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MEDITERRANEAN ACTION PLAN

Regional Activity Centre for Cleaner Production

Meeting of MED POL Focal Points and Government-designated Experts to review Regional Plans as part of the implementation of Art. 15 of the LBS Protocol

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GUIDELINES FOR THE APPLICATION OF BEST AVAILABLE TECHNIQUES (BATs) AND BEST ENVIRONMENTAL PRACTICES (BEPs) IN INDUSTRIAL SOURCES OF BOD, NUTRIENTS AND SUSPENDED SOLIDS FOR THE MEDITERRANEAN REGION.

EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

This document presents guidelines for the application of Best Available Techniques (BATs), Best Environmental Practices (BEPs) and Cleaner Production in general in the major industrial sources of BOD, nutrients (nitrogen and phosphorus) and suspended solids of the Mediterranean countries. Its purpose is to raise awareness of the environmental impacts of those industries and to highlight approaches that industry and governments can undertake to avoid or minimize these impacts by adopting BATs, BEPs and Cleaner Production.

The Guidelines as a regional initiative are intended to facilitate the implementation of the National Action Plans at the national level of all MAP countries. Furthermore, these Guidelines are presented together with the Regional Plan for the reduction of Nutrients from food sectors which under preparation in the framework of Art 15 of the LBS Protocol.. Namely, these Guidelines are designed to give the best approaches based on the application of BATs and BEPs for industrial sources of BOD, nutrients and suspended solids that industry and governments can undertake in order to mitigate the impacts of pollution resulting from land-based activities in the Mediterranean region. The guidelines are designed to serve the needs of those in governments, industry associations and entrepreneurs seeking information and practical advise on how to improve industry environmental performance and enhance its competitiveness within a sustainable perspective.

As these guidelines are launched in the context of the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (LBS Protocol), they cover the industrial sectors that are considered as major sources of BOD, nutrients and suspended solids. The main sectors according to SAP and covered under these guidelines are food and beverages, textiles, tanneries, paper and paper-pulp, phosphatic fertilizers and the pharmaceutical industry. Each of the industrial sectors is described in terms of production process and associated waste characteristics.

About food and beverage industries, the opinion about environment has been changing during the last 10 years and there is a global movement that promotes the use of new technologies. Food and beverage industries are more sustainable and respectful with the environment. This movement has arrived also to the Mediterranean Area.

The food and beverages industries produce both finished products destined for consumption and intermediate products destined for further processing. It is diverse compared to many other industrial sectors. This diversity can be seen in terms of the size and nature of companies; the wide range of raw materials, products and processes and the numerous specialist or traditional products on national and even regional scales.

The most significant environmental issues associated with food and beverage installations are water consumption and contamination; energy consumption; and waste minimisation.

The latest update of this Guide includes those new techniques that have been applied by Mediterranean Food Industries.

In all cases the objective is to reduce the water consumption, improve the energy uses and also decrease the water charge pollution to the Mediterranean Sea. Those new techniques are focussed on BOD reduction as this subject is still no improved in the food Mediterranean industries.

Environmental impact of BOD, nutrients and suspended solids in the Mediterranean

The known environmental impacts of these industrial pollutants are that the BOD changes the ecological balance in a body of water by depleting the dissolved oxygen content; nitrogen and phosphorus enhance eutrophication and stimulate undesirable algae growth and with regard to suspended solids impair normal aquatic life of the stream, and sludge blankets containing organic solids will undergo progressive decomposition resulting in oxygen depletion and the production of noxious gases. Their generations in large quantities pose a serious risk for surface water and groundwater quality and represent a potential cause of damage to human health, ecosystems, habitats and biodiversity in the Mediterranean region.

BATs and BEPs for the identified industrial sources of BOD, nutrients and suspended solids.

Definition and preliminary comments

BATs & BEPs offer win-win opportunities for waste reduction and increased efficiency in industry. The definition of BATs & BEPs adopted in the guidelines takes into consideration the criteria established by the LBS Protocol and secondarily, the philosophy of the European IPPC Directive. It encompasses a comprehensive integrated approach that is not limited to consumption and emission levels and pollution control techniques, but prioritize environmental management systems, good housekeeping, good operating practices, techniques for prevention and control of accidents, waste minimization, use of alternative materials/resources and rules for decommissioning. In action, the preventive techniques and practices (cleaner production) are considered first and end of pipe techniques, at the end of the spectrum available. The techniques explored include process design/redesign changes to prevent emissions and eliminate waste, process optimization, substitution of materials by environmentally less harmful ones, good housekeeping, recycling and re-use in water management, control measures and as last option, end-of-pipe treatment techniques.
The options selected are based on their technical merit, their economical feasibility and environmental benefits. Indeed, according to the definition of BAT and BEP, a technique or practice would have to be technically and economically feasible in order to be considered as BAT or BEP.

Techniques which are applicable in all food and beverage installations include operational practices, i.e. management tools; training; equipment and installations design; maintenance and methodology for preventing and minimising the consumption of water and energy and the production of waste.

GENERAL CONSUMPTION AND EMISSION INFORMATION IN FOOD AND BEVERAGE INDUSTRIES

WATER

Water consumption is one of the key environmental issues for the food and beverage sector.

Water has many different uses, e.g.:
- for cooling and cleaning
- as a raw material, especially for the drinks industry
- as process water, e.g. for washing raw materials, intermediates and products
- for cooking, dissolving and for transportation
- as auxiliary water, e.g. for the production of vapour and vacuum
- as sanitary water

The quality of water needed depends on the specific use.

WASTE WATER

The food and beverage sector has traditionally been a large user of water as an ingredient, cleaning agent, means of conveyance and feed to utility systems. Large food and beverage installations can use several hundred cubic metres of water a day.

Most of the water which is not used as an ingredient ultimately appears in the waste water stream. Typically, untreated food and beverage waste water is high in both COD and BOD. Levels can be 1- - 100 times higher than in domestic waste water. Untreated waste water from some sectors, e.g. meat, fish, dairy and vegetable oil production, contains high concentrations of fats, oils and greases (FOG). High levels of phosphorous can also occur, particularly where large quantities of phosphoric acid are used in the process, e.g. for vegetable oil de-gumming or in cleaning.

AIR EMISSIONS

Air emissions can be divided into ducted, diffuse and fugitive emissions. Only ducted emissions can be treated. Diffuse and fugitive emissions can, however, also be prevented and/or minimised.

The main air pollutants from food and beverage processes are dust and odour. Odour is a local problem either related to the process or to the storage of raw materials, by-products or waste.

LOSS OF MATERIALS

The main sources of solid out put are spillage, leakage, overflow, defects/returned products, inherent loss, retained material that cannot freely drain to the next stage in the process and heat deposited waste.

ENERGY

The food and beverage sector is dependent on energy for processing as well as for maintaining freshness and ensuring food safety.

BATs AND BEPs

1) BATs & BEPs in the food and beverage industry include a variety of options that are pertinent to most categories of food processing, and there are various good techniques that are used in one sector that may also be applicable in other sectors. General techniques on waste minimization through the industry include:

    1) Recover, reuse and recycle as much waste as possible throughout the plant.
    2) Convert as much waste as possible to animal feed.
    3) Segregate waste streams.
    4) Use dry cleanup methods.
    5) Drain all products from tanks and vats before cleaning.
    6) Develop a leak prevention program for valves, pumps, piping and equipment.
    7) Avoid hosing material into drains if possible.
    8) Install water meters and read them on a continual basis.
    9) Better inventory control.
    10) Monitor the treatment plant for BOD5 on a regular basis.

BATs & BEPs for specific food branches have the following general characteristics:

SUGAR MANUFACTURING

They should focus on process optimization, good housekeeping and recovery. Re-use of water, sludge treatment and waste water treatment are also addressed by the BAT for the sugar sector.

Minimising energy consumption is also achieved by avoiding drying sugar beet pulp if an outlet is available for pressed sugar beet pulp.

Examples for new techniques available described in this guide are:

- Avoid burning cane leaves in the field before harvest.
- Use bagasse (waste fiber) from the cane as fuel for steam and power generation.
- Use molasses beneficially as a feedstock.
- Use beet leaves and roots as an energy-rich feed.
- Sludge dewatering on drying beds for small-scale facilities and dewatering using belt presses and decanter centrifuges for medium – and large – scale facilities.
- Preliminary filtration for separation of filterable solids.

VEGETABLE OIL PROCESSING

For oil processing, they should focus on improvements in production efficiency by applying measures across the entire process, such as the use of citric acid instead of `phosphoric acid, where feasible, in degumming operations; use where appropriate of physical refining rather than chemical refining of crude oil; recirculate cooling waters, do not use chlorinated fluorocarbons in the refrigeration system; use of the supercritical process in the treatment of bleaching clay, reduce product losses through better production control, …

The environmental benefits of applying the additional BAT for the vegetable oils sector are mainly the reduction of energy consumption and the recovery of hexane used during extraction.

One BAT associated emission level was determined, i.e. BAT is to use cyclones, to reduce wet dust emissions arising from vegetable oil extraction, to achieve a wet dust emission level of <50mg/Nm^3.

BREWERIES

Application of the additional BAT for brewing reduce both water and energy consumption. For brewing, BAT is to achieve a water consumption level of 0.35 – 1m^3 /hl of beer produced. New techniques available are mash infusion process and re-use of hot water from wort cooling.

They should focus on improvements in production efficiency to reduce losses in production through application of measures throughout the entire process, such as the application of clean-in-place (CIP) methods for decontaminating equipment, the use of high-pressure low-volume hoses for equipment cleaning, the use of recirculating systems on cooling water circuits, the filtration of bottom sediments from the final fermentation tanks for use as animal feed, …

WINERY AND DISTILLERY

The approach based on BATs and BEPs would focus chiefly on measures leading to waste minimisation, such as avoid overfilling process vessels, use fine mesh baskets to keep raw materials out of the drainage system, return liquors to processes or recover them for animal feed or other reuse,
To minimise water consumption, they should focus on reuse the alkaline solution used for cleaning after cold stabilisation and addresses the method of its ultimate disposal to prevent disruption of the waste water treatment plant, optimise water consumption of the rising zone in the bottle cleaning machine, by controlling the rising water flow, installing an automatic valve to interrupt the water supply in case the line stops and using fresh water for the two last rows of rising nozzles, reuse bottle cleaning overflows after sedimentation and filtration.

FRUIT AND VEGETABLE PROCESSING

For the fruit and vegetables sector, BATs and BEPs should focus on address storage, dry separation of rejected raw material, collection of soil, peeling, blanching and optimise water re-use.

Techniques include the use of dry methods such as vibration or air jets to clean raw fruit and vegetables; use steam instead of hot water to reduce the quantity of wastewater to be treated; use dry caustic peeling or equivalent procedures wherever technically feasible; use pneumatic transportation instead of water channel as system for transporting products; use countecurrent systems where washing is necessary.

The environmental benefits of applying the BATs and BEPs for storage, peeling and blanching include, e.g. reducing energy consumption, water consumption and waste generation.

DAIRY INDUSTRY

There are additional BAT for dairies and specific BAT for producing market milk, powdered milk, butter, cheese and ice-cream. They address water consumption, energy consumption and waste prevention. There are both operational and technological BAT.

They should focus on improvements in production efficiency trough the application of techniques throughout the entire process such as the recover of energy by using heat exchangers for cooling and condensing; the use of high-pressure nozzles to minimize water usage; the use of the automation system of the plant to eliminate waste; the recirculation of cooling waters and the training of personnel in the proper operation and handling of equipment, …

Energy consumption levels may vary due to, e.g. production volumes. Warm climates may use more energy for cooling and vice versa. Water consumption and waste water emissions level may vary due to, e.g. different product portfolios, batch sizes and cleaning. The waste water emission level may be lower compared to the water consumption level because many dairies measure the intake of cooling water, but then discharge it unmeasured. In warm climates, water may be lost due to evaporation.

New techniques available are replacing batch pasteurisers with continuous ones; use regenerative heat exchange in pasteurisation; partially homogenise milk; reduce the required frequency of cleaning of centrifugal separators by improving the preliminary milk filtration and clarification; maximise whey recovery and use; …

SLAUGHTERING AND MEAT PROCESSING
Environmental issues specific to meat processing may include the following:

- Solid waste and by-products
- Special Risk Materials (SRM)

Since the pollutants generated by the industry are largely losses in production, improvements in production efficiency by applying techniques and good practices are recommended first to reduce pollutant loads and treatment of remaining waste.

The additional BAT for the meat and poultry sector applies to specific unit operations applied in some parts of the sector. They should focus first on improvements in production efficiency by applying techniques and good practices such as changing the sub-process of killing and bleeding from recovery of no blood to recovery of all blood; changing from a system of continuous water flow to one of “interruptible” water flow; changing sub-process of wet rendering with no evaporation of tank water to one in which tank water is evaporated; separation of product from wastes and recover and process blood into useful by-products; …

Recommended management techniques for pollution prevention of wastewater include:
- Screening
- Fat trap
- Flow and load equalisation
- DAF
- Diversion tank

There are other techniques focused on cleaning process such as to prioritize the removal of solid waste before it enters the wastewater stream.

FISH PROCESSING

The main environmental benefits of the additional BAT and BEP for the fish and shellfish sector are reduced waste and less water consumption and several apply to the thawing, scaling, skinning, eviscerating and filleting of fish.
Fish processing activities generate potentially large quantities of organic waste and by-products from inedible fish parts and endoskeleton shell parts from the crustacean peeling process.
The actual proportion depends on the edible fraction of each species being processed. Fish waste is a rich source of essential amino acids, and all inedible fish waste should be converted into by-products.

BATs and BEPs in fish processing typically focus on reducing the consumption of resources, increasing yields and reducing the volume and the organic load affluent discharges.

BATs and BEPs applicable to individual units operations within fish processing are, for example:

- Wastewater: conduct a dry pre-cleaning of equipment and production areas before wet cleaning; establish procedures for the dry removal of offal; use offal transport systems that avoid or minimise the use of water; recirculate water used in non-critical applications;…

- Effluent: in general, efforts to reduce water consumption will also result in reduced effluent generation.

- Process wastewater treatment: grease traps, skimmers or oil water separators for separation of floatable solids,…
- Solid waste and by-products: The actual proportion depends on the edible fraction of each species being processed. Fish waste is a rich source of essential amino acids, and all inedible fish waste should be converted into by-products.

- Thawing: thaw water is heated to 30 - 35°C to facilitate thawing and the water is agitated with an air sparge, giving a better contact between fish and water.
- De-icing, washing and grading
- Scaling
- Filleting
- Skinning
- Trimming and cutting
- Collection and transport of offal
- Odor prevention

BATs and BEPs measures reported by the fish processing facilities could be achieved mainly through good housekeeping practices, work procedures, maintenance regimes, resource handling …

All the presented list of BATs and BEPs for the fish sector is still applicable in shellfish sector. Specific measures for shrimp processing are outlined, essentially dry clean-up. To make it effective, the following techniques should be respected, such as:

- Collect any dripping batter by placing pans under breading tables.
- Squeegee spilled batter into a pan from the floor so batter will not enter the drain during wet cleanup.
- Empty batter tanks into barrels instead of pumping their contents into the drain.
- Etc.

2) BATs & BEPs in textiles could be achieved through selection and use of chemicals, environmental management and good housekeeping, process optimization, process modification, technology change and waste water treatment. Such techniques include the use of pad batch dyeing; matching process variables to type and weight of fabric; the use of transfer printing for synthetics; the use of water-based printing pastes, when feasible, the use of countercurrent rinsing, …

3) BATs & BEPs in tanning and leather finishing facilities could be achieved through water and wastewater management, substitution of chemicals, process optimization and modification. Such techniques include the use of carbon dioxide in deliming to reduce ammonia in wastewater; the use of drums instead of pits for immersion of hides; the use of batch washing instead of continuous washing; the use of non-organic solvents for dyeing and finishing, …

4) BATs and BEPs for the pulp and paper industry are mostly process-related because the environmental impact is caused on the level of the different manufacturing processes performed.
   These techniques are adapted to each process such as for Kraft pulp and paper mills.
   Techniques of reducing emissions into water include measures such as dry debarking of wood; oxygen delignification; ECF or TCF final bleaching, some mainly alkaline process water recycling in the bleach plant, …

5) BATs & BEPs in the phosphatic fertilizers industry could be achieved through water conservation, recycling and reuse practices and less by process-specific measures. Such techniques include the installation of spill catchment and containment facilities to avoid inadvertent liquid discharges; practicing good housekeeping and maintenance on all valves, fittings and pumps to prevent spills, …

6) BATs & BEPs in the pharmaceutical industry could be achieved through product change, process changes, input material changes, technology process changes, improved operating practices, recycling/reuse activities and treatment. Such techniques include the

use of automated filling to minimize spillage; the use of “closed” feed systems into batch reactors; recirculation of cooling water; the use of reverse osmosis or ultra filtration to recover and concentrate active ingredients; the use of non-halogenated solvents, the recovery of solvents, the use of high-pressure hoses for equipment cleaning to reduce wastewater, …

Economics

Applying BATs and BEPs requires studying and considering economical concerns due to the intrinsic definition of both terms, which specifies that a technique or practice will be considered BAT or BEP if it is economically feasible.
The approach adopted and proposed by these guidelines for assessing the feasibility of the options in general, and specifically, for determining their economic viability, is the one presented in the Regional guidelines for the application of Best Available Techniques (BATs), Best Environmental Practices (BEPs) and Cleaner Technologies (CTs) in industries of the Mediterranean countries.
Notably, it takes into consideration that implementing BATs and BEPs will entail plant or process-specific costs and benefits, and thus, assessing the economic feasibility of applying each option will have to be done case by case, by taking into account economical elements such as investments and their derived costs, operating benefits, the payback period and the so-called intangible benefits.
Several case studies from the MAP countries illustrate that the application of BATs & BEPs can provide both economical and environmental benefits.

Concluding remarks

In conclusion, these guidelines promote the concept of sustainable development in industrial sectors that are sources of BOD, nutrients and suspended solids. They are based on principles that environmental issues are no longer only limited to emissions of pollutants but also include the levels of consumption of raw materials, water and energy. The BAT and BEP approach incorporates the concepts of prevention, cleaner production and waste management with a view to improve the overall performance of the industry. It advocates an integrated approach that considers environmental issues upstream and down stream, thus prioritizing prevention technologies and practices first, and considers as a last option treatment technologies for achieving compliance with environmental regulations, which remain specific to each MAP country. It also stresses the human and organizational dimensions of environmental management that are required to develop sound plant management and operational practices. In this respect, the guidelines propose the application of a combination of BATs and BEPs as the best approach for the management of industry sources of BOD, nutrients and suspended solids. It is expected that their application will lead to achieving the goals of improving the environmental performance of industry beyond compliance with environmental norms and achieving further economical benefits.
As these guidelines are general in their scope, they only provide information on BATs & BEPs approaches, options that by no means are exhaustive, and necessarily need to be updated continuously by its users to reflect technology changes or new emerging BATs and BEPs.

Effective implementation of BATs and BEPs requires that industry maintains and sustains collaboration efforts with trade organizations, research institutions, and governmental agencies on an ongoing basis to discuss initiatives for continuous improvements and the future of the industry from both an economic and environmental standpoint. It is recommended to take actions focusing on:

- Information dissemination through organization of seminars, publication of technical newsletters, and development of databases on BATs and BEPs for the different

industrial sectors within industry organizations as well as research institutes and environmental organization in support of industry.

- Research and development relating to reduction of process effluents in quantity and quality through source and process integrated measures, cleaner technologies and design of environmentally friendlier products.
- Improving environmental performance through investigation leading to improved environmental compatibility of conventional and developing industrial processes; and complete closure of the effluent system should constitute a major goal for industrial sectors of the future.
- Recycling and improved recovery systems should continue to be priority environmental targets in the MAP countries.
- Process performance and higher efficiency through the use of increasingly sophisticated, online measurement and expert/control systems will be required to achieve higher environmental performance and anticipate to comply with increasingly stringent operating and environmental permits.
- Capacity building through training across the board will be continually required to increase awareness about environmental performance, upgrade the knowledge and skills about the use of best environmental practices and assimilate the best available techniques applicable in industrial sectors that are sources of BOD, nutrients and suspended solids.
- Implementation of environmental management systems will help sustaining the efforts for continuous improvement through the application of BATs and BEPs.

Therefore, the application of BATs and BEPs would play a pivotal role in achieving environmental improvement and economic growth in the industrial sectors that are sources of BOD, nutrients and suspended solids in the Mediterranean basin, thus offering a way out of the dilemma posed often to industry in terms of choice between economic growth today or long-term environmental sustainability.

It is finally noted that for those seeking more detailed information on BATs and BEPs for the studied industrial sectors generating BOD, nutrients and suspended solids, the guidelines make reference to other available and relevant sources of information such as the Best Available Techniques Reference Documents (BREFs), UNEP/DTIE and RAC/CP sector specific studies on pollution prevention and other references from international institutions.