J.S. (19850
Performance of buoyant media filter in metal plating shop wastewater treatment.
Proc. 40th Ind. Waste Conf. Purdue Univ., 1985, 459 - 465
The purpose of this paper is to report on a field study of a full-scale buoyant media filter used as a part of an actual metal hydroxide precipitation wastewater treatment system at a plating shop. The filter was studied both while operating as a substitute for a clarifier and while operating as a polishing filter for clarifier effluent. Its performance is compared to that of a slant tube clarifier.

JAKOBSEN J., LASKA R. (1977)
Advanced treatment methods for electroplating wastes.
Pollut. Eng., 1977, 9, n 10, 42-46
The methods must widely accepted by industry involve solvent/surfactant degreasing, oxidative destruction of cyanides, reduction of hexavalent, chrome, neutralization, precipitation of heavy metals as hydroxides, and disposal of sludge.

MALONE P.G., KARN R.A. (1982)
Toxic metal removal from electroplating wastewater using silylated silica gel.
Vicksburg, US Army Eng., Waterways Experiment Station, 1982, Misc. Pap. EL - 82-3, 30 P
This paper reports the results of an evaluation of a metal removal system for electroplating wastewater that is based on an immobilized complexing agent on a silica gel substance. The silica gel based system offers some significant advantage over currently used metal removal system.

OKAZAKI M. (1987)
Pollution abatement and control technologies for small and medium scale metal finishing industry.
UNEP Ind. Environ., 1987, 10, n 2, 23-28
This report focusses on the state of the art in measures taken for water pollution control in connection with factory siting in special designated areas, and to the provision of joint wastewater treatment plants, with particular attention to the development of the infrastructure in Tsubame City, Nigata Prefecture, where metal-finishing and allied industries are grouped and where dwelling and industrial plants are mixed.

TARE V., KARRA S.B., HAAS C.N. (1984)
Kinetics of metal removal by chelating resin from a complex synthetic wastewater.
Water Air Soil Pollut., 1984, 22, n 4, 429-439

TAY J.H. (1984)
Treatment of electroplating wastes
In 10th WEDC Conf., Singapore, 1984, 115-119

PETRO CHEMICAL INDUSTRY

BOOKS:

AMERICAN PETROLEUM INSTITUTE (1980)
Oil spills - their fate and impact on the marine environment.
London, Witherby, 1980, 30 P.
The purpose of this booklet is to outline the basic facts about what happens to oil, mainly crude oil, spilled in the open sea and in near-shore areas, and the probable consequences to the environment and to human health.

BRETON M., FRILLICI P., PALMER S. (1988)
Treatment technologies for solvent containing wastes.
Park Ridge, NDC, 1988, 770.
This book provides technical information describing management options for solvent containing wastes. These options include treatment and disposal of waste stream as well as waste minimization procedures such as source reduction reuse and recycling.

CONCAWE (1977)
Published regulatory guidelines of environmental concern to the oil industry in Western Europe.
The Hague, Stiching CONCAWE, 1977, Rep. 2, 58 P
This report deals with fuel oil sulphur content, gassoline composition, gasoline engine vehicle emissions, pipelines codes, noise control, effluent waters, and with effluent water regulation in Belgium, Switzerland, Denmark, France, Italy, West Germany.

CONCAWE (1982)
Approches to the characterisation of aqueous effluents from the oil refining industry.
The Hague, CONCAWE, 1982, n 9, 89 P.
This document covers such subjects as : chemical analysis at the micropollutant level, biodegradability, bioaccumulation, actue and chronic toxicity testing, ecological monitoring, and the assessment of mutagenic.carcinogenic potential.

CONCAWE (1984)
Trends in oil discharged with aqueous effluents from oil refinery effluents Convawe's assessment.
The Hague, CONCAWE, 1984, n 4, 13 P
This report summarizes information on Western European oil refineries wastewater quantity, oil content and treatment processes for 1981.

CONCAWE (1980)
The environmental impact of refinery effluents Concawe's assessment.
The Hague, CONCAWE, 1980, n 1, 35 P.
In this report the following aspects are covered : aqueous effluents discharged by oil refineries, ecological impact of refinery effluents in the marine and estuarine environment and in fresh water with particular reference to substances on list 1 of the EEC guidelines for water protection. The EEC Council Directives of 4 May 1976 and a glossary are given in the last chapters.

CONCAWE (1981)
The field guide to coastal oil spill control and cleanup techniques.
The Hague, CONCAWE, 1981, Rep. n 9/81, 113 P
The field Guide concentrates on reviewing typical actions that should be considered in a given situation while highlighting alternatives and identifying possible mistakes which should be avoided. It is based on the experience of spill control teams who have dealt with a great number of spill incidents both in Europe and in other areas of the world.

CONCAWE (1983)
Health and safty data sheets for petroleum products.
The Hague, CONCAWE, 1983, n 3/83, 45 P
This report presents first a survey of the current regulatory requirements and legislation for the supply of health and safety data on petroleum products in Western Europe in general and within the EEC in particular. It also covers petroleum companies procedures. Fron this analysis, in order to help develop a common oil industry approach and to minimise possible confusion due to misunderstanding in this critical area, guide lines for drafting health and safty data sheets for petroleum products are proposed. Two specimen health and safety data sheets are included as illustrations.

CONCAWE (1987)
Health aspects of lubricants.
The Hague, CONCAWE, 1987, Rep. n 5/87, 43 P
This report reviews potential health hazards of mineral base oils and types of additives incorporated in them. It also covers health aspects of bacterial contamination in lubricants containing water and the biocides used for control. Potential hazards of used and reclaimed oils are also reviewed. General recommendations on safe handling practices and precautions to avoid adverse health effects are provided but it is emphasised that specific advice on individual products should be obtained from the suppliers.

CONCAWE (1985)
Trends in oil discharged with aqueous effluents from oil refineries in Western Europe.
La Haye, CONCAWE, 1985, Rep. n 8/1985, 15 P.
This report summarizes the information gathered in a 1984 survey of CONCAWE'S Western European oil refineries effluent water quantity, oil content and treatment processes. It compares the 1984 data with the results of previous surveys, and shows that the trend towards reduction of oil discharges continued during 1984, although crude throughput remained essentially at previous levels. The report shows that refinery water is now being now being more efficiently used and more effectivelly treated before discharge. Not only has the total quanitity of aqueous effluent discharged fallen significantly, but the average oil content of the effluents has also fallen. Furthermore, it also shows that the ratio of oil discharged to oil processed has fallen by half since 1981. The report indicates that around 70% of the refineries now include biological treatment in their wastewater treatment facilities.

CONNER W.G., ALKON P.U. (1978)
Oil spill workshop
McLean, The Mitre Corporation, 1978, MTR 7843, 487 P
This document presents the final results of a workshop on oil spill ecological damage assessment held at Harrford, Connecticut, during 28-31 August 1977. The principal aim of the workshop was to identify scientific needs and capabilities to be incorporated into a regional response plan for assessing the ecological damage due to major oil spills.

COSTLE D.M., JORLING T.C., ERICKSON A.J. (1977)
Petroleum refining industry, Interim final supplement for pretreatment to the development document.
Washington, EPA, 1977, 440/1-76-083A, 125 P.
Supporting data and rationale for development of pretreatment levels based on best practicable pretreatment technology are contained in this report.

DICKERMAN J.C., RAYE T.D., COLLEY J.D., PARSONS R.H. (1977)
Industrial process profiles for environmental use : Chapter 3 - Petroleum refining industry.
Cincinnati, EPA, 1977, 153 P.
The petroleum refining industry is involved primarily in the conservation of crude oil into more than 2500 products including liquefied petroleum gas, gasoline, kerosene, aviation fuel, diesel fuel, a variety of fuel oils, lubricating oils, and feedstocks for the petrochemical industry. The industry is discussed in five segments : crude separation, light hydrocarbon processing, middle distillate processing, residual hydrocarbon processing, and auxilary processes. Four process flow sheets and 32 process descriptions characterize the industry. For each process description, available data is presented on input materials, operating parameters, utility requirements,

and waste streams.

ENVIRONMENTAL PROTECTION AGENCY (1979)
A small oil spill at west Falmouth.
Washington, EPA, 1979, 600/9 -79-007, 31 P
This is a report about oil and its effects in marine environments, a technically complex subject that is further shrouded by controversy between conflicting interests. This report focuses on an investigation of a modest oil spill which occurred at West Falmouth, Massachussetts in September, 1969.

JOHNSTON, C.S., MORRIS R.J. (1980)
Oily water discharges, Regulatory, technical and scientific considerations.
London, Applied Sci. Pub., 1980, 223 P.
This book contains papers presented at a seminar organised in 1978 by the Institute of Offshore Engineering, Edinburg, Scotland, to consider the potential environmental risk from the discharge of the oily water effluents. It covers such topics as : the Paris Convention and its relation to North Sea oil developments, sources and effects of oil in the marine environment: contorl technology/performance at the new onshore oil terminals and offshore installations; criteria and methodology for monitoring oily water emission.

JONES H.R. (1971)
Environmental control in the organic and petrochemical industries
Park Ridges, NDC, 1971, 260 P
This book is another one in the series dealing with environmental contamination problems. The present treatise aims to provide helpful directions for the proper handling of waste materials from chemicals manufacture by the petroleum industry. Chemical, technologial, statistical, mineralogical, zoological, pharmacological and medical, as well as legal and legislative sources have been consulted. Great pains have been taken to explain what measures can be applied by the industry to prevent further contamination of the environment.

JORDAN R.E., PAYNE J.R. (1980)
Fate and weathering of petroleum spills in the marine environment.
Ann Arbor, Ann Arbor Sci. 1980, 184 P.
The literature review exposes as much pertinent information as possible on the various chemical and physical alterations occuring to petroleum as a result of natural processes. Biological effects of petroleum hydrocarbon spills are not considered in detail.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (1982)
Ecological study on the Amoco Cadiz oil spill.
Rockville, NOAA, 1982, 488 P.
A workshop was held in Charleston, South Carolina, on September 17-18, to report on the physical and chemical studies. A second workshop was held in Brest, France, on October 28-30, 1981, to report on the biological effects studies. This document is the report of those workshops and forms the body of the final report to Amoco from the Joint NOAA/CNEXO Scientific Commission.

OYEZ INTERNATIONAL BUSINESS COMMUNICATION Ltd (1978)
First European Forum on waste water treatment in the petro-chemical industry.
London, OYES IBC, 1978, 96 P.
Petrochemical effluents : environmental impact and legislative measures - The use of biochemical systems for the treatment of petrochemical wastewaters - Gravity separation, flocculation and floatation - Petrochemical effluent treatment : present situation and development of technology. Future of wastewater treatment - A contribution on recent experiences with refinery effluent in Southampton water - Recovery and reclamation - The attitudes of the U.K. Water Authorities.

SITTIG M. (1978)
Petroleum refining industry - Energy saving and environmental control.
Park Ridge, NDC, 1978, Pollut. Technol. Rev. n 39, 380 P
Many approaches to saving energy and avoiding pollution in petroleum refineries are presented in this volume,

which is based upon various technological studies and sixteen US patents.

TRACY H.B. (1981)
Contingency plan for spills of oil and hazardous substances.
Washington, DEP, Ecology, 1981, 260 P.
This study includes a) preparation of a concept of the state water plan. b) preparation of an outline of the state water plan. c) preparation of the schedule for state water plan formulation. d)review and comment on value of selected reports to state water plan preparation, e) recommendations on responsibilities for initiating and funding projects, and f) evaluation of the Washington State Department Water Resources capability to accomplish the state water plan formulation.

VANDERMEULEN J.H., HRUDEY S.E. (1987)
Oil in freshwater : chemistry , biology, countermeasure - Proceedings of the Symposium on Oil Pollution in Freshwater, Edmonton, Alberta, Canada 15-19 October 1984.
Oxford, Pergamon Press, 1987, 525 P
The first published summary of the behavior and effects of oil in freshwater, this volume addresses the various aspects of oil contamination in rivers, lakes, drinking water and groundwater. It includes the chemistry of oil in freshwater, its physical fate and distribution, microbial degradation, biological effects and toxicity, and countermeasure technology.

WILKINS G.F. (1977)
Industrial process profiles for environmental use : Chapter 2 - Oil and gas production industry.
Cincinnati, EPA, 1977, 600/2 - 77/023b, 130 P
The oil and gas production industry is discussed in five segments : 1) exploration and site preparation, 2) drilling, 3) crude processing, 4) natural gas processing, and 5) secondary and teritary recovery. Two process flow sheets and twenty process descriptions have been prepared to characterize the industry. Within each process description available data have been presented on input materials, operating parameters utility requirements and waste streams.

WEINSTEIN N.J. (1974)
Waste oil recycling and disposal.
Cincinnati, EPA, 1974, 670/2 - 74 - 052, 342 P
This study has developed information on sources and quantities of waste oils, current and potential recycle and disposal methods, and the environmentla impact of these methods. In addition to an extensive literature search, surveys (of refiners, collectors and processors, the Pittsburg Pennsylvania Metro area and Standard Industrial Classification groups) were conducted to develop information reporter.

PAPERS:

BENGSTON H.H., CANNON C.E. (1989)
MCRT for control of cokemaking wastewater treatment.
JWPCF, 1989, 60, n 8, 1454-1456.
The study is based on operating data from the first 11 months of plant operation. Analysis of the operating data showed effluent SS discharge to correlate with MCRT much better than with FM radio; as a result, the treatment plant is now operated with MCRT as the control parameter.

BLAIM H., SEILER H., BAUMGARTEN J. (1984)
Microbial population in an activated sludge treatment plant of a chemical combine.
Z. Wasser Abwasser Forsh., 1984, 17, n 2, 37-41
This paper reports on a study of two effluent treatment reactors at a chemical combine that has been conducted over a period of several months in order to identify the dominant groups of microorganisms at the generic level.

BROWN K.W., DONNIELLY K.C., THOMAS J.C., DAVOL T.P. (1986)
Mutagenic activity of soils amened with two refinery wastes.
Water, Air Soil Pollut. 1986, 29, n 1, 1-13.
The mutagenic potential of the acid base, and nuetral fractions of petroleum sludge amended soil was determined using the Salmonella/microsome assay and Aspergillus methionine assay.

DAVIES R., CURTIS R.E., LAUGHTON R.V. (1985)
Hayes Dona ultrafiltration system.
Proc 32nd Ontario Ind. Waste Conf., Toronto, 1985, 191-208
Plant operating results of a full scale facility.

FARRAN A., GRIMALT J., ALBAIGES J. (1987)
Assessment of petroleum pollution in a Mexican river by molecular markers and carbon isotope ratios.
Marine Pollut. Bull., 1987, 18, n 6, 284-289
The authores report in this paper the application of the molecular characterization of sedimentary hydrocarbons and analysis of carbon isotope ratios, for the assessment of petroleum pollution in the Coatzacoalcos river (Veracruz, Mexico)

GADJIEV V.G., CHIAN E.S.K. (1976)
Advanced waste treatment of oily wastewater
Proc. 31st Ind. Waste Conf. Purdue Univ., 1976, 965-974
The purpose of this laboratory study was to evaluate the potentials of various physical chemical process in treating oily wastes originating from one of the world's largest aerosol manufacturing plants.

GARDNER D.A., SUIDAN M.T., KOBAYASHI H.A. (1988)
Role of GAC activity and particle size during the fludized-bed anaerobic treatment of refinery sour water stripper bottoms.
JWPCF, 1988, 60, n 4, 505-513

GYUNTER L.I., SHATALAEV I.F. (1986)
Prevention of water pollution by wastewater of the petrochemical industry.
Water Resour., 1986, 13, n 2, 206-213.

HAKANSSON H. JERNELOW A. (1977)
Petroleum and petrochemicals.
IVL, 1977, n B 346, 36 P
In the paper a division of the field is made into crude oil, petrochemicals and final use of the products. Within each of these, special emphasis is paid to the biological, ecological and medical effects of the chemical compounds. Finally, the use of petochemical products is treated. A brief summary of the effects on the environment caused by the combustion of oil and its products is given.

HOMODA M.F., AL-HADDAD A.A. (1987)
Investigation of petroleum refinery effluent treatment in an aerobic fixed-film biological system.
The objectives of this study were to determine the feasibility and design parameters for using an ASFF reactor to treat petroleum refinery wastewater

HEADWORTH H.G., CULLEN J. (1986)
Water abstraction and pollution controls for on-shore oil exploration and development.
J. Inst. Water Eng. Sci., 1986, 40, n 3, 263-270
This paper describes how Southern Water Authority seeks to avoid the risk of pollution, and it comments on the legal controls over the abstraction of water and the prevention of pollution in relation to on-shore oil exploration activities.

McTERNAN W.F., KING P.H. (1987)
Removal of toxic materials from in situ tar sand process water.
J. Energ. Eng., 1987, 113, n 3, 79-91.
This paper reviews the coagulation experiments completed. Additional data are presented which descibe powdered activated carbon adsorption of coagulated effluents, various analytical resultsm and some toxicological experiments used to characterize the raw and treated waters as well as assisting in defining treatment process efficiency.

METCALFE C.D., SONSTEGARD R.A., QUILLIAM M.A. (1985)
Genotoxic activity of particulate material in petroleum refinery effluents.
Bull. Environ. Contam. Toxicao., 1985, 35, n 2, 240-248.
The purpose of this study was to evaluate the genotoxic hazard associated with the discharge of suspended particulates in oil refinery effluents.

MOURSY A.S., EL-ABAGY M.M (1982)
Biodegradability of hydracarbons in the refinery wastewater form Moustorod Oil Refinery.
In "Manage. Ind. Wastewater Dev. Nations", Oxford, Pergmon, 1982, 453-466.

MUELLER J.A., WU K.B., KAEZMAREK S. (1985)
Nitrification in refinery wastewater treatment.
Proc. 40th Ind Waste Conf. Purdue Univ., 1985, 507-522.
The purpose of this paper is to compare the nitrification performance of different activated sludge systems, to identify the dynamic responses of nitification under feed quality upsets, and to examine the resilliency of the process.

INCINERATION

Books:

A.S.M.E. (1984)
1984 National waste processing conference.
New York, ASME, 1984, 700 P.
Planning - Design - Operating experience - Air pollution control - Hazardous waste - Mechanical processing - Refuse and ash handling - Miscellaneous topics.

ACKERMAN D.G., SCINTO L.L., BAKSHI P.S. (1983)
Destruction and disposal of PCBs by thermal and non-thermal methods.
Park Ridge, NDC, 1983, 416 P.
Thermal methods : Introduction, thermal destruction technology, administrative requirements, evaluation of Annex I incinerators, evaluation of high efficiency boilers, the PCB regulations - Non-thermal methods : development of evaluation criteria, a review of potential non-thermal disposal methods, evaluation of physicochemical processes, evaluation of biological processes, comparison of thermal and non-thermal methods, approval process for alternative PCB disposal methods.

TD811.5 B78
BRUNNER, CALVIN R. (1989).
Handbook of Hazardous Waste Incineration.
TAB Professional and Reference Books, Blue Ridge Summit, PA, 1989, 388 P.
Hazardous waste - Incineration.

EXNER J.H. (1982)
Detoxication of hazardous waste.
Butterworth, Ann Arbor Sci., 1982, 373 P.
The book is divided into four sections : Incineration and waste management - Treatment, recovery and destruction of PCB - A case study of the destruction of dioxins - The biological detoxication potential of genetic engineering, microbial and enzymatic techniques.

LAGREGA M.D., LONG D.A. (1984)
Toxic and hazardous wastes.
Lancaster, Technomic, 1984, 294 P.

MAJUMDAR S.K., MILLER E.W. (1984)
Hazardous and toxic wastes. Technology, management and health effects.
Harrisbourg, Pennsylvania Acad. Sci., 1984 440 P.
This document is divided in five parts which are : Waste types, treatment and disposal technology - Sites-distribution, selection and geological considerations - Transportation, emergency response, and preparations - Management, regulations, and economic considerations - Environmental and health effects.

METRY A.A. (1980)
The handbook of hazardous waste management.
Westport, Technomic, 1980 448 P.
This document summarizes waste management technologies, outlines their applicability to general waste types, and presents the pros and cons of each option.

NATIONAL ACADEMY OF SCIENCES (1977)
Materials of construction for shipboard waste incinerations.
Washington, Natl. Acad. Sci. 1977, 250 P.
Shipboard wastes : composition and definition - Combustion characteristics of wastes during combustion - Conditions inside incinerators which affect materials performance - Materials of construction - Failure modes,

systems reliability, and safety - Amelioration of conditions to favor materials performance - Testing and future experimental work.

TD811.5 O25
Ocean Incineration : Its role in Managing Hazardous Waste.
Congress of the United States, Office of Technology Assessment, Washington, 1986, 223 P.
Hazardous waste - United States - Incineration, Waste disposal in the ocean - United States.

SITTIG M. (1979)
Incineration of industrial hazardous wastes and sludges.
Park Ridge, NDC, 1979, 351 P.
This book, dealing with incineration and related combustion processes, such as pyrolysis, is especially designed to help in conforming with RCRA-based regulations. The large expanded table of contents is organized so it can serve as a subject index. It provides easy access to the information contained in this book which is based on various studies produced by and for diverse governmental agencies under grants and contracts, supplemented by pertinent U.S. patents. These primary sources are listed at the end of the volume under the heading Sources Utilized. There is also an index of patent numbers, inventors, and companies. The titles of additional publications pertaining to topics in this book are found in the text.

TD1062 T55
TILLMAN, DAVID A; ROSSI, AMADEO J; VICK, KATHERINE M. (1989).
Incineration of Municipal and Hazardous Solid Wastes / ..., Amadeo J. Rossi and Katherine M. Vick.
Academic Press, New York, 1989, 343 P.
Incineration - United States, Refuse and refuse disposal - United States, Hazardous waste United States.

YEN HSIUNG KIANG, METRY A.A. (1982)
Hazardous waste processing technology.
Sevenoaks, The Butterworth Group, 1982, 571 P.
This book is divided into two parts: Part 1 describes thermal processing technologies, covering thermal processing requirements, thermal incineration fundamentals, thermal incineration equipment, thermal incineration special topics, thermal incineration perispheral systems, and miscellaneous and developing technologies. Part 2 discusses treatment technologies, including process and site selection requirements, physical treatment, chemical treatment and biological treatment.

PAPERS:

BAKER L.E. (1978)
Incineration - Solid waste disposal.
In 1st Eur. Forum Wastewater Treat. Petrochem. Ind., 1978, 69-74.
This paper has endeavoured to cover the generalities of incineration from the waste disposal contractor's viewpoint. The detailed discussion of specific wastes, the problems associated with them, and the solutions derived have not been entered into.

BARNER H.E., CHARTIER J.S., VETTER J.A. (1984)
Overview of hazardous waste incineration technology.
In "Natl. waste proc. conf.", 1984, 535-552.

BECKER K.P., WALL C.J. (1976)
Waste treatment advances : fluid bed incineration of wastes.
Chem. Eng. Progr., 1976, 72, no. 10, 61-68.
Fluid beds, which originated from coal gasification work during the 1930s and 40s and were first used in the U.S. for producing gasoline, are now being applied to waste disposal problems.

BINDER J.J. (1984)
Considerations regarding incineration of industrial plastic and hazardous waste : a case study.
In "Natl. Waste Proc. Conf." 1984, 458-470.
This paper will review, by way of case study of a manufacturing facility in the North-east, technical, environmental, business, and economic consideration when making a decision to install and operate an on-site industrial waste incineration/heat recovery system. The case study focuses on incineration of hazardous wastes and highly chlorinated plastics. The case study examples also addresses available incineration technologies that have been demonstrated for hazardous and "special" industrial solid waste.

BRADY J.D., VAN STRATUM J.A.C. (1987)
Incineration of toxic and hazardous wastes.
In UNIDO workshop hazardous materials, waste manage. ind. safety. Vienna, 1987, 28 P.
This paper focuses on commercial incinerator designs which are available today, the important operating variables for such incinerators, and the secondary emission control systems which are employed with these incinerators. Typical process flowsheets and operating conditions are described and the resultant capital and operating costs for model plants are presented.

BRIDLE T.R., CAMPBELL H.W., SACHDEV A.K. (1983)
Thermal destruction of chlorophenol residues.
Proc. 38th Ind. Waste Conf. Purdue Univ., 1983, 299-309.
This paper describes an equipment developed which is capable of generating precise thermal data at destruction efficiencies of up to 99 %, and the use of kinetic modelling permits data extrapolation. Based on the pure chlorophenol destruction data, it is estimated that at 900° C. a gas residue time in excess of 2.8 seconds is required to ensure complete (99.99 %) destruction of both TCP and PCP. Two industrial residues chlorophenol contaminated woodchips and sludge, were also studied. For most of the tests conducted, TCP and PCP destruction efficiencies were lower than expected. Based on these studies, it is suggested that monitoring of pilot or full scale boilers or incinerators handling chlorophenol contaminated wastes include assessment of process temperatures in the range of 700-1,000° C. (if possible). It is imperative that both PCP and TCP be monitored.

BRUNNER C.R., BROWNELL R.P., ROWLAND J.R. (1984)
Pharmaceutical plant waste disposal by incineration.
In "Natl. Waste Proc. Conf.", 1984, 451-457.

CARNES R., OPPELT E.T. (1984)
A sequenced industrial waste incineration research program.
In "Hazardous and toxic wastes", 1984, 12-26.

CARNES R.A., BERGSTROEM J., AITTOLA J.P. (1986)
Industrial waste management at the Swedish facility in Norrtorp.
Waste Manage. Res., 1986, no. 4, 347-359.

CLUNIE J.F., LEIDNER A., HESTLE J.T. (1984)
The importance of proper loading of refuse fired boilers.
In "Natl. Waste Proc. Conf.", 1984, 169-177.

BARANOW S., LAI G.Y., ROTHMAN M.F. (1984)
Materials problems in incineration plants.
In "Natl. Waste Proc. Conf.", 1984, 154-168.

DUNN K.S. (1981)
Incineration of toxic industrial wastes - environmental success of failure.
Environ. Pollut. Manage., 1981, 11, no. 1, 12-16.
This paper describes the five conditions necessary if toxic industrial wastes are to be destroyed by incineration without creating further environmental problems.

DUNN K.S. (1982)
Incineration of toxic and dangerous wastes.
Environ, Pollut. Manage., 1982, 12, no. 1, 14-18.

FABIAN H.W., REHER P., SCHOEN M. (1982)
Problem chemical waste incineration with heat recovery - Part One.
Environ. Pollut. Manage., 1982, 12, no. 1, 18-22.
Incineration of waste with heat recovery is possible even when the waste give rise to corrosive effluent gases. However, care must of course be taken when designing such an installation. The No. II incinerator system at Bayer Leverkusen has been carefully designed to cope with these problems.

FABIAN H.W., REHER P., SCHOEN M. (1982)
Problem chemical waste incineration with heat recovery - Part Two.
Environ. Pollut. Manage., 1982, 12, no. 2, 51-53.
In the first part of this article, the authors discussed the various types of problematic waste which may be incinerated with heat recovery using the No. II incinerator system at Bayer Leverkusen. In this concluding part the incinerator system itself is studied in greater detail.

FERNANDES J.H. (1984)
Uncertainties and probable error involved in various methods of testing incinerator/boilers.
In "Natl. Waste Proc. Conf.", 1984, 230-240.
This paper will review the various methods for obtaining the performance of an Incinerators/Boilers with particular reference to the efficiency of the system.

HAJDU A., MATULAY S., NYIRO Z. (1988)
Experience in burning of hazardous wastes in boilers.
In "Hazardous wastes: detection, control, treatment", 1988, 1475-1485.
The subject matter of the lecture discusses the experience acquired in the course of burning pumpable hazardous waste (waste oil and ester manufacturing destillation residue) in a traditional oil-fired boiler.

HILL M., RUTKEY F. (1984)
Development of an industrial waste incineration system : pilot testing through full-scale operaton.
In "Natl. Waste Proc. Conf.", 1984, 471-477.

HITCHCOCK D.A. (1979)
Solid-waste disposal : incineration.
Chem. Eng., 1979, MAY 21, 185-194.
Thermal decomposition greatly reduces waste volume, destroys toxic organics and affords waste heat recovery. Here are selection criteria and operating parameters for the major incineration processes.

HUENING W., NENTWIG H., GOCKEL C. (1985)
Incineration of waste from a chemical plant.
Ger. Chem. Eng., 1985,8,146-151.

HUNT G.R., WOLF P., FENNELLY P.F. (1984)
Incineration of polychlorinated biphenyls in high-efficiency boilers : a viable disposal option.
Environ. Sci. Technol., 1984, 18, no. 3, 171-179.
This paper presents the results of comprehensive PCB incineration programs conducted in accordance with EPA test protocols at each of three high-efficiency boiler sites. The use of high-efficiency boilers is seen as a viable disposal option for PCB contaminated (50-500 ppm) waste oils when conducted in strict accordance with existing EPA protocols.

KORTE F., BIENIEK D. (1988)
Incineration of wastes - A solution to a present-day problem.
In " Hazardous waste : detection, control, treatment", 1988, 1381-1388.

KODRES C.A. (1984)
Numerical simulation of energy recovery incinerators.
In "Natl. Waste Proc. Conf.", 1984, 178-194.
In this paper a mathematical model is developed to simulate the dual combustion chamber energy recovery incinerator.

LANDRY J.C., SPOERLI P., BIANCO M.A. (1988)
Incineration efficiency of a rotary kiln, a case study in Geneva.
In "Hazardous waste : detection, control, treatment", 1988, 1399-1408.

LORUSSO S., MERLI F., TUPINI P.G. (1988)
The incineration of waste in Italy and related environmental problems.
In Conf. Venice, Sept. 1988.
Incineration is one of the technologies used for waste reduction with recovery of energy. An outline of the various incineration plants in Italy and the containment systems more often used, showing also the pollutants quantity produced in connection with the incinerated quantity of wastes, are here given.

MARKS C.H., GALLAGHER P.E. (1984)
Ocean incineration of hazardous wastes : regulatory aspects.
In "Natl. Waste Proc. Conf.", 1984, 553-565.
The paper reviews the various U.S. and international environmental regulations dealing with the incineration of hazardous wastes on the high seas.

MOORE W.P., CLARK A.W. (1984)
The technical and regulatory status of burning wastes in industrial boilers.
In "Toxic and hazardous wastes", 1984, 85-98.
This paper presents a comprehensive overview of the more important technical aspects of industrial boiler design and operation as they relate to the burning of waste materials in these units for heat recovery. This technical overview is followed by a brief discussion of the present regulatory status under RCRA of industrial boilers burning hazardous wastes, the future regulatory status of these units as proposed by EPA.

PHILIPBAR W.B. (1984)
Rotary reactor : a new concept for the incineration of low heat content hazardous wastes.
In "Toxic and hazardous wastes", 1984, 78-84.

PRINCETON I. (1982)
Three new ships to burn toxic wastes.
Solid wastes Manage., 1982/July, 20-53 (2 P.).

PITTS D.M., CUDAHY J.J. (1984)
Hazardous waste incineration design considerations.
In "Hazardous and toxic wastes", 1984, 28-47.
The scope of this chapter is limited to the considerations associated with the design or up-grading of a liquid injection incinerator, primarily the burner and combustion chamber.

REED J.C., TING J.C. (1984)
Application of reactor models to hazardous waste incineration tests.
In "Toxic and hazardous wastes", 1984, 108-112.

REGAN R.W. (1984)
Classification and properties of hazardous and toxic wastes.
In "Hazardous and toxic wastes", 1984, 2-11.

REYNOLDS R.M. (1988)
Incineration feasibility study for battery plant trash and crushed rubber battery cases.
In "Hazardous waste : detection, control, treatment", 1988, 1449-1470.
The purpose of this study is to investigate in detail the economic, technological and regulatory feasibility of constructing a centrally located facility to incinerate lead-contaminated battery plant trash generated by battery manufacturers and combustible lead-bearing crushed rubber scrap from battery cases generated by secondary lead smelters. This technical paper discusses the waste characterization and quantification and addresses specific regulatory requirements developed in the study. Conceptual process and plant designs are developed and a detailed conceptual plant cost estimate is given.

SENKAN S.M. (1988)
Thermal destruction of hazardous wastes.
Environ. Sci. Technol., 1988, 22, no. 4, 368-370.
The need for fundamental chemical kinetic research.

SHEA T.G., MAYHEW J.J.(1983)
A comparative assessment of incinerators versus landfills for hazardous waste management.
Proc. 38th Ind. Waste Conf. Purdue Univ., 1983, 261-171
This paper presents the findings of an investigation conducted by the Chemical Manufacturers Association (CMA) to identify and evaluate decision factors affecting the selection of landfilling versus incineration to manage hazardous wastes. The study addressed hazardous wastes from the organic chemical industry that can be managed by either technology.

SHEN T.T. (1988)
Hazardous waste incineration technologies and emission control.
In "Hazardous waste : detection, control, treatment", 1988, 1389-1408.
Incineration, whether at sea or on land, is widely accepted as a preferred method of waste management because it can provide an optimum, permanent solution to detoxication of hazardous waste. Incineration technologies and emission control equipment are commercially available to meet current regulatory requirements, but they are costly. The impact of public opposition to the siting and permitting of both land-based and ship-borne incineration operation has delayed the issuance of permits for conducting burns of hazardous waste on land and at sea.

SPAANS L. (1988)
The cease-fire in fires on the sea.
Mar. Pollut. Bull., 1988, 19, no. 6, 256-259.
Leo Spaans, of the North Sea Directorate of Rijkswaterstaat, The Netherlands, has been involved in the technical and scientific aspects of incineration at sea for ten years. During the last year he was not involved in policy-making in this field. This gives him the opportunity to give his own personal view on the recent developments.

TAYLOR P.H., DELLINGER B. (1988)
Thermal degradation characteristics of chloromethane mixtures.
Envrion. Sci. Technol., 1988, 22, no. 4, 438-447.
This paper presents the results of a laboratory thermal degradation study of chloromethane mixtures under various reaction conditions.

TIERNAN T.O., TAYLOR M.L., SOLCH J.G. (1982)
Incineration of chemical wastes containing polychlorinated biphenyls : assessment of tests conducted at rollins environmental services deer park, Texas, and energy systems company, El Dorado, Arkansas.
In "Detoxification of hazardous waste", 1982, 143-154.
This chapter describes the two incinerators used in these tests and the relevant operating parameters. In addition, the sampling and analytical procedures developed and implemented to determine levels of toxic chlorocarbons emanating from the stacks of the two incinerators during these tests are discussed. Finally, the levels of CDD/CDF that were determined to be present in the stack effluents are reported, and the results of the risk

assessment for the incinerators that was accomplished by EPA using the latter data are summarized.

SHAUB T.W. (1982)
Chemical processes in the incineration of hazardous materials.
In "Detoxification of hazardous waste", 1982, 41-45.
This chapter will begin by giving a qualitative picture of how a large polyatomic molecule breaks down under incinerator conditions from the point of view of elementary processes. The authors attempt to make these concepts quantitative, first in terms of thermodynamic equilibrium and then from a more detailed consideration of the rates of the pertinent elementary processes then they will pay particular attention to sources of data and the availability of estimation schemes. Finally, they will list a number of unanswered questions and suggest certain types of experiments that will help provide a proper methodology and data base for design and operational purposes in the incineration of hazardous wastes.

VANDER VELDE G., GLOD E., NASSOS G.P. (1988)
Ocean incineration : the European experience.
Waste Manage. Res., 1988, 6, no. 1, 70-79.
Ocean incineration has a unique place in the treatment of hazardous waste, being especially suited for environmentally persistent and toxic organochlorine waste. Despite an extremely positive experience in Europe since the early 1970s and a need for additional incineration capacity in the U.S., the regulatory process for permitting this technology in the U.S. has been slow and deliberate. This paper reviews shortly the present knowledge.

WEETER D.W. (1984)
Utilization of an industrial waste oil as an alternative feel for a municipal sludge incinerator.
In "Toxic and hazardous wastes", 1984, 99-107.

YEZZI J.J., BRUGGER J.E., WILDER I. (1984)
Results of the initial trial burn of the EPA-ORD mobile incineration system.
In "Natl. Waste Proc. Conf.", 1984, 514-534.
This paper discusses the sampling and analytical methods for, the implementation of, and the results of the initial trial burn conducted with the EPA-ORD Mobile Incineration System.

LANDFILL

BOOKS :

BATSTONE R., SMITH J.E., WILSON D. (1989)
The safe disposal of hazardous wastes. The special needs and problems of developing countries. Vol. II.
Washington, World Bank, 1989, 200 P.
The chapter of this volume is concerned with technical requirement for the safe disposal of hazardous wastes.

BASS J. (1986)
Avoiding failure of leachate collection and cap drainage systems.
Park Ridge, NDC, 1986, 139 P.
This book summarizes current knowledge and experience regarding potential failure mechanisms and presents information on factors to consider in design, construction, inspection, maintenance and repair of leachate collection and cap drainage systems.
It was written to provide general guidance to design engineers, facility operators, and others involved in regulating waste facilities. It will be an important guide for those involved in the review of new and existing hazardous waste facilities.

TD811.5 H3986
BROWN, KIRK W., ed., EVANS, GORDON B., ed., FRENTRUP, BETH D., ed., ADAMS, JEANETTE (1983).
Hazardous Waste Land Treatment / Edited by Kirk W. Brown, Gordon B. Evans, and Beth D. Frentrup ; Written by J.Adams Umet Alu.
Butterworth Pub., Boston, 1983, 692 P.
Hazardous wastes, Waste disposal in ground.

CHEREMISINOFF P.N., GIGLIELLO K.A. (1983)
Leachate from hazardous wastes sites.
Lancaster, Technomic Publ., 1983, 92 P.

E.C.C. (1986)
Evaluation of leachates volumes on landfill sites.
Luxembourg, ECC, 1986, 60 P.

EHRENFELD J., BASS J. (1984)
Evaluation of remedial action unit operations at hazardous waste disposal sites.
Park Ridge, NDC, 1984, 440 P.

E.P.A. (1979)
Adapting woody species and planting techniques to landfill conditions. Field and laboratory investigations.
Cincinnati, EPA, 1979, 111 P.

E.P.A. (1979)
Investigation of sanitary landfill behavior. Vol. II.
Cincinnati, EPA, 1979, 120 P.
The two main sections of this document deal with : 1. Laboratory experimental study (column test arrangement, solid waste composition, leachate analysis, discussion of results, leachate contaminant cumulative curves, comparison of D6 leachate and D7 leachate) - 2. Field facility experimental study (deep well study, wells 12 and 13, well 3, shallow well study, ground water total dissolved solids study).

E.P.A. (1985)
Remedial action at waste disposal sites (revised).
Cincinnati, EPA, 1985, 650 P.
Remedial action selection process - Surface water controls - Air pollution controls - Groundwater controls - Gas

control - On-site and off-site disposal of wastes and soil - Removal and containment of contaminated sediments -In-situ treatment - Direct waste treatment - Contaminated water supplies and water and sewer lines.

VF 2964
KOSSON, DAVID S. : AHLERT, ROBERT A., jt. auth.(1984).
In-situ and On-situ Biodegradation of Industrial Landfill Leachate : An On-site or In-site field pilot-scale experiment demonstrates promising results for the treatment of Aqueous Hazardous Wastes / ... and Robert A., jt. auth..
s. n., S. 1., 1984, 176-182 P.
Factory and Trade waste, Sanitary landfill.

LU J.C.S., EICHENBERGER B., STEARNS R.J. (1985)
Leachate from municipal landfills. Production and management.
Park Ridge, Noyes Publ., 1985, 463 P.
Production and management of leachate from municipal landfills are evaluated in this book, for the purpose of identifying information and techniques useful to design engineers and site operators. Also assessed are : advantages, limitations, and comparative costs of various approaches for the estimation and mitigation of environmental and public health impacts, management options, and additional research needs on the generation, control, and monitoring of landfill leachates.

MICKAN B. (1987)
Parameters characterizing toxic and hazardous waste disposal sites - Management and monitoring.
Luxembourg, CEC, 1987, 219 P.
The present study summarizes the necessary criteria for toxic and hazardous waste disposal sites.

N.T.I.S. (1977)
Sanitary landfill operator's manual.
Springfield, NTIS, 1977, 134 P.
Sanitary landfills - Sanitary landfill operation - Cell construction - Roads and traffic control -- Inclement weather operations - Vector and litter control - Monitoring for leachate - Hazardous waste disposal procedure - Sewage sludge disposal in a sanitary landfill - Sanitary landfill equipment - Map reading - Osha and safety - Records - Inspections - Sources of assistance - In fine, ruls and policies in hazardous waste.

TD811.5 L365
PARR; JAMES FLOYD, 1929- , ed., MARSH; PAUL BRUCE, 1914- , ed., KLA; JOANNE M,, ed. (1983).
Land Treatment of Hazardous Wastes, Edited by James F. Parr, Paul B. Marsh and Joanne M. Kla.
Noyes Data , Park Ridge, N.J., 1983, xvi, 422 P.
Hazardous waste, Waste disposal in ground.

TD811.5 S57
SITTIG M. (1979)
Landfill disposal of hazardous wastes and sludges.
Park Ridge, NDC, 1979, Pollut. Technol. Rev. no. 62, 372 P.
In this book, the landfill technology and the directions for the disposal of unwanted hazardous and toxic substances are based on reports and guidelines mostly issued by the EPA. Excerpts from pertinent recent US patents are also included. The expanded table of contents is organized in such a way as to serve as a subject index and provides easy access to the information contained in this book. The bibliography at the end of the volume lists the important government reports under the heading sources utilized.

TD811.5 S48
SHUCKROW; ALAN J. ; PAJAK; ANDREW P., jt. auth., TOUHILL; C. J., jt. auth. (1982).
Hazardous Waste Leachate Management Manual, by ..., Andrew p. Pajak and C.J. Touhill.
Pollution Technology Review. no. 92, Noyes Data Corp., Park Ridge, N.J., 1982, xiii, 379 P.
Hazardous wastes, Sanitary landfill, Leaching.

WAGNER K., BOYER K., CLAFF R., EVANS M., HENRY S., HODGE V. (1986)
Remedial action technology for waste disposal sites.
Park Ridge, NDC, 1986, 664 P.
This book covers remedial action technology designed to control, contain, treat, or remove contaminants at waste disposal sites, particularly hazardous waste sites. The book will be a basic reference tool on remedial methods, of constant assistance to industrial and governmental officials and technical personnel who must select potentially applicable technologies and plan remedial action. The book begins with an overview of the remedial investigation/feasibility study (RI/FS) process as outlined in the National Contingency Plan (NCP). The remaining sections describe remedial technologies. The technologies are organized according to the type of site problem they are intended to remedy (e.g. surface water controls, groundwater controls). Emphasis is placed on those technologies which have been demonstrated for hazardous waste sites.

X...(1982)
Control inspection surveillance of landfill waste disposal sites. Conf. Kensington, 14th May, 1982.
Miami, Sci. Tech. Stud., 1982, 143 P.
The duties and rights of inspection : the legal requirements - Monitoring and inspection of compliance with site licensing conditions - Inspection of landfill sites - Inspection of waste; control of disposal - Inspection for compliance with section 17 regulations - How effective can inspection be ? - Legislation.

X..(1983)
Landfill completion symposium, 25 May 1983.
Harwell, Symp. 1983, 129 P.

PAPERS :

BLACK W.V., KOSSON D.S., AHLERT R.C. (1989)
Characterization and evaluation of environmental hazards in a large metropolitan landfill.
43rd Ind. Waste Conf., Purdue Univ., 1989, 147-158.

CARTWRIGHT K., GILKESON R.H., JOHNSON T.M. (1981)
Geological considerations in hazardous waste disposal.
J. Hydrol., 1981, 54, 357-369.

EDWARDS R., YACKO D.G. (1989)
Field measurement of landfill clay linear permeability.
43rd Ind. Waste Conf. Purdue Univ., 1989, 141-146.
This paper concluded that if proper construction practices are followed landfill liner permeabilities measured in the laboratory will be representative of the permeability of the actual constructed landfill liner.

EVERETT L.G., WILSON L.G., McMILLION L.G. (1982)
Vadose zone monitoring concepts for hazardous waste sites.
Ground Water, 1982, 20, no. 3, 312-324.

FISHER E.L., GRIFFITH G.T. (1989)
Design considerations for a Wisconsin paper mill landfill.
43rd Ind. Waste Conf. Purdue Univ., 1989, 123-132.
The authors present the case history of this landfill because the project has several unique features which required special design considerations. These special design considerations were required because the site did not have all of the desired locational and design features specified in the State of Wisconsin solid waste management regulations.

GHASSEMI M. (1986)
Leachate collection systems.
J. Environ. Eng., 1986, 112, no. 3, 613-617.
This technical note presents the key findings and conclusions of a recent review of available information and

experience with LCS in fullscale facilities.

JAFFE R., HITES R.A. (1984)
Environmental impact of two, adjacent, hazardous wastes disposal sites in the Niagara river watershed.
J. Great Lakes Res., 1984, 10, no. 4, 440-448.
This paper deals with a study in Niagara River at locations adjacent to the Love Canal and the 102nd Street dumps, two hazardous waste disposal sites in the City of Niagara Falls, New York. Based on the qualitative and quantitative data obtained the source of these pollutants were identified, and the relative migration of chemicals from the two dumps to the Niagara River was established.

KINCANNON D.F., LIN Y.S. (1985)
Microbial degradation of hazardous wastes by land treatment.
Proc. 40th Ind. Waste Conf. Purdue Univ., 1985, 607-619.
This paper provides a better understanding of the biodegradation of the organic constituents in land treatment of hazardous wastes. The development of kinetic constants for the assimilative capacity of a given soil under given environmental condition for designing land treatment systems is provided.

KOVACIK T.L., MOLINE D.M., MUNN P.F. (1987)
Protection of waterlines traversing a hazardous waste landfill.
JAWWA, 1987, 79, no. 2, 39-44.
This paper describes the waterline security agreement for the water plant intake lines for the city of Toledo, Ohio, passing through a privately operated hazardous waste disposal site. The waterlines security agreement described in this article was a complished outside of regulatory processes since there were no specific federal, state, or local regulations covering such a situation.

KRUG T.A., McDOUGALL S. (1989)
Preliminary assessment of a microfiltration/reverse osmosis process for the treatment of landfill leachate.
The results of this work has demonstrated the feasibility of a two steps process for the treatment of landfill leachate containing a complex mixture of inorganic and organic contaminants.

LEE G.F., JONES R.A. (1984)
Is hazardous waste disposal in clay vaults safe ?
JAWWA, 1984, 76, no. 9, 66-73.
This paper discusses the safety and adequacy of clay-lined disposal pits for containing the migration of leachates from hazardous wastes into groundwater systems. Approaches are discussed for establishing criteria for monitoring, maintenance, and remedial cleanup to ensure long-term protection of public health and the environment.

LEVINE A.D., REAR L.R. (1989)
Evaluation of leachate monitoring data from co-disposal, hazardous, and sanitary waste disposal facilities.
43rd Ind. Waste Conf., Purdue Univ., 1989, 173-182.
The objectives of this chapter are : 1) to identify significant differences in the characteristics of codisposal, hazardous, and sanitary landfill leachates; and 2) to evaluate the effectiveness of nonspecific tests to detect toxic contaminants in leachates.

PARKHURST D.F. (1984)
Optimal sampling geometry for hazardous waste sites.
Environ. Sci. Technol., 1984, 18, no. 7, 521-523.
This paper compares the use of triangular grids over square grids to search for toxic materials buried in abandoned dumps and landfills. The paper also considers whether sampling wells should be distributed regularly or randomly.

POHLAND F.G., GOULD J.P., GHOSH S.B. (1985)
Management of hazardous wastes by landfill codisposal with municipal refuse.
Hazardous Waste Hazardous Mat., 1985, 2, no. 2, 143-158.

Landfill stabilization and assimilative capacity for heavy metals originating from metal plating waste treatment sludges codisposed with municipal refuse are discussed.

PUGH M.P., RUSHBROOK P.E., PARKER A. (1985)
Design and operation of future landfills in Hong Kong.
Waste Manage. Res., 1985, 3, no. 4, 325-338.
The study was carried out to obtain cost data for use by the Hong Kong Government in the preparation of their waste disposal plan. The results of the study showed wide variations in estimated annualized costs, reflecting the range of site-specific development work required.

ROBINSON H. (1987)
Design and operation of leachate control measures at compton bassett landfill site, Wiltshire, U.K.
Waste Manage. Res., 1987, 5, no. 2, 107-122.
This paper describes the conversion of a difficult landfill, inherited by Wiltshire Country Council during local government re-organization in 1974, into a high-standard landfill, providing containment of wastes. It can now provide the capacity to continue to receive wastes for at least the next 30 or 40 years. The design philosophy and difficulties encountered during the commissioning of the plant are described in this paper.

THEIS T.L., RIPP J.A., VILLAUME J.F. (1989)
Physical and chemical characteristics of unsaturated pore water and leachate at a dry fly ash disposal site.
In 43rd Ind. Waste Conf. Purdue Univ., 1989, 161-167.
The purpose of this chapter is to present information on the design, construction, and instrumentation of the test cell and the current hydrophysical and chemical data from the site.

ZIRSCHKY J.H., HARRIS D.J. (1986)
Geostatistical analysis of hazardous waste site data.
J. Environ. Eng., 1986, 112, no. 4, 770-784.
In 1971, dioxin contaminated wastes were dumped on a dirt farm-road in rural Missouri. Subsequent migration of the soil led to the contamination of the shoulders of an adjacent state highway. Kriging, a geostatistical estimation technique, was used to identify the sections of the highway shoulders that require cleanup. This case study indicates that kriging can be a useful technique for estimating the distribution of contaminants at a hazardous wastes site.

X...(1985)
Pitseau pioneers leachate process.
WQI, 1987, no. 1, 36-37.
Investigations into methods of handling surplus leachate at an industrial waste site have led to design features new to Britain.

X...(1985)
Remedial response at the Richmond, California hazardous waste site.
Waste Manage. Res., 1985, 3, no. 1, 9-25.
This paper describes the installation of a subsurface clay barrier wall and dike around an existing coastal landfill to prevent leachate from entering San Francisco Bay. Coasts, equipment used and method of construction are reported in detail.

SOFTWARES FOR MANAGEMENT OF HAZARDOUS WASTES AND INDUSTRIAL RISKS

BOOKS :

FEDRA K., SCHNEIDER J., DITTERICH K (1987)
Advanced decision-oriented software for the management of hazardous substances. A survey of software and sources of information.
Luxembourg, Off. Publ. Europ. Communities, 1987, 64 P.
The objectives of this report is to design and develop an integrated set of software tools, adapted even for non technical users. This report is a state-of-the-art survey including : Categories of hazardous substances - Lists of hazardous substances and the industries releasing the wastes - Institutions, regulations and directives - Data base and a collection of models - Methods for comprehensive assessments.

FEDRA K., WEIGKRICHT E., WINKELBAUER L. (1987)
A hybrid approach to information and decision support systems : hazardous substances and industrial risk management.
Laxenburg, IIASA, 1987, RR-87-12, 10 P.
This document describes a large scale, model-based decision support system with embedded Artificial Intelligence (AI) technology, and a largely symbolic color graphics user interface. Designed for industrial risk assessment and the management of hazardous substances, its primary purpose is to allow the efficient use of methods of analysis and information management and to provide a power full tool in the hands of planners, managers, policy and decision makers. This new generation of model-based decision support system should lead to a more informed, structured, comprehensive and interdisciplinary management of hazardous substances.

PAPERS :

AMBROSE R.B., BARNWELL T.O. (1989)
Environmental software at the U.S. Environmental Protection Agency's Centre for exposure assessment modelling.
Environ. Software, 1989, 4, n° 2, 76-91.
This paper has reviewed 12 simulation models available from EPA's Centre for exposure assessment modelling. The software is completely in the public domain and source code is provided with the programs. Users are encouraged to register with the CEAM in order to receive continuing information on software update and training opportunities.

ANTOENLLO F., CORILIANO L. (1987)
Approach to identify potential sources of accident emergency plan and accident response at "Montedipe".
In world Conf. "Chemical accidents", Rome July, 1987, 121-125.
MONTEDIPE, the petrochemical company of the Montedison Group, has developed some practical approaches to identify potential sources of accidents and their consequences. The setting up of emergency plans to control the events and to mitigate their consequences as well as the tank truck accident response arc features of MONTEDIPE's concern.

ARGENTESI F., BOLLINI L., FACCHETTI S. (1987)
CHEM : an expert system for the management of chemical accidents involving halogenated aromatic compounds.
In World Conf. "Chemical Accidents", Rome July, 1987, 227-230.
At present CHEM is capable of dealing with the most common types of accident involving PCB. The current implementation is still to biased towards the present state of the accident with a limited evaluation of the time evolution of the threat. Adaptation of the knowledge base, which will take in to account the time dependent character of the threat are in progress. These adaptations are based on the established concepts of migration

routs and targets. CHEM is designed for the following types of organizations : Local authorities - Large industrial facilities - Civil protection- Defence.

CRINER G.E., McPARTLAND M.E. (1987)
Economic evaluation of waste treatment projects with microcomputers.
Biocycle, 1987, 28, n° 10, 39-41.
The microcomputer spread sheet program described in this paper will yield valuable economic information quickly and may held end the era of "back of the envelope" economic analysis.

CHOUDHARI S.R., MODAK P.M. (1989)
The low- and non-waste technology database at the Centre of Environmental Science and Engineering, Bombay.
UNEP Ind. Environ., 1989, 12, n° 1, 48-54.
Methodology - Characteristics of the LNWT database - Utilization of the database.

FEDRA K. (19880
Information and decision support system for risk analysis.
Laxenburg, IIASA, 1988, 6 P.
Risk analysis and risk management, designed to control and minimize these risks, involve numerous information processing aspects of considerable complexity, and as a consequence, induct the use of computers. Computer systems designed to provide information and decision support, not only during operation, but primarily in the design and planning stage of hazardous installations and the handling of hazardous materials, that extensively use data bases, models, and the proper use and interpretation of results. Some of these questions are discussed in this paper.

FEDRA K. (1988)
Modelling chemical production : software tools for risk analysis.
Laxenburg, IIASA, 1988, 13 P.
Industrial risk management is a complex procedure. To truly support this task, computer-based tools should make it easier for planners and decision makers, and not add the complexity of using sophisticated computer models and techniques of analysis and information retrieval to the already demanding task. User friendliness, ease of operation, directly understandable and directly useful formats are therefore important components of any practical information and decision support system.

GALATOLA E. (1987)
SONATA : an accident database for industrial activities and transport. Scope, organization and main results.
In World Conf. "Chemical accidents", Rome July 1987, 117-120.
An accident database is a collection of information about accidents which have happened. In order to better define such a database it is first of all necessary to define the word accident. The database discussed in detail in this paper.

GIGUERE P.R. (1989)
Advancing computerized planning for wastewater collection.
Water Eng. Manage., 1989, 136, n° 4, 24-27.
Continued advances in computer software and hardware are making wastewater collection study projects easier and more productive.

KERPELMAN C. (1988)
International disaster management information network.
Confluence, 1988, n° 12, 8-10.
The office of the United Nations Disaster Relief Co-ordinator (UNDRO) serves as the focal point within the United Nations system for the collection and dissemination of disaster-related information. In order to fulfil this role, UNDRO's Data Processing and Communication Unit has developed, over the last few years, an up-to-date computerized Disaster Management Information System. The author presents this system.

VALENTINETTI R. (1989)
Site program demonstration of the CF system Inc. organic extraction unit.
In 3rd Int. Conf. on new frontiers for hazardous waste management, Pittsburg, September, 10-13, 1989, 425-433.

WHITE S.L., JOHNSON R.R. (1986)
A software solution for environmental information : a case study on waste management.
Environ. Software, 1986, 1, n° 2, 82-89.
The modular ECOTRACTm system enables users to customize a system to their data management needs. Based on dBase IIItm, the system offers the flexibility to meet specific needs without extensive programming or computer knowledge. Standard reports allows consistent and timely reporting to management and regulatory authorities. Case studies demonstrate efficiencies gained through use of commercially available environmental data management software for microcomputers. ECOTRACTm software has proven useful to a variety applications, and has been favorably received by independent technical reviewers.

X...
Advanced computer applications (ACA)
Laxenburg, IIASA, 4 P.
The ACA project integrates several completely externally funded research and development projects in the field of model-based decision support and applied Artificial Intelligence (AI). The project's results are customized software systems, implemented at client institutions, as well as more general methodological contributions; The intended users of the results, other than the well-defined clients and sponsors, are decision and policy makers and their technical and scientific advisors at the level of international, national, and regional institutions, governments as well as industries.

CRITERIA OF RISKS - RISKS ASSESSMENT

BOOKS :

CALABRESE E.J. (1978)
Pollutants and high-risk groups. The biological of increased human susceptibility to environmental and occupational pollutants.
Chichester, Wiley, 1978, 282 P.
The book opens with a comprehensive, state-of-the-art synthesis of the relevant bio-medical literature. It gives indepth consideration to those biological factors that predispose certain individuals to the effects of pollutants. Later sections present not only the currently recognized high-risk groups, but also identify several new ones; nearly each section contains some theoretical high-risk groups which must be tested to verify the proposed hypothesis. The book then reviews the likelihood of medical surveillance for high-risk groups, with special regard to the industrial setting. Additionally, it interprets the role of high-risk groups in the development of environmental and occupational health policy as it relates to standard setting (environmental and occupational; carcinogens and noncarcinogens), economic health cost and assessment, environmental impact statements, and the new toxic substances control act.

CARDWELL R.D., PURDY R., BAHNER R.C. (1985)
Aquatic toxicology and hazard assessment - 7th symposium, Milwaukee, 1983.
Philadelphia, ASTM, 1985, STP 854, 590 P.
The papers in this volume have been divided into five sections. The first addresses the area of foremost ASTM emphasis, methods development and validation. Results of single-species tests are presented; the greatest emphasis is on several species of daphnids, the main toxicological invertebrata test species in freshwater. The remaining four sessions implicitly or explicitly address the theme of ecological relevance. There is much research interest concerning the potential toxicity of chemicals that are bound to
particulate, whether natural particulate (e.g., detritus and clay), sewage sludge, or wastewaters. The section on evaluation of chemicals and chemical wastes consists of papers addressing this area in terms of methods for assessing and interpreting toxicity and hazard evaluation data. The third section, assessing impacts of wastes on aquatic ecosystems, addresses the complex issue of whether effects of chemicals and chemical wastes, determined by laboratory testing, can be predicted or in fact occur in the environment.

CONWAY R. (1982)
environment risk analysis for chemicals.
Wokingham, Van Nostrand Reinhold, 1982, 571 P
This book divided into two parts. Part one is on principles of environmental risk analysis, including basic properties of materials, entry of chemicals into the environment, the risk of chemicals to aquatic environment, atmospheric environment, terrestrial environment, mathematical modeling for prediction of chemical fate, model ecosystems and diseases caused by chemicals. Part two includes case studies on Syracuse Research Corporation's approach to chemical hazard assessment, environmental risk analyses of wastewater produced by synthetic fuels technologies, sequential risk analyses of wastewaters produced to synthetic fuels technologies, sequential testing for chemical risk assessment, chemical pollution for environmental decisions, models for predicting bioaccumulation and ecosystem effects of kepone and other materials, an environmental fate model leading to preliminary pollutant limit values for human health effects, the development of testing requirements under the toxic substances control act, and a risk assessment approach for evaluating under the toxic substances control act, and a risk assessment approach for evaluating the environmental significance of chemical contaminants in solid wastes.

COULSTON F., ALBANY N.Y. (1972)
Environmental quality and safety. Vol. 1 - Global aspects toxicology and technology as applied to the environment.
Stuttgart, Georg Thieme, 1972, 266 P
Environmental quality and safety is a serial publication comprising original publications, monographs and review articles which deal with the global environmental aspects of chemistry, toxicology, ecology, engineering, physics,

etc. Due to the increasing importance of these questions, special attention will be given to the evaluation of safety of chemicals, drugs, natural products and physical agents on plants, animals, and man. Newer techniques of chemistry, biology, physics and engineering that will help solve the problems of environmental changes in air, water, and the soil, will be included. Particular emphasis will be given to the definition of chemical hazards that apply to the ecology of food supply.

E.P.A. (1985)
Protecting health and safety at hazardous waste sites. An overview.
Cincinnati, EPA, 1985, 625/9-85/006, 46 P.
This booklet summarizes those guidelines and presents key issues to consider in designing, implementing, or evaluating a health and safety program for work at inactive hazardous waste sites. Much of the information is also relevant to planning for response to emergencies involving hazardous substances.

GILAD A., TARKOWSKI S. (1982)
Health aspects of chemical safety - Risk assessment.
Copenhagen, WHO, 1982,333 P.
This document contains the papers delivered at the seminar, grouped roughly according to the components of the risk management process, i.e., toxicity data, epidemiological data. extrapolation, assessment and evaluation, decision marking, and case studies.

GREALLY J.F., SILANO V. (1983)
Health aspects of chemical safely - Allergy hypersensitivity to chemicals.
Copenhagen, WHO/Luxembourg, CEC, 1983, 288 P.
Proceedings of a joint WHO/CEC workshop on allergy responses and hypersensitivities induced by chemicals held at Frankfurt am Main, October 1982. It provides background information on problem areas, pathways and mechanisms of action, health effects and prevention and control. It highlights the known or suspected aspects of allergenic chemicals, identifies knowledge gaps and needed research area.

GRISHAM J.W.(1986)
Health aspects of the disposal of waste chemicals.
Oxford, Pergamon Press, 1986, 462 P.
This book represents the review by over by over 40 academic scientists of the salient aspects of human health risk from uncontrolled chemical disposal. It is intended to provide a broad base for interdisciplinary understanding and communication among the diverse professions interested in this problem. It reviews the current state of knowledge of human health effects that have been attributed to waste chemicals from uncontrolled disposal sites and provides a critical scientific assessment of the investigations of such effects associated with 21 specific sites. The strengths and weaknesses of the approaches to understanding positive associations and establishing causal relationships are analyzed. A synoptic presentation of the current "state-of-the-art" and discussion of practical approaches to assessing risks to human health are provided.

HIGHLAND J.H.(1982)
Hazardous waste disposal. Assessing the problem.
Ann Arbor, Ann Arbor Sci./Sevenoaks, Butterworth Group, 1982,
341 P.
The breadth of the hazardous waste problem : four case studies - Assessing the environmental impact of waste disposal - Methods for detecting adverse health impacts-Occupational risks associated with waste disposal practices - Remedial clean-up : techniques and responsibilities.

KEMP H.T., LITTLE R.L., HOLOMAN V.L. (1973) Water quality criteria data book. Vol.5 - Effects of chemicals on aquatic life.
Washington, US Gover. Printing Off., 1973, 511 P.
This report is an extensive compilation of data on the effects of chemicals on aquatic life which were extracted from literature published during the period 1968 - 1972. The data are arranged alphabetically by chemical and are concisely presented in a columnar format which includes organism name, type of study, chemical effect, controlled parameters, significant comments on the test, and source of the data.

KOEMAN J.H., STRIK J.J.T.W.A. (1975)
Sublethal effects of toxic chemicals on aquatic animals.
Amsterdam, Elsevier, 1975, 234 P.
There are various reasons why research workers may become interested in studies on sublethal effects of chemicals on living organisms. In first instance some of them are primarily motivated by their scientific curiosity and want to find out how foreign chemicals interfere with physiological and biochemical processes. A second category of scientists is particularly interested in the development of testing and monitoring procedures, which can be used to assess the toxic properties of chemicals routinely or which can serve as watch-systems to check the quality of certain natural resources. A third category represents those who use the ultimate results of the toxicity trials in order to evaluate environmental standards from the dose-response and time-response relationships established. It was the aim of this book to bring representatives of the different categories together in the hope that this would be beneficial for all of them.

KYLAE-HARAKKA-RUONALA T. (1989)
Chemicals risk modeling : toxic effect risks imposed on aquatic organisms by industrial activity.
Helsinki, Natl. Boards Water Environ., 1989, 56 P.
This study deals with the development of a mathematical model, which provides tools for the assessment of the toxic effect risk on aquatic organisms, associated with random releases from the industrial processing and handling of chemicals.

LEDUC G., PIERCE R.C., McCRAKEN I.R. (1983)
The effects of cyanides on aquatic organisms with emphasis upon freshwater fishes.
Ottawa, NRCC, 1983, n° 19246, 143 P.
This document briefly reviews the physicochemical properties of cyanide compounds along with analytical methodologies used for water sample. The fate of cyanide-containing compounds in the aquatic environment is also examined. The majority of information contained in this document refers to the toxicity of molecular HCN to freshwater fish, especially at the chronic level of exposure. Where available, information on the effects of cyanides on other aquatic organisms is included.

MANUFACTURING CHEMISTS ASSOCIATION (1976)
Guidelines for risk evaluation and loss prevention in chemical plants.
Washington, MCA, 1976, 19 P.
This document provides guidelines on risk evaluation, loss prevention reviews and loss prevention review check lists in chemical plants.

NATIONAL RESEARCH COUNCIL OF CANADA (1976)
Effects of chromium in the canadian environment.
Ottawa, NRCC, 1976, 168 P.
This report discusses the effects of emissions of Cr chemicals on the various living organisms in the environment. Naturally occurring levels and forms of Cr are compared with those resulting from industrial and domestic activities in order to assess their environmental impact.

NATIONAL RESEARCH COUNCIL OF CANADA (1978)
Effects of arsenic in the canadian environment.
Ottawa, NRCC, 1978, 349 P.
This document covers general background information on arsenic including history, usage, and chemistry. Natural and anthropogenic as levels in air, soil, and water are reported and discusses. The effects of arsenic and its chemical derivatives on various life forms (vegetation, microorganisms, aquatic life, terrestrial animals, and humans) are covered in detail. Arsenic carcinogenesis is also discussed.

NATIONAL RESEARCH COUNCIL OF CANADA (1979)
Effects of mercury in the canadian environmental quality.
Ottawa, NRCC, 1979, 290 P.
This report contains chapters on biogeochemistry of mercury, emissions of mercury into the environment, the effects of mercury on aquatic environment, terrestrial plants, humans and animals.

NATIONAL RESEARCH COUNCIL OF CANADA (1982)
Chlorinated phenols : criteria for environmental quality.
Ottawa, NRCC, 1982, n° 18578, 191 P.
The purpose of this monograph is to provide an analysis of the scientific criteria as well as research recommendations that are specific to the chlorophenols. Particular emphasis has been given to a analysis of the theoretical understanding of the action of chlorophenols in our environment, including their fate, persistence and key toxicological effects.

N.C.A.S.I. (1988)
Assessment of potential health risks to pulp to pulp and paper mill workers from dermal exposure to dioxin in bleached pulp, paper and pulp-based products.
NCASI Tech. Bull., 1988, n° 549, 60 P.
ROSE D., MARIER J.R. (1977)
Environmental fluoride 1977.
Ottawa, NRCC, 1979, 175 P.
This report emphasizes cause/effect interrelation of environmental fluoride, and also attempts to identify deficiencies in the current scientific knowledge.

SHUGAR S. (1979)
Effects of asbestos in the Canadian environment.
Ottawa, NRCC, 1979, n° 16452, 185 P.
This document critically surveys the literature on asbestos up to early 1978, and contain chapters on the occurrence, chemistry and analytical determination on asbestos, its uptake and distribution in animals and man, as well as its effect on plants, animals and humans. In particular, altered pulmonary function, asbestos bodies, pleural plaques, asbestosis, mesothelioma and other cancers and suppression of immune response are discussed. Cause-effect data are analyzed and some clues to the mode of action are offered.

SITTIG M. (1979)
Hazardous and toxic effects of industrial chemicals.
Park Ridge, NDC, 1979, 466 P.
This handbook consists about 250 individual entries arranged alphabetically by the common name of each organic and mineral substance described. It is intended to be a working guide for the industrial hygienist and other concerned persons. There is a continuing need to assess the status of potentially dangerous substances including those now available and those that may reach commercial availability in the future. This should be done with a predictive view to avoid or at least to ameliorate catastrophic episodes similar to those that have occurred with methyl mercury., polychlorinated biphenyls, vinyl chloride monomer, dioxin and a number of pesticides.

W.H.O. (1987)
Health and safety component of environmental impact assessment - Report on a WHO Meeting Copenhagen, 1986.
Copenhagen, WHO, 1987, 90 P.
This meeting was concerned with the adverse health effects of industrial development projects but many of the principles of assessment may be applied to other types of project. The purpose of the meeting was to recommend how health impact assessment should be approached in EIAs and to determine the need for guidelines for training in EHIA.

W.H.O. (1988)
Health impact of biotechnology.
Copenhagen, WHO, 1984, 62 P.
After a general review of biotechnology, it is presented in this book seven topics for special consideration : the definition of biotechnology; recombinant DNA techniques; health aspects of waste disposal; assessment of possible short-term health hazards; assessment of possible indirect and long-hazards; present beneficial uses and future developments; and human and environmental health.

X... (1972)
Pollution related diseases and relief measures in Japan.
Tokyo, Environ. Agency, 1972, 28 P.
The number of persons suffering from diseases caused, or aggravated, by air and water pollution is increasing, specially in heavily industrialized areas. A brief summery of relief measures which have been instituted in Japan for the victims of these diseases is included. Also, an appendix is attached to describe the case of rice bran oil poisoning by polychlorinated biphenyl (PCB), a substance which is potentially a serious source of water pollution.

PAPERS:

AHLOBROG U.G., VICTORIN K. (1987)
Impact on health of chlorinated dioxins and other trace organic emissions.
Waste Manage. Res., 1987, 5, n° 3, 203-224.
Reports on high level of potentially harmful chlorinated dioxins and dibenzofurans in fish and human milk caused the Swedish Environmental Protection Board to issue a moratorium to allow the building of new or expanded MSW incinerators. A governmental committee was call upon to study the whole issue. The National Institute of Environmental Medicine was subsequently asked to perform a study on the potential health effects of municipal solid wastes, (MSW) incineration. The present report summarizes the findings from that study with regard to organic compounds.

GOLDMAN B.A. (1986)
The use of risk assessment during selection of off-site response actions.
Hazardous Waste & Hazardous Materials, 1986, 3, n° 2, 205-219.
This paper addresses the need for incorporating risk assessment procedures into the decision making for off-site response action under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or "Superfund") and the Resource Conservation and Recovery Act (RCRA).

HARRIS R.H., HIGHLAND J.H., HUMPHREYS K. (1984)
Comparative risk assessment : tools for remedial action planning.
Hazardous Waste, 1984, 1, n° 1, 19-33.
This paper discuss the details of the HRS, and by way of example some of the methodological limitations and inconsistencies in the model that limit its usefulness.

RODRICKS J. (1984)
Risk assessment at hazardous waste disposal sites.
Hazardous Waste, 1984, 1, n° 3, 333-362.
This paper provides in Part 1, a discussion of the elements of human health risk assessment long in used to evaluate toxic chemicals in other contexts. The discussion is largely non-technical, and is designed to provide an introduction to the subject for those from other disciplines involved in remedial action planning and implementation. Part 11 contains the essential elements of a risk evaluation scheme that might used to select the most cost effective remedial action plan for a given site, where effectiveness is measured by the degree of long-term health protection achieved.

SCOTT M.P. (1987)
Application of risk assessment techniques to hazardous waste management.
Waste Manage. Res., 1987, 5, n° 2, 173-181.
Applications of risk assessment techniques to hazardous waste management are briefly discussed in terms of selecting appropriate waste management technologies, assessing operating sites, setting priorities for clean up of problem sites, determining the appropriate level of clean up and planning new facilities. A specific case history involving risk assessment for the siting of a waste management facility in the province of Ontario, Canada is described in more detail.

SIEGENTHALER C. (1987)
Hydraulic fracturing - A potential risk for the safety of clay-sealed underground repositories for hazardous waste.
Hazardous Waste & Hazardous Materials, 1987, 4, n° 2, 280-286.
Clay backfill as an artificial seal is a common component in plans for underground waste repositories. A simple experiment, simulating the fluid pressures in an artificially emplaced protective clay layer after the sealing and abandonment of an underground waste repository, supports this evidence. Hydraulic fractures would destroy expected favorable properties of the backfill and may represent a risk for the safety of a hazardous waste repository.

THONGKAIMOOK A., PANSWAD T. (1989)
Risk assessment for hazardous waste management in Thailand.
In AIT Conf., Bangkok, 9-10/11/1989, 51-63.
As a result of a severe environmental impacts from the improper treatment and disposal of hazardous wastes, the Royal Thai Government (RTG) decide to develop an action-oriented National Hazardous Waste Management Plan. This plan is described in this paper.

ACCIDENT PREVENTION

BOOK:

HE17 A47 no. SEE-81-2
Safety Effectiveness Evaluation -- Federal and State enforcement efforts Hazardous Materials transported by truck.
United States, National Transport Safety Board, Report no. NTSB-SEE-81-2, Washington, 1981, ii, 109 P.
Traffic, United States, Hazardous Substances, Transportation.

HE17 A47 no. SEE-78-2
Analysis of proceedings of the National Transport Board into derailment and Hazardous Materials : April 4-6 1978.
United States, National Transport Safety Board, Report no. NTSB-SEE-78-2, Washington, 1978, 49 P.
Railroads - Safety measures, Hazardous substances.

T55.3 H3 H43
BENNETT, GRAY F., ed. FEATES, FRANK S., ed. WILDER, IRA, 1945, ed. (1982).
Hazardous Materials Spills Handbook/ Gray F. Bennett, Frank S. Feates and Ira Wilder.
McGraw-Hill, New York, 1982, 1 v. (various paging).
Hazardous substances, Accidents, Handbook, Manuals, etc..

TD194 U53 no. 3
Storage of Hazardous Materials : A Technical Guide for Safe Warehousing of Hazardous Materials.
United Nations Environment program, Industry and Environment office, Technical Report Series ; no. 3, United Nations Environment Program, Paris, 1990, 90 P.
Hazardous substances.

PAPER :

C.E.F.I.C. (1988)
Safe warehousing of chemicals.
UNEP Ind. Environ., 1988, 11, no. 3, 31-33.
The European chemical industry, aware of the potential hazards of warehousing chemicals, initiated action through CEFIC (European Council of Chemical Manufacturers' Federations) to prepare a Guide to Safe Warehousing for the European Chemical Industry in the course of 1986. This article is limited to a general review of the CEFIC guide to safe warehousing presenting a brief indication of the points and topics covered by the guide.

GALLIOT F. (1988)
The national strategies for the prevention and response of industrial accidents : an overview.
UNEP Ind. Environ., 1988, 11, no. 3, 24-27.
This document is concerned with the safety and health of employers and the neighboring population, and the author tries logic response to limit the consequences and damages in the case of industrial accidents.

Van KUIJEN C.J. (1988)
Prevention of industrial accidents in the Netherlands.
UNEP Ind. Environ., 1988, 11, no.3, 2-6 (3 P.).
This paper outlines broad principles of accidents prevention in the Netherlands.

PHANTUMVANIT D., THANH N.C. (1987)
Strategies for major accident prevention in the chemical industry - Case of Thailand.
In UNIDO Expert Workshop, 1987, Vienna, 23 P.
This study underlies the fact that routine inspection and regular maintenance alone are not adequate to contain

potential hazards. There is a need for additional "fail-safe" measures in the form of a "major hazard assessment". The inadequacy of statistics and information on the cause of accidents, properties of dangerous substances and chronic health effects is also highlighted. Finally, the success in accident prevention ultimately lies with the attitude of all parties concerned. Proper training on accident prevention of workers, safety officers and government inspectors is a pre-requisite.

TRAINING

BOOK :

DUFFUS J.H., GILAD A. (1981)
Manpower development for control of chemicals.
Copenhagen, WHO, 1981, 102 P.
This document contains the results of the WHO manpower development programme : occupational profiles in toxic chemicals control, a target curriculum for training in toxicology and training of nontoxicologists involved in toxic chemical control.

PAPERS :

FINGAS M.F. (1987)
Personal protection in spill situations.
Spill Technol. Newsletter, 1987, 12, no. 2, 41-61.
Response to chemical spills requires a comprehensive program of action to protect employees from many potential hazards, the greatest hazard being chemical exposure. The program should include equipment acquisition, medical testing, training, retraining, practice, and equipment maintenance, upgrade and replacement. The program should be based on a carefully developed policy regarding entry procedures and minimum training/equipment requirements.

GEARS A.M. (1985)
Training of waste operators pays in the long term.
Waste Manage. Res., 1985, 3, no. 4, 303-306.
The experience of the Biffa Waste Services Company (United Kingdom) in the training of waste operators is reviewed. The Company has adopted a marketing platform for its many services which recognizes the important part that the environment plays and believes that only through training of everyone will its objectives be achieved.

HOLLIS W.L. (1987)
Cooperative industry efforts with developing countries to improve agrochemical registration, labeling and education and training.
UNEP Ind. Environ., 1987, 10, no. 3, 34-37.
Most Caribbean nations are legally unable to accommodate the recommendations until they establish the pre-requite legislation. IICA is preparing a working document for the governments of the Caribbean to use to establish their own regulations. An informal consultation between industry and environmental groups to resolve problems associated with the safe use of agrochemicals and the status of the Food and Agriculture Organization (FAO) Draft Code of Conduct on the Distribution and Use of Pesticides are also mentioned.

ENVIRONMENTAL ASSESSMENT

TD788 U5 NO.102C
MCCANDLESS, L. C. (1975).
Assessment of Industrial Hazardous Waste Practices Storage and Primary.
U.S. ENVL. Protection Agency. Office os...Report No. EPA/530/SW-102C. Versar,Inc. Springfield. 1975.

TD195 H39 S25
SALCEDO, PODOLFO N; CROSS, FRANK L; CHRISMON, RANDOLPH L.
Environmental Impacts of Hazardous Waste Treatment storage and Disposal Facilities/..., Frank L. Cross and Randolph L. Chrismon.
Technomic Pub., Lancaster, Penn. 1989. 160 P.
Hazardous waste management industry - Environmental aspects.
Environmental impact analysis.
Liability for hazardous substances pollution damage - United States.

EMERGENCY PLANNING

T55.3 H3 C487
CHEREMISINOFF, PAUL N. (1989).
Hazardous Materials Emergency Response : Pocket Handbook.
Technomic Pub., Lancaster, Penn., 1989, 161 P.
Hazardous substances - Handbook, Manuals, etc..

TD811.5 A55 1989
Remedial Action, Treatment and Disposal of Hazardous Waste : Proceedings / Sponsored by the U. S. EPA, office of Research and Development, Risk reduction engineering laboratory ; coordinated by JACA Crop. and PEI Associated ; project officers : Eugene F. Harris, John Glaser and Teri Shearer.
Annual Research Symposium on Remedial action, Treatment and disposal of Hazardous wastes, 15th, Cincinnati, OH., 1989.,Risk Reduction Engineering Laboratory, Cincinnati, 1989, 598 P.
Refuse and refuse disposal - Congresses, Hazardous wastes - Congresses.

ENVIRONMENTAL LAW & POLICY

TD811.5 A8 1986a
TD811.5 A8 1986a c. 2
Guidelines for establishing Policies and Strategies for Hazardous Waste Management in Asia and the Pacific.
ASEAN-UNEP-CDG Workshop on Polices and Strategies for Managing Hazardous Waste in Asia and the Pacific, Singapore, 1986, s. n., Singapore, 1986, 29, 8 P.
Hazardous wastes, Congresses.

RISK ASSESSMENT

TE7 N251 no. 103
ROWE, WILLIAM D. (1983).
Risk Assessment Processes for Hazardous Waste Materials Transportation.
National Cooperative Highway Research Program, Synthesis of highway practices no. 103, Transportation Research Board, National Research Council, Washington, 1983, 27 P.
Transportation, Research.

VF 2964
RODRICKS, JOSEPH V.(1984).
Risk Assessment at Hazardous Waste Disposal Sites.
Mary Ann Liebert, s. l., 1984, 333-362 P.
Hazardous wastes.

TD811.5 M368
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