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GLOBAL MERCURY PARTNERSHIP

Mercury from Non-Ferrous Metals Mining and Smelting: current knowledge and tools towards sustainable practices

Webinar, Thursday 20 March 2024

Opening remarks and scene setting

Rodges Ankrah

U.S. Environmental Protection Agency, Co-Chair of the UNEP Global Mercury Partnership Advisory Group

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For the smooth running of the webinar, please :

Keep microphones off unless when making an intervention, cameras are optional.

Use the **"Chat"** to ask technical questions or share views.

The **webinar will be recorded**. Please indicate if you have any objection.

AGENDA

The event will be facilitated by Kenneth Davis, *Chemicals and Health Branch, UNEP*, and Misuzu Asari, *Co-lead of the Waste Management Area*

Opening remarks and scene setting, Rodges Ankrah, *U.S. Environmental Protection Agency, Co-Chair of the UNEP Global Mercury Partnership Advisory Group*

- Study report on mercury from non-ferrous metals mining and smelting, Peter Nelson, *Lead author of the Technical Study report on Mercury from the Non-ferrous Metals Mining and Smelting, Macquarie University, Co-lead of the Partnership Area on Mercury Releases from Coal Combustion*

- Latest Developments in the context of the Minamata Convention, Eisaku Toda, *Secretariat of the Minamata Convention*

- Mercury management in zinc smelting, Mic Gilles, *International Zinc Association*

Questions and Answers

- Environmentally sound management of mercury from the mining and smelting of non-ferrous metals in Argentina, Marisol Diaz Rivera, *National Coordinator of Hazardous Waste in the Undersecretary of Environmental, Ministry of Interior*

- Treatment of mercury wastes and stabilization of mercury from the non-ferrous metal industry, David Hunter, *BATREC Industrie AG*

- Treating mercury waste from non-ferrous metals mining and smelting: best available treatment technologies and mercury conversion as the safest option for final disposal, Xavier Ibarz, *Econ Industries*

Questions and Answers

Next steps and closing remarks, Rodges Ankrah, *U.S. Environmental Protection Agency, Co-Chair of the UNEP Global Mercury Partnership Advisory Group*

Part 1

facilitated by Kenneth Davis, *Chemicals and Health Branch, UNEP*

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STUDY REPORT ON MERCURY FROM NON-FERROUS METALS MINING AND SMELTING

WEBINAR: Mercury from Non-Ferrous Metals Mining and Smelting: current knowledge and tools towards sustainable practices
Thursday 21 March

Peter Nelson
Professor Emeritus of Environmental Studies
Macquarie University
Co-lead UN Environment Mercury in Coal Combustion Partnership

peter.nelson@mq.edu.au

Work on cross-cutting themes

- Mercury from oil and gas and from non-ferrous metals
- Decision by Partnership Advisory Group in November 2019 (PAG-10)
- Expert consultations launched in April 2020
- Study report published online following comments from experts and relevant stakeholders

Report on mercury in non-ferrous metals mining and smelting

- Supported by UN Environment through a Small Scale Funding Agreement (SSFA) with Macquarie University

- Timeline:
  - Draft version of outline circulated for comment 30th November
  - Annotated outline discussed at PAG-11
  - First draft of report 15 January
  - Review GMP secretariat, co-chairs and interested Partnership Area leads 29 January
  - Second draft mid March
  - Expert Consultation of 2nd Draft 30 April 2021
  - Final draft
  - Circulation of final report with call for final comments November 2021
  - Final report appears online 2022

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Study report on mercury from non-ferrous metals

Aim: to provide a better understanding of the mercury mass balance globally between

- supply,
- storage, and
- waste treatment related to non-ferrous metals mining and smelting operations

- Be concise
- Benefit from global experience

Methodology of Report

- expert consultations,
- open access sources of information, including
  - published reports and toolkits,
  - websites and
  - the peer reviewed scientific research literature
- presents
  - a critical review of existing knowledge and information gaps concerning mercury from the non-ferrous sector;
  - a showcase of the different methods currently in use for reducing mercury emissions and releases and disposing of mercury from mining and smelting at different key stages of the processes; and
  - suggestions for further work including capacity development.

10

Methodology

- Lead author: Macquarie University (Australia)
- Consultations of experts and relevant stakeholders (online meetings, call for input and comments)
- Open access sources
- Emphasis on copper, lead, zinc and large-scale gold

The report presents:

- Review of existing knowledge and information gaps
- Showcase the different reduction methods
- Suggestions for further work including capacity development

Study report - overview

Study report – overview *(continued)*

4. Mercury emissions and releases estimates from the non-ferrous sector – existing knowledge and knowledge gaps

4.1. Background on previous work on estimation of mercury emissions and releases and mercury release mechanisms and speciation

4.2. Methodology for estimating emissions and releases from the non-ferrous sector – key inputs and knowledge gaps

4.3. The impact of global trade in concentrates on the location of mercury emissions and releases

5. Control of mercury emissions and releases

5.1. Process descriptions

5.2. Emission control techniques

5.3. Smelter/ roasting waste and by-product management and releases to land and water

5.4. Case studies prepared for BAT/BEP guidance

Study report – overview *(continued)*

6. Major conclusions and identified needs for further investigation, research and cooperation

7. Guidance on best practices

8. References and bibliography

9. Attachment: case studies

Draft study report – key findings

Large source of mercury releases to the environment:

- 3rd largest source of emissions to air – about 10 to 15 % of total emissions, estimated at more than 300 tonnes per year (but industry estimates significantly lower and this difference requires resolution)
- 2nd largest source of release to water – about 40% of total releases, estimated at more than 200 tonnes per year, mostly from large scale gold production
- Releases to land and waste production estimated to be much larger, but include secure impoundments such as controlled tailings piles or engineered landfills; however large uncertainties remain

Large source of global mercury supply, estimated at around 500 tonnes per year, about 15% of total – need to strengthen data

Sector is likely to grow considerably over the next 30 years

Draft study report – key findings

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Large source of global mercury supply, estimated at around 500 tonnes per year, about 15% of total – need to strengthen data

Sector is likely to grow considerably over the next 30 years

Draft study report – key findings *(continued)*

Identified uncertainties and knowledge gaps :

- Hg content in ores and concentrates, at plant and country level
- Hg air emissions test data
- Hg concentrations in reject material
- Hg distributions between emissions and other releases
- Activity data (amounts of ores and concentrates processed)
- Effects of pollution control technologies, incl. on distribution of Hg between emissions to air, and capture in solid and liquid waste
- Additional quantitative information on how mercury deports to emissions and releases to air, land, water, waste and by-products

Draft study report – key findings *(continued)*

Identified needs :

- Effective and sustainable regional solutions for Hg secure and long-term storage
- Research and development on improvements to mineral processing
- Further investigations / information-sharing on Hg fate during mining and smelting of copper, lead and zinc and large-scale gold production
- Sharing of best practices and case studies, including Hg removal systems, off-gas cleaning systems in smelters, risks mitigation measures as well as options for environmentally sound interim storage and disposal of mercury.

Draft study report – key findings *(continued)*

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DISCUSSION

(ABC News: file photo)

Latest Developments in the context of the Minamata Convention

Global Mercury Partnership: Mercury from Non-Ferrous Metals Mining and Smelting: current knowledge and tools towards sustainable practices

21 Mar 2024

Fifth meeting of the Conference of the Parties

Fifth meeting of the Conference of the Parties to the Minamata Convention on Mercury (COP-5)

Geneva, Switzerland, 30 Oct 2023 - 03 Nov 2023

More than 800 participants and 115 Parties represented

21 decisions adopted

COP-5 Decisions

- 5/1: The effects of mercury pollution on Indigenous Peoples and on local communities
- 5/2: Mercury supply sources and trade
- 5/3: Study of the global supply, trade and use of mercury compounds
- 5/4: Amendments to annexes A and B
- 5/5: Preparation of a report on cosmetics listed in part I of annex A to the Minamata Convention on Mercury
- 5/6: Information on the Economic and Technical Feasibility of Mercury-Free Catalysts in VCM Production
- 5/7: Artisanal and small-scale gold mining
- 5/8:Mercury emissions
- 5/9:Guidance on BAT/BEP to control releases
- 5/10: Mercury waste thresholds
- 5/11: Review of the financial mechanism
- 5/12: Capacity building, technical assistance and technology transfer
- 5/13: National reporting
- 5/14: First effectiveness evaluation of the Minamata Convention on Mercury
- 5/15: Gender action plan
- 5/16: Knowledge management
- 5/17: Contribution of the Minamata Convention to the Kunming-Montreal Global Biodiversity Framework
- 5/18:Enhanced international cooperation and coordination
- 5/19: Cooperation between the secretariat of the Minamata Convention on Mercury and the BRS secretariat
- 5/20: Programme of work and budget for 2024-2025
- 5/21:Dates and venue of COP-6

Compilation of decisions available from Convention website.

Follow-up letter sent to Parties and stakeholders.

Minamata Convention Controls the whole life cycle of mercury

- By-product mercury from Non-Ferrous sector to be identified as supply source

Article 3: Supply
Trade

Guidance on identifying mercury stocks (COP-1)
Guidance and format for import consent (COP-1)

Article 4: Products
Article 5: Processes
Article 7: ASGM

NAP guidance (COP-1)

- Smelting and roasting processes in Pb, Zn, Cu and Au production is listed as a point source category.
- Requirement for control of emission to air and emission inventory.

Article 8: Emissions
Article 9: Releases

BAT/BEP & inventory guidance (COP-1)
Inventory guidance (COP-4)
BAT/BEP guidance (COP-5)

- Metals production may be identified as relevant point source of mercury releases to land and water
- Requirement for release control and inventory

Article 10: Storage

Interim storage guidelines (COP-2)

- By-product mercury needs to be stored properly

Article 11: Waste

Thresholds (COP-3, 4 and 5)
Basel Convention guidelines

- Mercury waste from metals production needs to be managed in an environmentally sound manner

Article 12: Contaminated sites

Guidance on management (COP-3)

Contaminated sites related to metals production need to be addressed

Life cycle of mercury

Mercury waste thresholds

MINAMATA CONVENTION ON MERCURY

Minamata Convention Article 11

2. For the purposes of this Convention, mercury wastes means substances or objects:
(a) **Consisting of mercury or mercury compounds**;
(b) **Containing mercury or mercury compounds**; or
(c) **Contaminated with mercury or mercury compounds**,
in a quantity above **the relevant thresholds** defined by the COP, in collaboration with the relevant bodies of the Basel Convention in a harmonized manner, that are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law or this Convention.

COP Decisions 3/5 and 5/10

No threshold needs to be established for waste consisting of mercury, and waste listed in Table 1 shall be regarded as such mercury waste.

No threshold needs to be established for waste containing mercury, and mercury-added products that are disposed of, are intended to be disposed of or are required to be disposed of, including those listed in Table 2, will be regarded as such mercury waste;

COP established **15 mg/kg total concentration of mercury as the threshold for waste contaminated with mercury**, allowing Parties to use alternative approaches to define such waste.

Table 1: List of mercury waste consisting of mercury or mercury compounds

- Recovered elemental mercury
- Elemental mercury
- Mercury (I) chloride and mercury (II) chloride
- Mercury (II) oxide (mercuric oxide)
- Mercury (II) sulfate (mercuric sulfate)
- Mercury (II) nitrate (mercuric nitrate)
- Cinnabar concentrate
- Mercury sulfide

Table 2: Non-exhaustive list of waste containing mercury or mercury compounds

- Non-electronic measuring devices containing mercury (barometers, hygrometers, manometers, thermometers, sphygmomanometers)
- Electrical and electronic switches, contacts, relays and rotating electrical connectors with mercury
- Fluorescent bulbs, high intensity discharge (HID) bulbs (mercury vapour bulbs, metal halide and high-pressure sodium bulbs), neon/argon lamps
- Batteries/accumulators containing mercury
- Biocides and pesticides containing mercury and their formulations and products
- Paints and varnishes containing mercury
- Pharmaceuticals containing mercury for human and veterinary uses, including vaccines
- Cosmetics and related products containing mercury
- Dental amalgam
- Scientific instrument used for the calibration of medical or scientific devices containing mercury

Mining waste in Minamata Convention

MINAMATA CONVENTION ON MERCURY

Minamata Convention Article 11

2. For the purposes of this Convention, mercury wastes means substances or objects....
This definition excludes overburden, waste rock and tailings from mining, except from primary mercury mining, unless they contain mercury or mercury compounds above thresholds defined by the Conference of the Parties

COP Decisions 3/5, 4/6 and 5/10

No need to develop thresholds for overburden and waste rock at the time of Decision MC-3/5.

COP established the following two-tier thresholds:

(i) Tier-1 threshold to be applied first: 25 mg/kg total mercury content;

(ii) Tier-2 threshold to be applied to tailings above the tier-1 threshold: 0.15 mg/L in the leachate, using an appropriate test method simulating the leaching of mercury at the site where the tailings are deposited.

COP invited Parties to use the guidance document UNEP/MC/COP.5/INF/13 on the test methods for the tier-2 threshold.

UNEP/MC/COP.5/INF/13: Guidance document on test methods to be used for the tier-2 threshold for tailings from mining other than primary mercury

Key considerations in selecting or defining tier-2 test methods

Liquid/Solid ratio
As the L/S ratio affects liquid-solid equilibrium over the residence time of eluent in a leach test, the L/S ratio of the chosen test should not differ ±20% from a ratio of 10:1.

Test pH
As no in-situ pH control exists at sites where tailings are deposited, it is recommended to use an eluant at neutral pH (such as deionized water) without pH control (buffering).

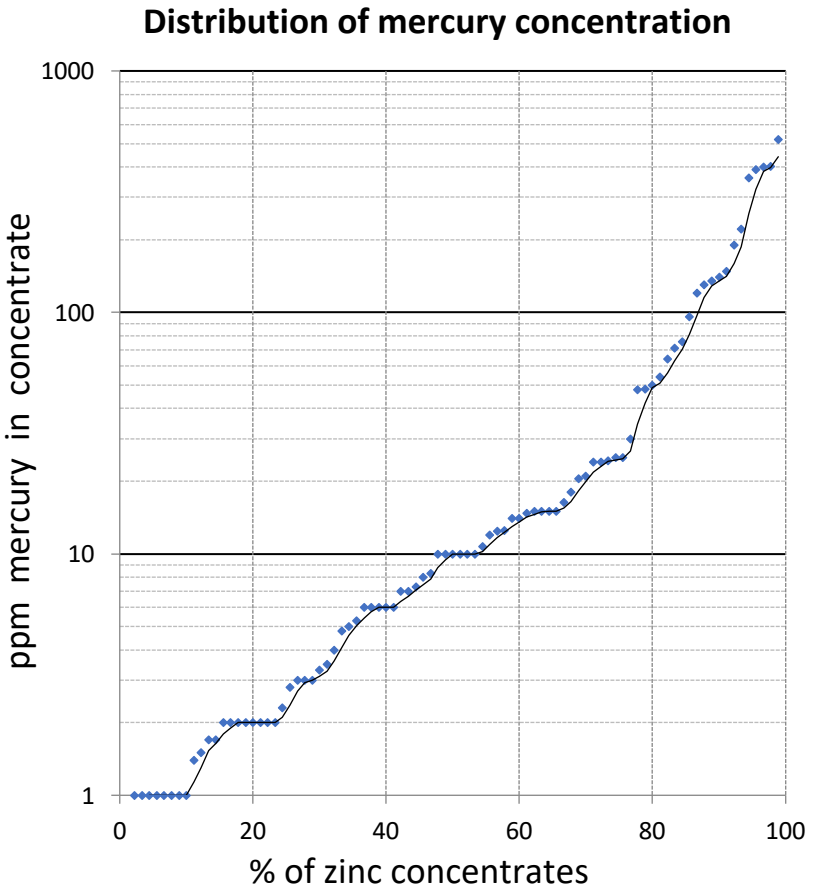
Test duration
As oxidation, dissolution and interaction of “fresh” minerals in tailings are known to be slow enough to approximate initial near-equilibrium conditions, and weathering processes control release from tailings over the longer term , the duration of the chosen test is not to exceed 24-hours.

Mercury management in zinc smelting

- General considerations on emission control in zinc smelting
- Environmental performance of EU zinc smelters

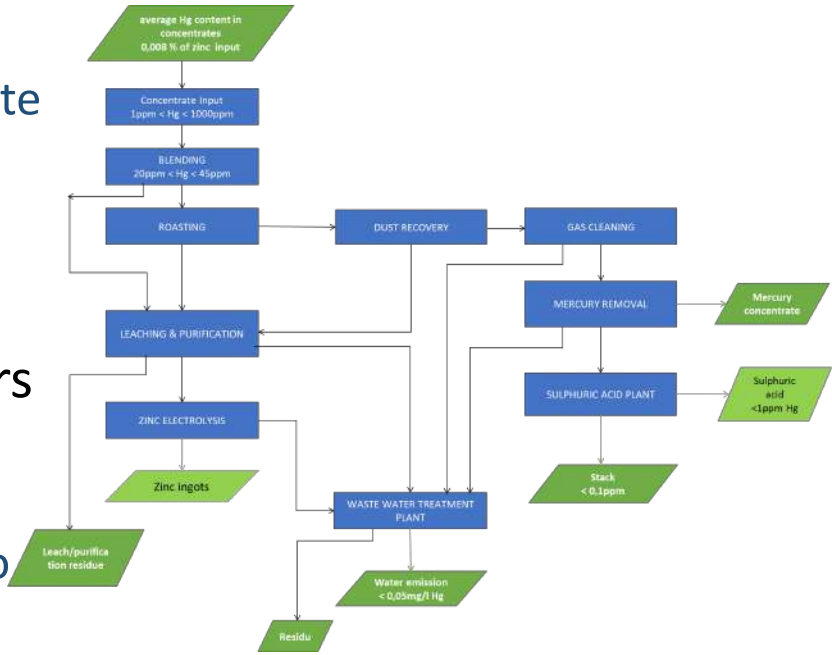
Zinc mineral concentrates in zinc refining:

- Mercury is found in small concentrations in zinc mineral deposits
  - Zn concentrates (+/-50% Zn) can contain a.o. up to 0,1% Hg
  - 50% of Zn concentrates have less than 10 ppm Hg
  - Average value 40 ppm Hg
- Zinc refineries use mixed concentrate input.
  - Most zinc mines produce too little concentrates to run a smelter
  - Composition of many zinc concentrates is not ideal to process in a zinc smelter
  - Smelters use a mix of mineral concentrates and secondaries to ensure a stable composition and controllable behaviour in the process.



Mercury removal in zinc smelting:

- Coolers and scrubbers remove +/- 50% of the mercury
  - Output is a water flow which is treated to precipitate Hg, typically as HgS.
  - Precipitated sludge from wastewater treatment is stored in approved waste storage facilities.
  - Final emissions to water are very low (<0,05% of input)
    - ✓ Precipitation of Hg as HgS allows removal down to very low concentrations of Hg in water (<1µg/l, often <0,1µg/l)
- Additionally, the Boliden-Norzink process is applied by most smelters which captures another 50% of the mercury
  - Output is a calomel sludge
  - Can be refined to metallic mercury or stabilized and disposed according to regulations.
- Other techniques to capture mercury exist but far less common.
- Stack emissions of mercury typically <1ppm (<0,25% of total Hg input)



=> UNEP toolbox was updated to reflect evolution in zinc smelting

Mercury: disposal or sales?

- Commercialized mercury originating from zinc smelters is steadily decreasing
- Several reasons
  - ➢ Legislative restriction to sell or export mercury (e.g. in EU)
  - ➢ Falling demand due to restrictions in use or development of alternatives for mercury
    - ✓ Hg gas discharge lights replaced by LED lights
    - ✓ Dental amalgam replaced by ceramics
    - ✓ Replacement in instrument like temperature and pressure measurement and switches
  - ➢ Big uncertainty about downstream sustainable use
    - ✓ Companies become more hesitant to commercialize mercury due to uncertainty on its final use.
      - Balancing between legal (un)certainty of acceptable mercury disposal conditions and control over downstream use when commercialized
      - Sustainability of operations has moved high on the agenda of zinc refiners.

Mercury disposal in the EU

- Most mercury from EU zinc smelters' BNZ filters is stabilized and environmentally safely stored according to EU waste regulation
  - Stabilized as very stable compound: sulphide or sulpho-selenide
  - Stabilisation often done by specialized third parties
  - Packed in sealed drums
  - Mostly stored in decommissioned potash mine caverns at K&S Germany but some in granite rock caverns.
- Precipitated mercury from waste water treatment is stored in sealed ponds.
  - Storage conditions aligned with regulation, ensuring appropriate containment and avoiding releases to the environment (groundwater, air)

Mercury emissions and releases in the EU

- Releases to water (E-PRTR): 6,35kg/y
  - Releases of most plants below the reporting threshold of 1kg/y.
  - Total release by all EU zinc smelter: <15kg/y (including from smelters below reporting threshold)
- Releases to air (E-PRTR): E-PRTR: 58kg/year
  - Releases of most plants below the reporting threshold of 10kg/y.
  - Total EU emissions to air from zinc smelting <100 kg/year (including from smelters below reporting threshold)

Note: Refined zinc output from EU + Norway represents 1/6 of world zinc output.

Global outlook

- The Minamata Convention has brought the environmental hazard of mercury to the attention of regulators worldwide.
  - Increasing number of zinc smelters outside EU have installed mercury filters
  - Implementation of sulphide precipitation in waste water treatment has become more standard practice
- The status in the EU demonstrates what is achievable:
  - When average environmental performance relative the mercury of all zinc smelters worldwide reaches the same performance as EU zinc smelters, the worldwide mercury releases to the environment would be limited to:

    < 90 kg/y to water

    < 600 kg/y to air

Thank you for your attention

Mik Gilles
International Zinc Association
mgilles@zinc.org

Questions and Answers

facilitated by Kenneth Davis, *Chemicals and Health Branch, UNEP*

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Part 2

facilitated by Misuzu Asari, *Co-lead of the Waste Management Area*

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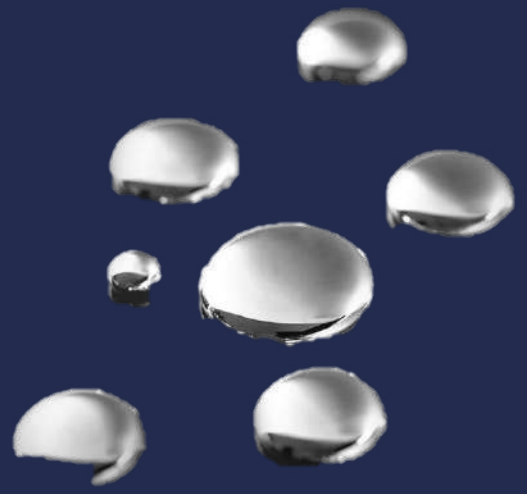
Environmentally sound management of mercury from the mining and smelting of non-ferrous metals in Argentina



Webinar on Mercury from Non-ferrous Metals Mining and Smelting

Thursday 21 March 2024

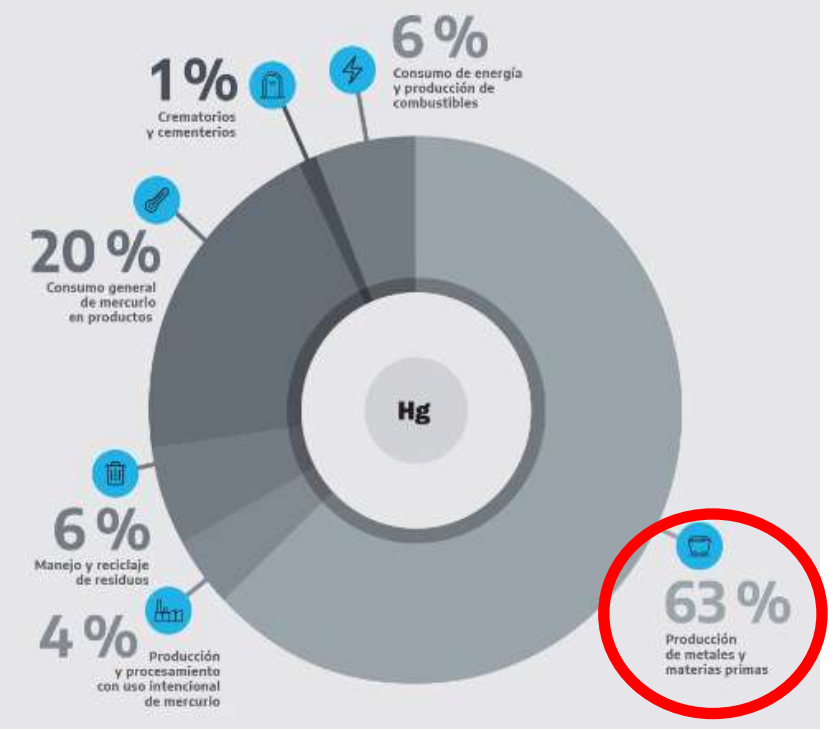
Secretaría de Turismo, Ambiente y Deportes
Ministerio del Interior

Subsecretaría de Ambiente

Coordinación de Residuos Peligrosos

Coordination of Hazardous waste

Initial Assessments of the Minamata Convention



- 60% to Byproducts and impurities (mainly from gold extraction by methods other than amalgamation)
- 15% to waste that will receive treatment that includes the sector, but is not the only one.

- Argentina does not register primary production of mercury.
- Large-scale gold production is distributed in 12 mining sites and the presence of mercury was detected in 2 of them.

Environmentally sound management of mercury

Argentina regulations

1991

Law 23.922
Basel Convention approved

Law 24.051
Hazardous Waste Management

2017

Law 27.356
Ratification of the Convention Minamata in Argentina

2019

Resolution 71/2019
PIC for mercury impo/expo

Resolution 75/2019
Prohibitions are established according to the Convention

2021

Resolution 299/2021
Regulates the supply, trade and use of elemental mercury and compounds, and its exemptions

- Prohibition of the use of elemental mercury, its mixtures or compounds in production processes
- Import prohibition: If the elemental mercury, its mixtures and/or compounds are intended to be used in small and large scale amalgamation extraction and gold processing activities and in artisanal gold extraction

2022

Resolution 503/2022
Conditions relating to reconversion plans

2023

Resolution 350/2023
Storage conditions element mercury: substance and waste

2025

Exemption for production and trade of mercury thermometers ends

2030

Exemption ends for chlor-alkali industrial process

Resolution 350/2023:

- The minimum technical requirements for the storage of mercury are established, which must be met by those subjects who have said material in their possession.

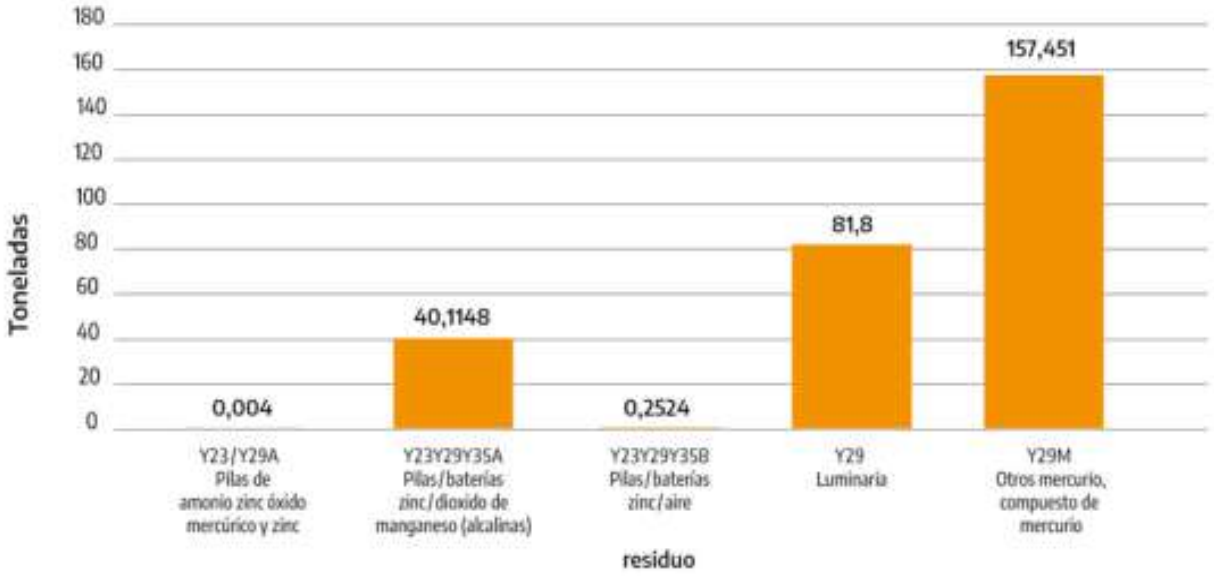
- Some requirements:
- IDENTIFICATION OF MERCURY

- 1.1. Identification of the substance:

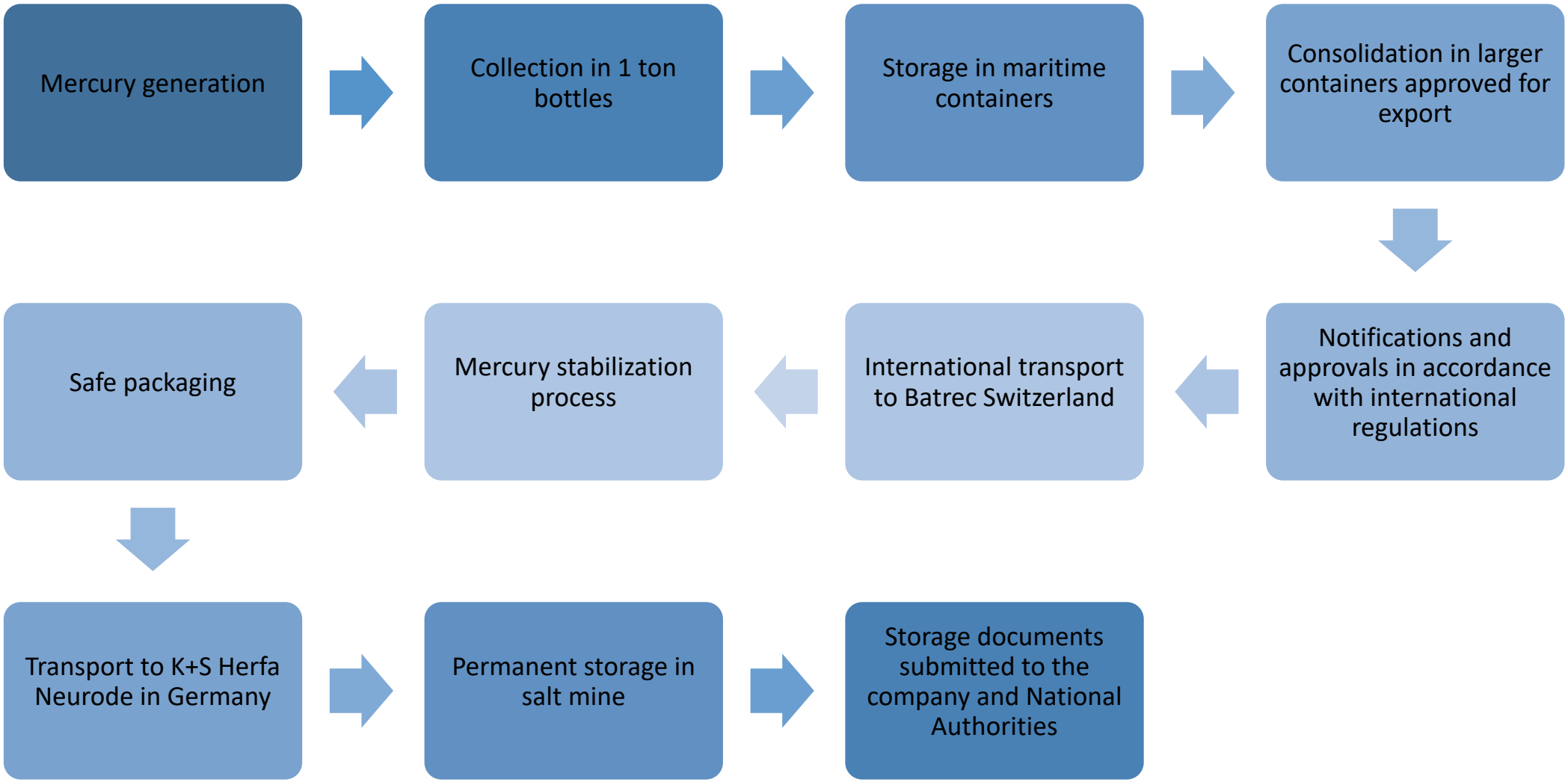
- 1.2.4. Labeling or Label:

Environmentally sound management of mercury waste

- Within the framework of Law 24051 there is only one mercury compound waste operator, located in the province of Buenos Aires.
- There are currently no operators authorized to treat waste elemental mercury and other mercury compounds.
- For its management, it is exported to countries with said treatment and final disposal capacity.
- This process of cross-border movement is regulated by the Basel Convention, hence the synergy process with the Minamata Convention.
- Regarding waste generated in 2022, around 279.62 tons have been treated.



Export process from generation: example of gold mining



Ministerio de Ambiente y Desarrollo Sostenible Argentina

CIAM Centro de Información Ambiental

SInIA Sistema Integrado de Información Ambiental

Institucional Datos Geoinformación

Buscar

Agua | Suelo | Biodiversidad | Bosques | Áreas protegidas | Educación y Participación | Residuos | Riesgo | Cambio climático

- agroquimicos obsoletos (Y4) tratados
- Cantidad de residuos de mercurio tratados
- Cantidad de residuos de pilas y baterías tratados
- Cantidad de residuos hidrocarburos, emulsiones y aceites vegetales tratados
- Cantidad de residuos peligrosos tratados en interjurisdicción, por operación de eliminación
- Eliminación de residuos contaminados con PCBs
- Exportación de Residuos Peligrosos
- Indicador 12.4.1 Nivel de cumplimiento de los compromisos y obligaciones ante los Acuerdos Multilaterales de productos químicos y desechos de los cuales Argentina es Parte
- Operaciones de acuerdo al Anexo III de la Ley

Residuos / **Residuos peligrosos** / Cantidad de residuos de mercurio tratados

TABLA | GRÁFICO | METADATOS

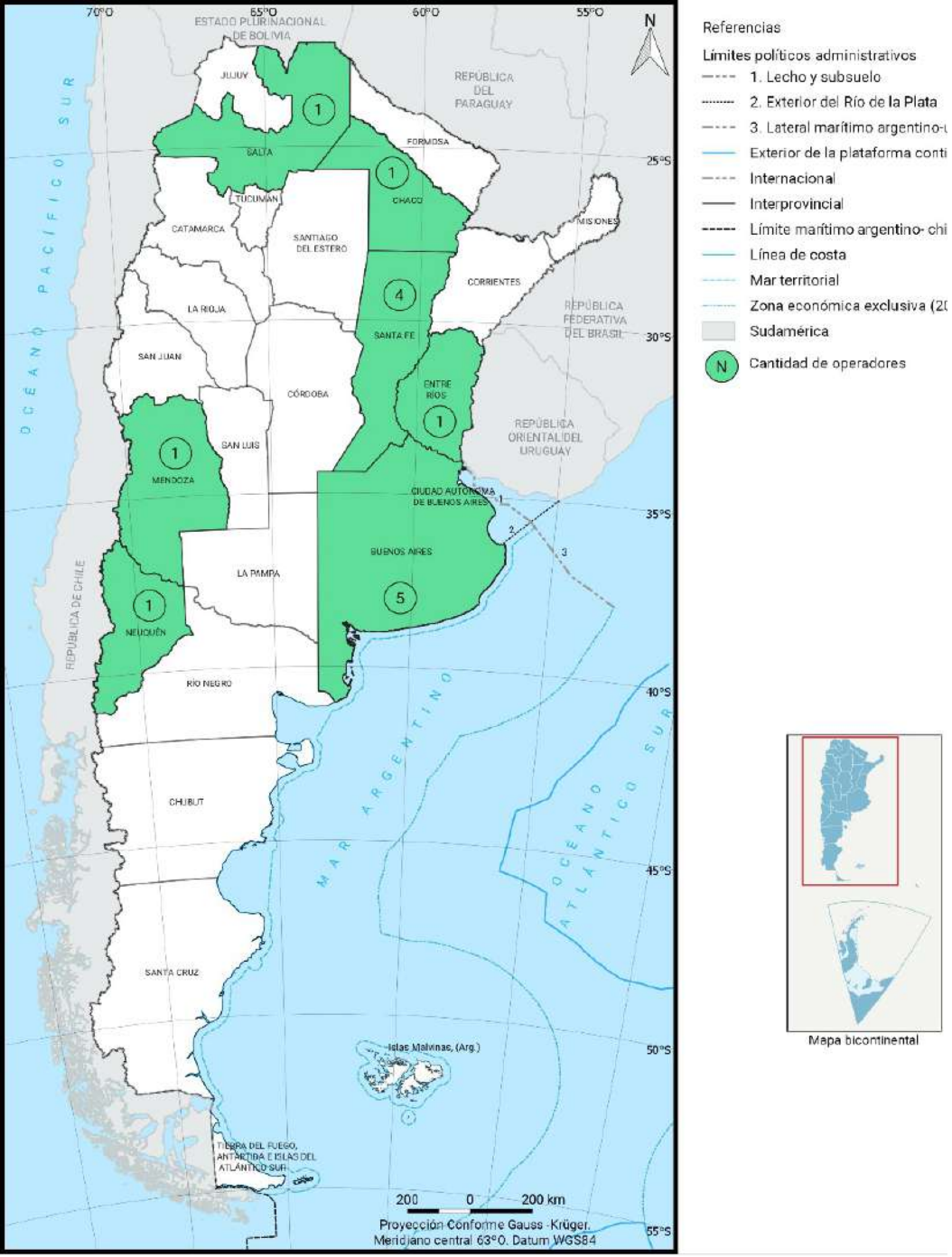
tipo de residuo tratado	descripción de residuo	toneladas
Y23/Y29A	Pilas de amonio zinc óxido mercúrico y zinc.	0.00
Y23Y29Y35A	Pilas/baterías zinc/dióxido de manganeso (alcalinas)	40.11
Y23Y29Y35B	Pilas/baterías zinc/aire	0.25
Y29	Luminaria	81.8
Y29M	Otros mercurio, compuesto de mercurio	157.45

Strengthening analytical capacity

Two laboratories from public national universities were equipped, which collaborate with the Ministry. This investment makes it possible to improve the quality of environmental data produced in the academic field and put it at the service of management and decision-making for public policies.
The total amount invested was more than 63 thousand dollars.
The objective is to carry out environmental monitoring, including pilot projects developed and national monitoring plans.
The first monitoring was carried out in a gold extraction mine in Argentina.

Registry of Emissions and Transfer of Pollutants (RETC)

It is a key tool for pollution prevention and access to environmental information.



Fuente: Elaboración propia con datos de la Dirección Nacional de Sustancias y Productos Químicos, MAyDS.

Challenge and needs in managing mercury

In particular from this Sector:

1. Mercury waste management
- Treatment of elemental mercury waste and compounds
- Treatment technologies / technology transfer

2. Reduction of emissions and releases and waste generation.

3. Data collection on emissions and releases

4. Articulation and coordination with local authorities.

¡Thank you!

Marisol Diaz Rivera
National Coordinator of Hazardous Waste
Argentina

Official website: chemicals and hazardous waste in Argentina

Secretaría de Turismo, Ambiente y Deportes
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Coordination of Hazardous waste

Global Mercury Partnership
Waste Management Area

Batrec Industrie AG

Treatment of mercury wastes and stabilisation of mercury from the Non-Ferrous Metal industry

David Hunter 21st March 2024 david.hunter@batrec.ch +41 7 93 83 53 12

SARPI in brief – European hazardous waste network of Veolia

BATREC
Swiss quality recycling solutions

*OUR **MISSION***

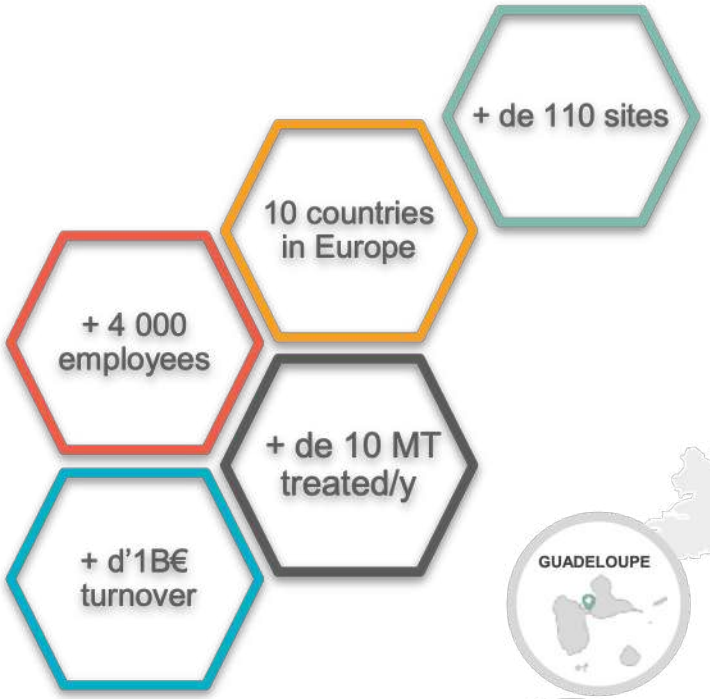
“ To support industrial and territorial development through sustainable risk management of waste.”

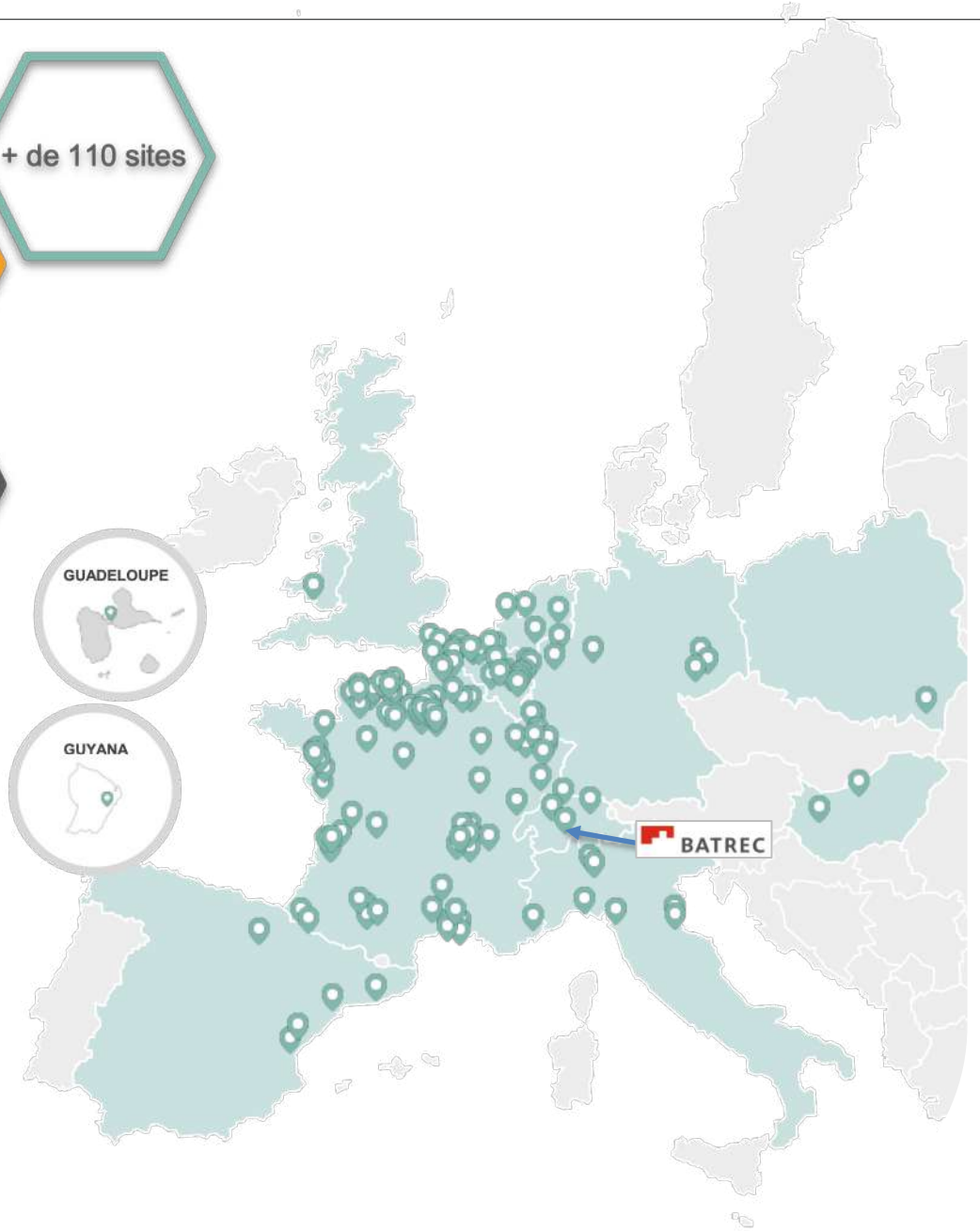
*OUR **JOB***

“ Treatment and recovery of hazardous waste and polluted sites.”

*OUR **MODEL***

“ A european network of facilities and services integrating the entire treatment and recovery chain including final containment of residual waste.”





SARPI VEOLIA

BATREC Industrie AG

BATREC
Swiss quality recycling solutions

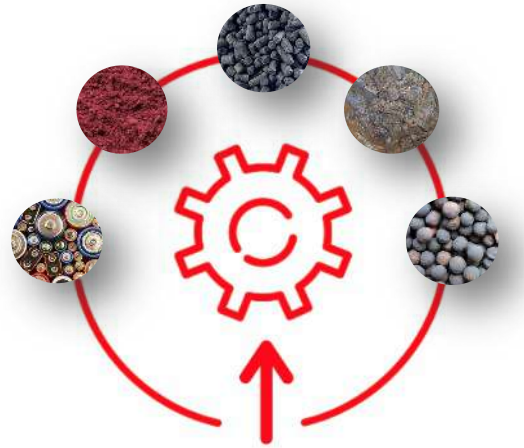
Wimmis

1991

FUNDATION

ISO 9001
ISO 14001
OSHAS 18001

CERTIFICATIONS



Liquid Mercury Stabilisation
Activated Carbon reactivation
Mercury wastes treatment
Mercury adsorbents recycling
Battery recycling

5 CORE SPECIALITIES

BATREC Industrie AG

BATREC
Swiss quality recycling solutions

Wimmis

Mercury Waste Treatment – Batrecs Capabilities

BATREC
Swiss quality recycling solutions

able to treat any type of waste containing Mercury

Distil Hg-containing waste ➔ Transform highly toxic Hg to HgS ➔ Permanent Storage of HgS

Mercury Waste Treatment – Batrecs Capabilities

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Wastes from Non-Ferrous Metal Mining/Smelting Industry

BATREC
Swiss quality recycling solutions

Batrecs advantage – versatility, expertise and focus

How can Batrec remain so versatile?

Treatment Flexibility
Multiple treatment options for different mercury wastes

Expertise
Batrec attracts and develops world experts in the fields of mercury waste, technology, HSE and regulation

Health & Safety
Experts in mercury safety and world class safety systems installed to deal with dangers of mercury

Permitting
Established permits and control systems with Swiss and International authorities for uninterrupted waste flow

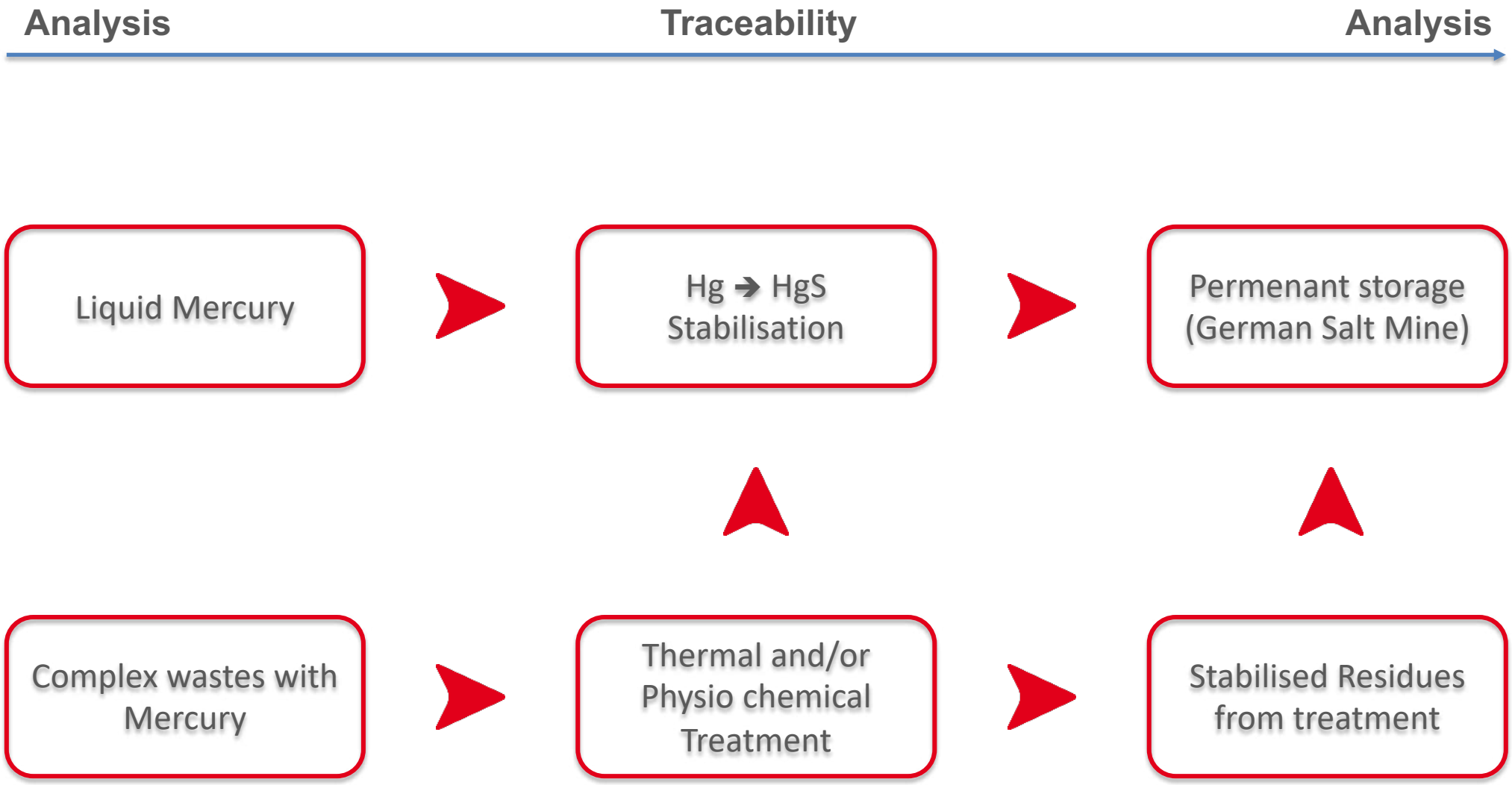
Compliance
Complete traceability of Hg and compliance with international laws and protocols

Capacity

~6,500 t /year

of incoming wastes containing mercury

Wastes from Non Ferrous Smelting Industry



Options – Cost and liability of treating mercury waste

= Non-Ferrous Metal Industry

= Batrec, dedicated mercury waste treatment plant

Treatment of Mercury Wastes

BATREC
Swiss quality recycling solutions

Treatment Process

Flowsheet

1 THERMAL TREATMENT

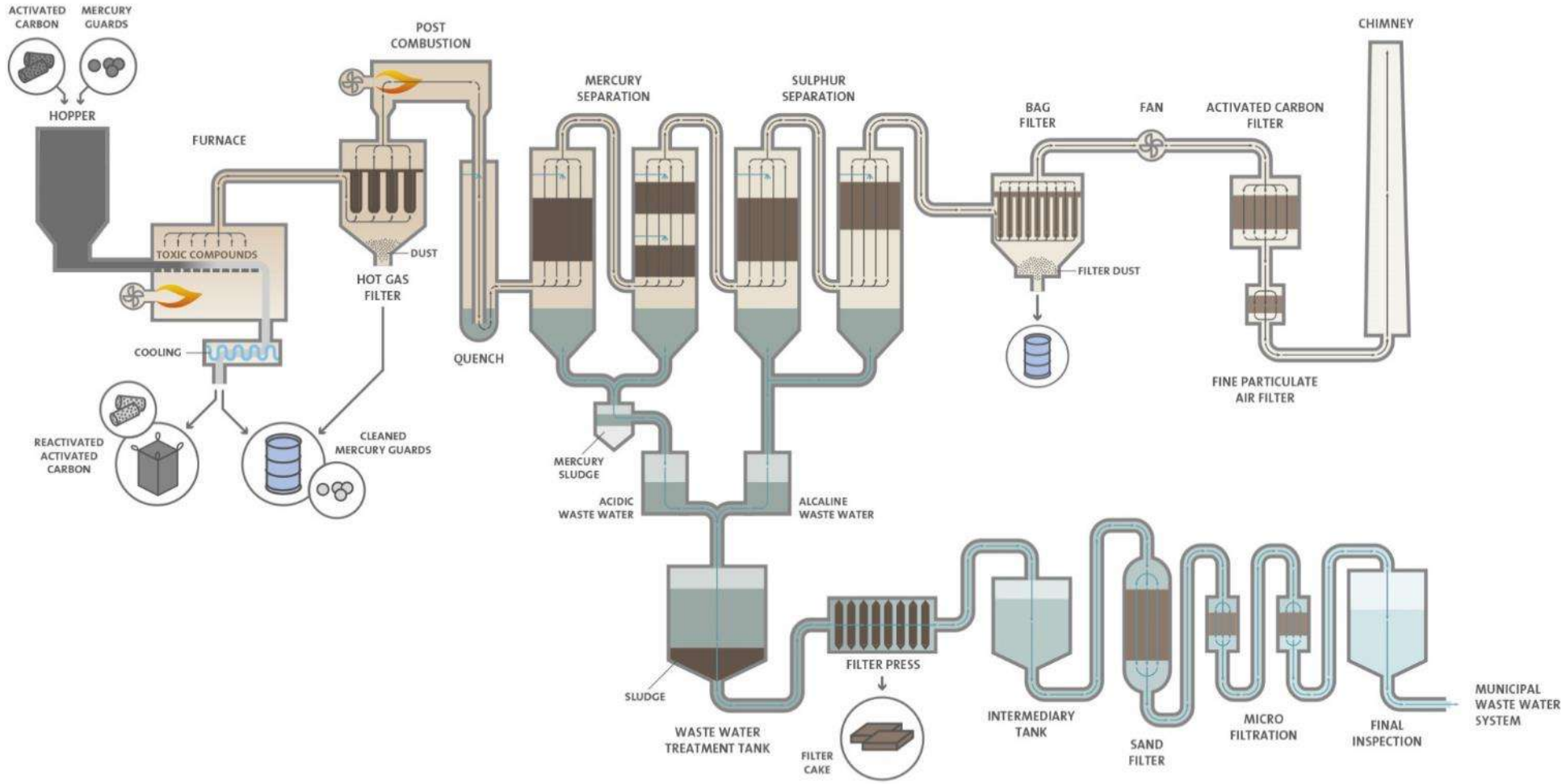
- desorption of the pollutants at 750 – 850°C
- destruction of the organic pollutants in the post-combustion chamber

2 WASTE GAS WET CLEANING

- condensation of Mercury
- removal of Sulfur

3 WASTE GAS DRY CLEANING

- removal of trace level Mercury
- removal of other pollutants and fine dust removal HEPA Filter



WASTE WATER TREATMENT

Treatment Process

Decontamination Furnace

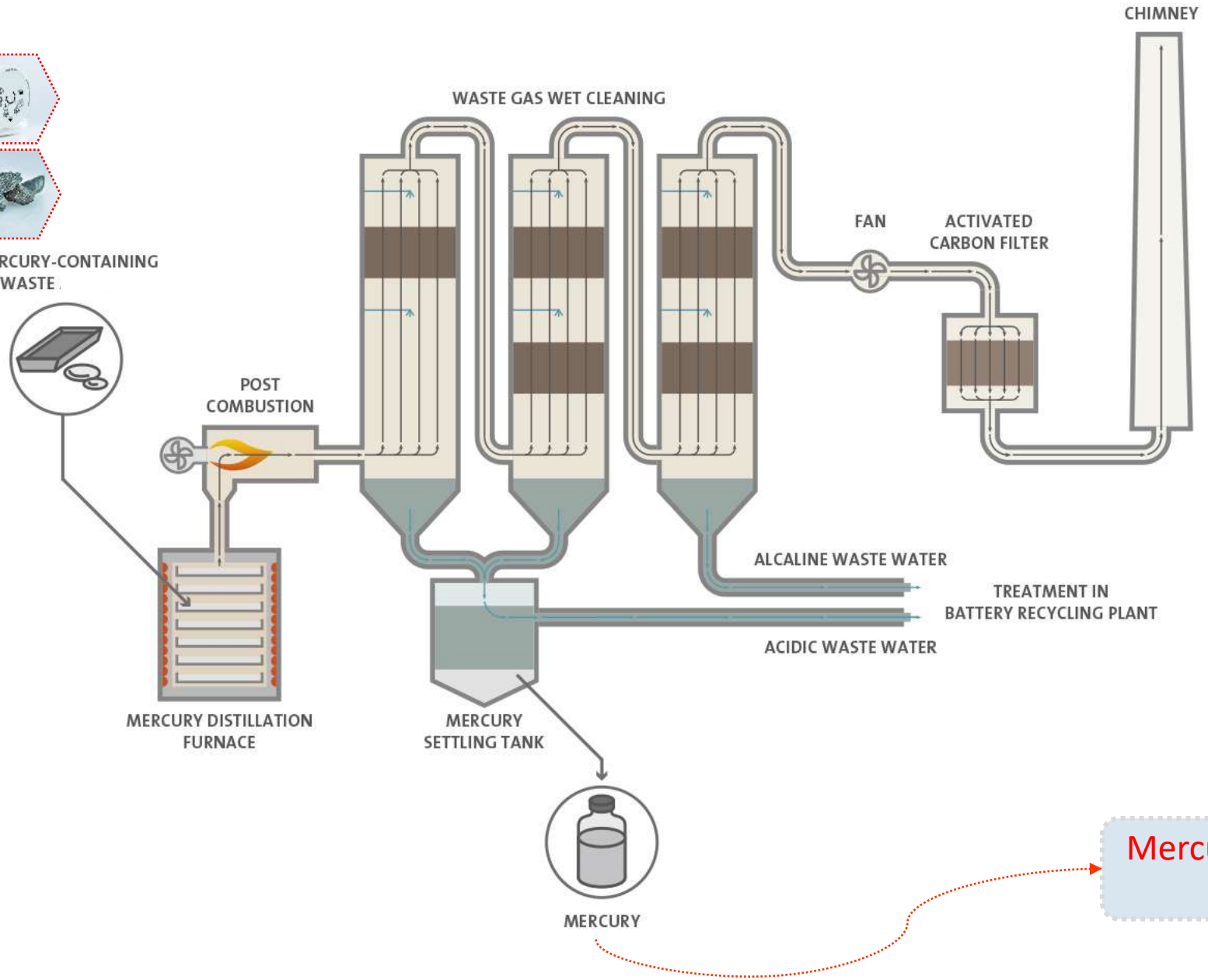
BATREC
Swiss quality recycling solutions

Treatment Process

Post-combustion chamber

BATREC
Swiss quality recycling solutions

Mercury Distillation – Process



Treatment of Mercury Wastes

BATREC
Swiss quality recycling solutions

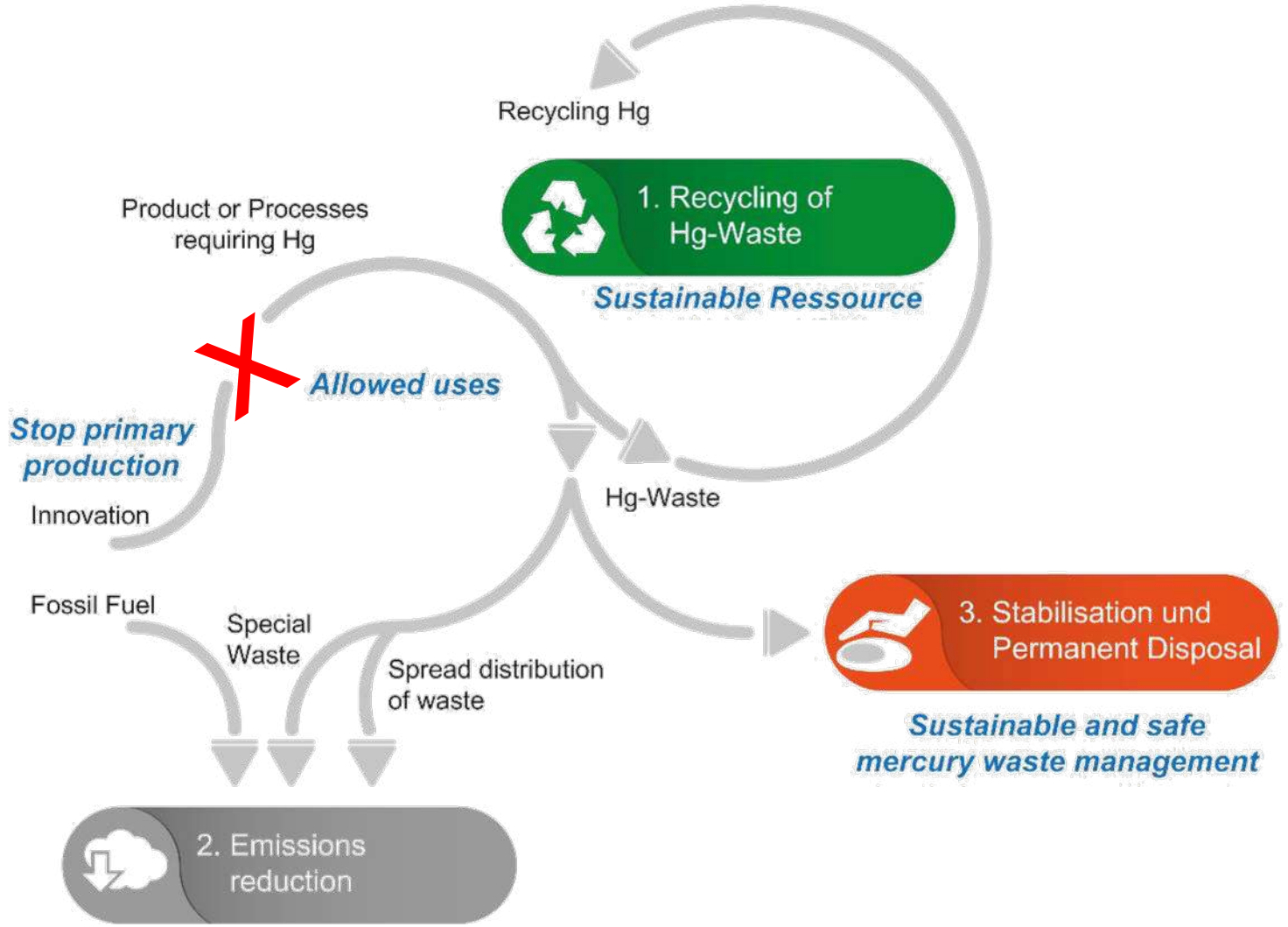
Mercury Operations

BATREC
Swiss quality recycling solutions

Why Stabilise Mercury? - The Minamata Convention

2018

Multilateral environmental agreement that addresses specific human activities which are contributing to widespread mercury pollution.

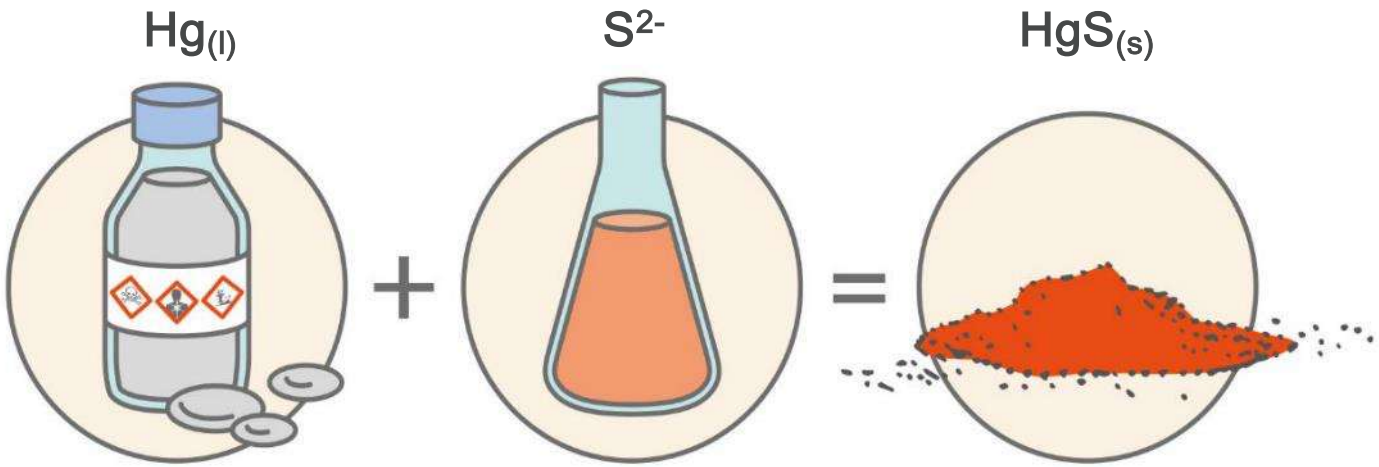


Mercury Stabilisation – Process

BATREC's approach

Transform highly toxic Hg into non-toxic HgS

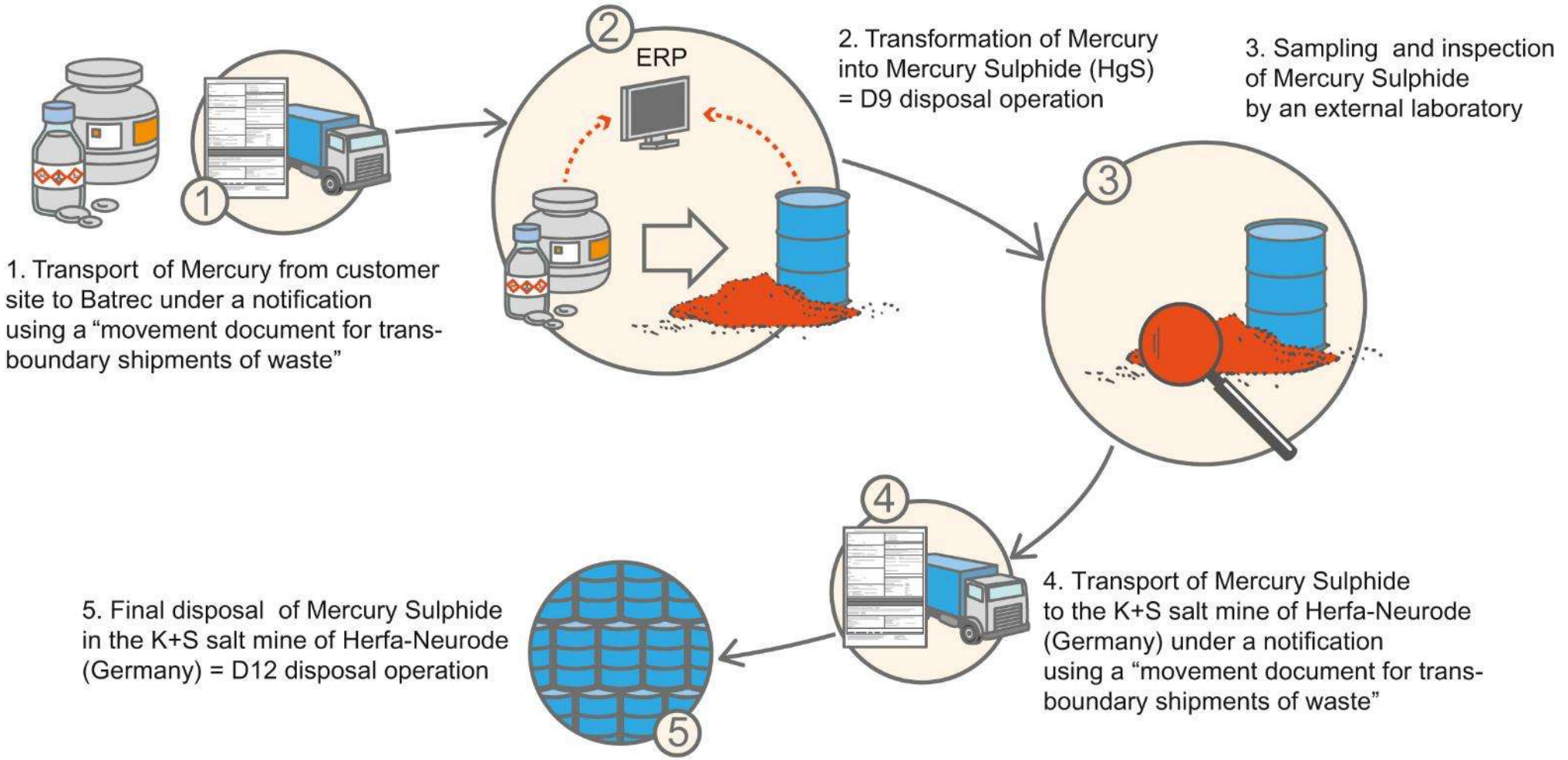
Controlled reaction at ambient temperature and pressure ➔ low risk, high conversion and consistent product



- HgS is non-toxic
- HgS is the most stable mercury compound
- HgS is the most insoluble mercury compound
- HgS is the natural mineral form [cinnabar] of Hg

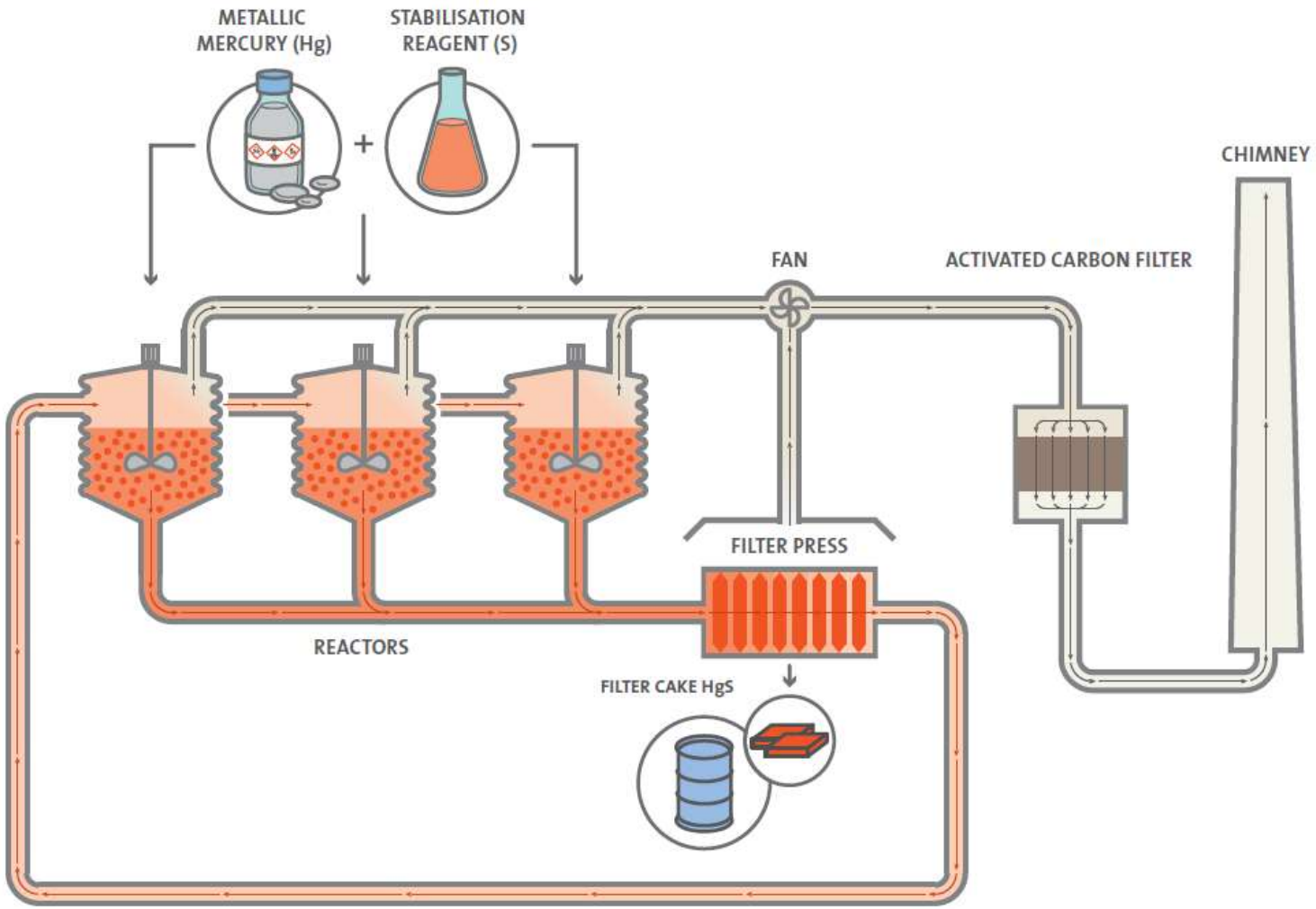
Mercury Stabilisation – Disposal solution - Salt Mine

Traceability is key



Mercury Stabilisation – Process

Capacity: 1.200 t/year



Process characteristics

- ✓ batch process
- ✓ wet process at low temperatures in a closed circuit limits the risk of Hg emissions
- ✓ no gaseous Hg in the process
- ✓ stabilisation solution is regenerated
  → *zero effluents produced*
- ✓ simple reactants

Mercury Stabilisation – Disposal solution

Safe permenant storage of HgS in a salt mine (Germany)

Long-term-safe removal of hazardous wastes from the biosphere

Acceptance criteria

Restricted acceptance criteria

e.g.
Not biodegradable
Not releasing gases
Non-liquid
Not radioactive
No insufficient stability of geomechanical conditions

Shaft transport

Underground transport

Storage chambers

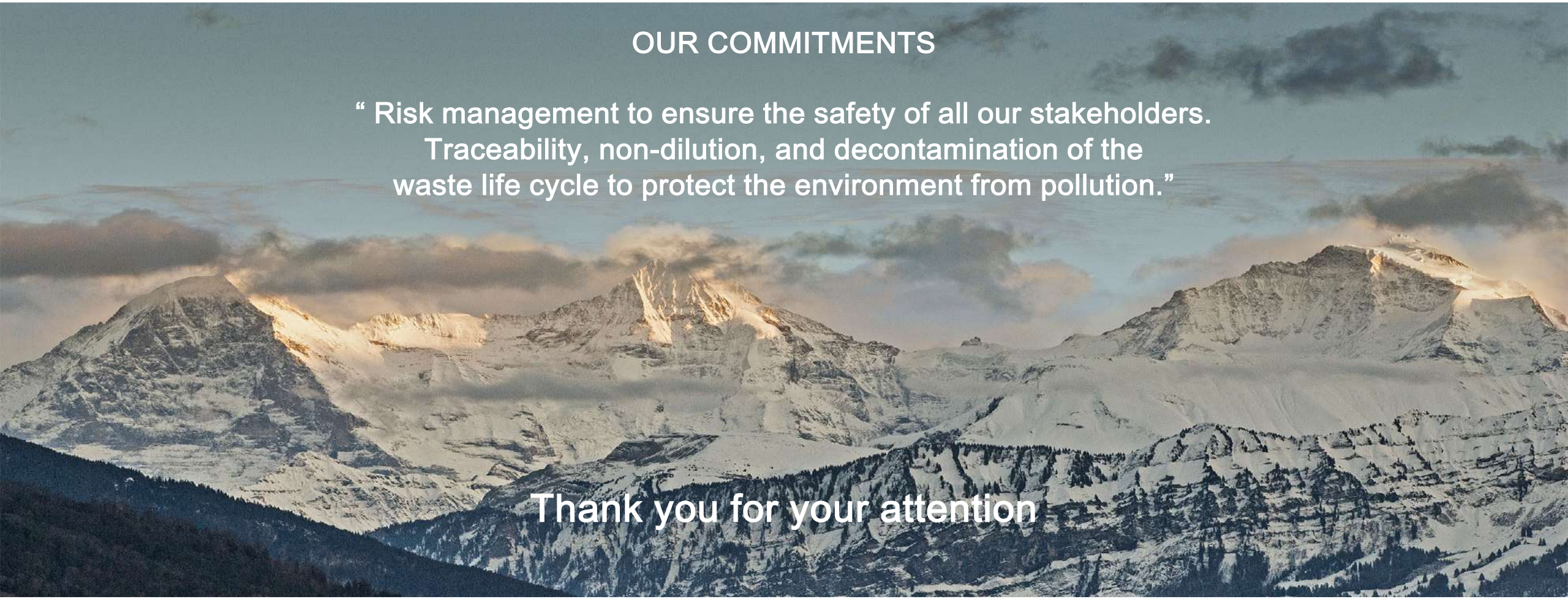
Sealing of by walls

Natural barriers

Salt
Clay
Bunter stone

Artificial barriers

Waste packaging
Brick walls…



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econ INDUSTRIES

VacuDry®

On-site Mercury Stabilization: The safest solution for Hg disposal

Agenda

1 Market Position

2 Technologies for Mercury Treatment

3 Mobile Mercury Conversion unit

4 References

Market position

Who we are

- econ is a family owned business & was founded in 2003 as machinery supplier
- 30 hazardous waste treatment projects (20 VacuDry® units) worldwide, on 3 continents, in 13 different countries
- econ provides the most efficient and cleanest solutions to recover resources from industrial hazardous wastes

2007

World's first mercury recovery from NORM waste

2016

Mobile Mercury Conversion Unit

2018

1st mercury recovery facility of the southern hemisphere (Australia)

2021

VacuDry® for mercury clean up in India

2023

NORM waste treatment center

Currently commissioning two VacuDry® units for Greece and manufacturing one MMCU unit for Australia

Agenda

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4 References

Mercury Treatment Technologies

3 Technologies for recovery & disposal

Recovery of mercury

VacuDry®

VacuDry® - vacuum distillation

- Max. 400 °C
- Low vacuum < 50 mbar(abs)
- For soils & sludges cont. with elemental mercury

HTTU

High Temperature Treatment Unit

- Max. 1000 °C
- Atmospheric pressure
- For spent activated carbon & catalyst cont. with mercury compounds

Conversion of mercury

MMCU

Mobile Mercury Conversion Unit

- max. 200 °C
- Atmospheric pressure
- Conversion of pure elemental Hg to HgS (cinnabar)

Mercury Treatment Technologies

Concept

Recovery of mercury from hazardous wastes and stabilization for final disposal

Mercury waste

Vacuum Distillation Pre-treatment

- Water
- Oil
- Mercury
- Solids
- Off-gas

Recovered Mercury

Conversion of Hg to HgS

Safe disposal / safe storage

Agenda

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4 References

Mobile Mercury Conversion Unit

Conversion process / Working principle

Elemental Mercury

Elemental Sulphur

MMCU - Mobile Mercury Conversion Unit

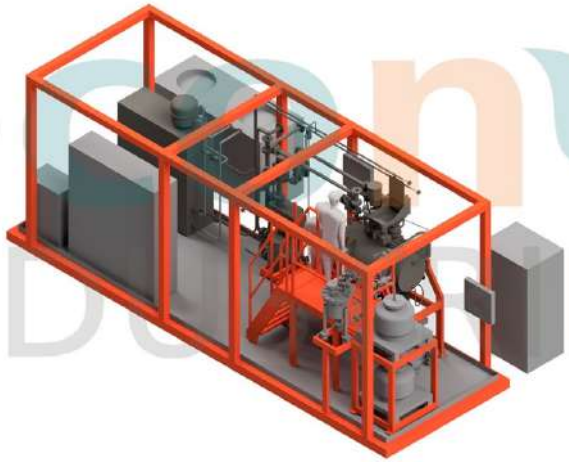
Mercury sulphide (HgS)

Conversion of pure elemental mercury (Hg) to mercury sulphide (HgS / cinnabar)

Mobile Mercury Conversion Unit

Technical specifications

MMCU 150



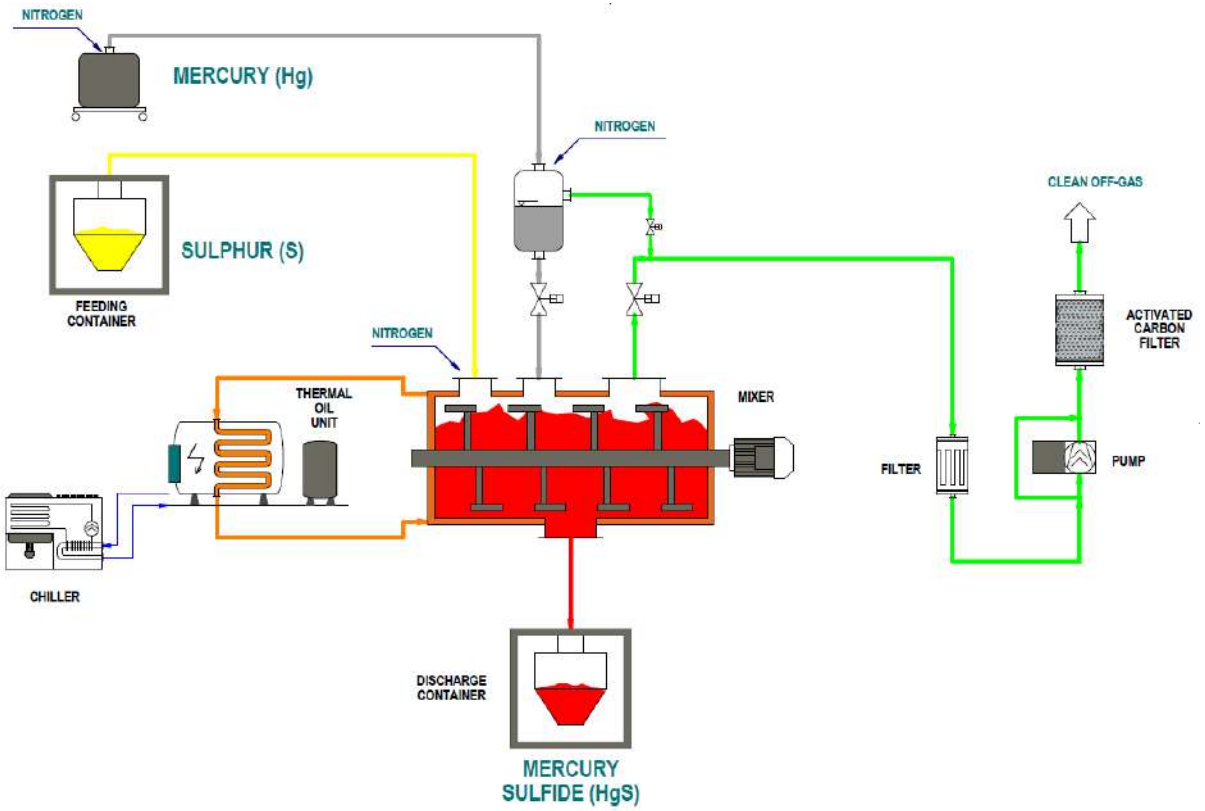
MMCU 1 500

- **Input material:** metallic mercury + sulphur
- **Throughput capacity*:** 200 kg per batch (MMCU 150)
  1,500 kg per batch (MMCU 1 500)
  ** 3 – 4 batches per day*
- **Product treatment parameters:** liquid conversion process
  max. 200 °C material temperature
  at atmospheric pressure
  nitrogen atmosphere
- **Solid output material:** 99.999 % conversion to HgS with
  Hg emissions < 10 µg/m³
  discharge temperature < 80 °C
- **Staff required:** 1 staff for MMCU 150
  2 staff for MMCU 1 500
- **Delivery time:** 8 – 9 months for manufacturing

Mobile Mercury Conversion

For final disposal of pure elemental mercury

MMCU Flowchart



Specifications

- Nitrogen atmosphere, safe and hermetically closed mixer
- Operation under ambient pressure
- Mercury and sulphur are fed to the mixer
- Increased temperatures inside the mixer by the thermal oil unit
- active cooling of the mixer
- Liquid phase chemical reaction
- Low off-gas flow during stabilization process

An inert atmosphere and a liquid phase chemical reaction ensure safe operations

Mobile Mercury Conversion Unit

Disposal procedure

- Once stabilised into mercury sulphide (cinnabar), the mercury can be disposed of underground in salt mines (Germany - Europe) or in secure or chemical landfills (other continents).

Packaging (requirement)

- Plastic inliner

- Metal drum

The resulting HgS successfully passes the landfill acceptance criteria.

- Mercury conversion – 99.999%
- Hg emissions “air” < 10 µg/m^3 (20 µg/m^3 – Salt mine threshold)
- Leachate test < 0.025 mg/L (Method TCLP1311 - US EPA) – not required in Europe

Agenda

1 Market Position

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3 Mobile Mercury Conversion unit

4 References

References / Update

econ stabilized more than 500 tons of Hg on-site

UK – chlor-alkali plant:

400 tons Hg converted to HgS on-site

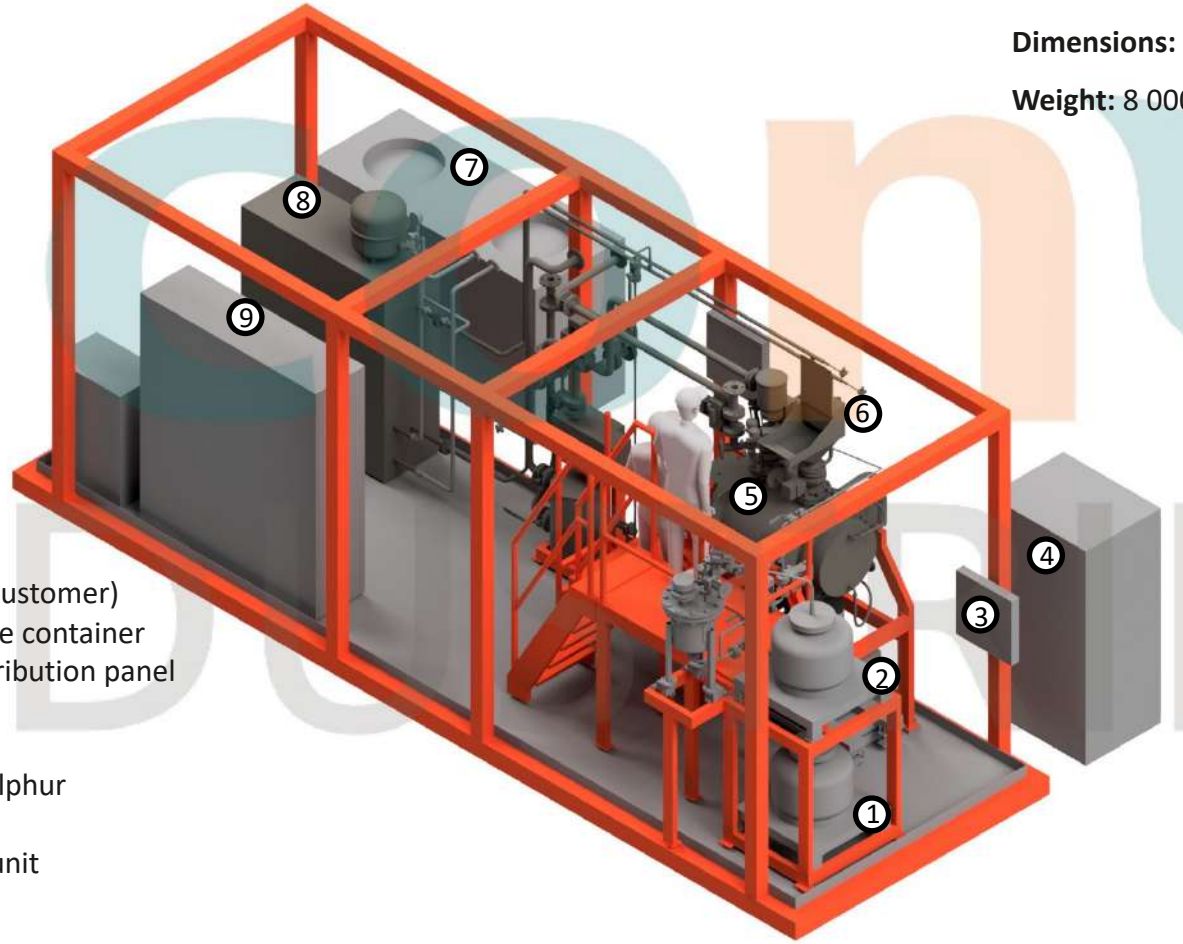
Poland – chlor-alkali plant:

130 tons Hg converted to HgS on-site

HgS was sent to salt mine (K+S) for final disposal

References / Update

MMCU 150 for Australia



Dimensions: 8m x 2.6m x 3.2m (L x W x H)

Weight: 8 000kg (approx.)

1. Mercury container (customer)
2. Mercury intermediate container
3. Air and nitrogen distribution panel
4. Nitrogen supply
5. MMCU – Mixer
6. Feeding Hopper – Sulphur
7. Cooling system
8. Thermal oil heating unit
9. Electrical cabinet

Australia will be 100 % independent in terms of sustainable Mercury Waste Treatment

Conclusion

Outcomes and Main Benefits

Mercury Stabilization
- **>99.995%** conversion of Hg to HgS

Local Treatment
- **Lower transport costs** and risks
- Avoid transboundary permits

Mobile Unit
- **Skid-mounted** units
- **Increased flexibility** in terms of treatment sites

Safe and Final Disposal
- **HgS** is the **most stable Hg compound** for final disposal (low leachability)

Reliable
- **>500 tons already stabilized** in Europe using the MMCU technology

econ industries provides
the most efficient and cleanest
solutions …

… to recover resources
from special wastes worldwide.

Q&A

econ INDUSTRIES

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Questions and Answers

facilitated by Misuzu Asari, *Co-lead of the Waste Management Area*

UN environment programme

GLOBAL MERCURY PARTNERSHIP

Next steps and closing remarks

Rodges Ankrah
U.S. Environmental Protection Agency, Co-Chair of the UNEP Global Mercury Partnership Advisory Group

UN environment programme

GLOBAL MERCURY PARTNERSHIP