

Mercury Handling Guidelines



1. Facts and figures

Physical properties of mercury

Chemical symbol	Hg	
Density	13.55 g/cm ³ (at θ = 25 °C) [1]	
Molar mass	200.59 g/mol [1]	
Melting point	234.29 K (-38.86 °C) [1]	
Boiling point	629.88 K (356.73 °C) [1]	
Vapor pressure	0.0253 Pa	(at θ = 0 °C) [2]
	0.17 Pa	(at θ = 20 °C)
	0.391 Pa	(at θ = 30 °C)
	0.81 Pa	(at θ = 40 °C)
	1.69 Pa	(at θ = 50 °C)
Mass concentration θ in air (after reaching equilibrium)	2.0 mg/m ³	(at θ = 0 °C) [2]
	13.6 mg/m ³	(at θ = 20 °C)
	29.6 mg/m ³	(at θ = 30 °C)
	62.7 mg/m ³	(at θ = 40 °C)
	126.0 mg/m ³	(at θ = 50 °C)
Evaoparation rate	56 $\mu\text{g}/(\text{h cm}^2) \cdot \text{cm}^2$ [3]	
Solubility of elemental mercury in water	0.06 mg/L	(at θ = 25 °C) [1]

Toxicity

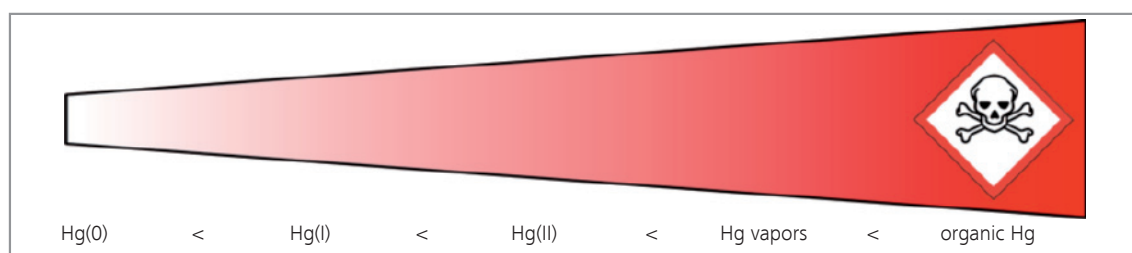
Mercury metal has a liquid state of matter at room temperature (approx. 20 °C) and normal pressure (approx. 1000 hPa).

Mercury and its compounds are toxic since they react with sulfur-containing enzymes and inactivate them. The toxicity depends on the chemical and physical state of the mercury [2, 4–6].

- **Metallic liquid mercury** is relatively harmless, but it is readily resorbed through the skin and finds its way through glandular passages into lower skin regions where it is oxidized and carried on as a salt.
- The sparingly soluble, inorganic **mercury(II) compounds** and metallic mercury in the form of a coherent liquid have low toxicity when taken up orally (but not through the skin!).
- **Mercury(II) compounds** are more readily soluble and therefore much more toxic.
Toxicity to fish: LC50 – *Oncorhynchus mykiss* (rainbow trout) – 0.016 mg/L – 96 h [13].

- **Mercury vapor**, which is already formed at room temperature, is highly toxic: vapor with a mercury concentration exceeding the TLV (threshold limit value) of 0.1 mg/m³ air causes chronic poisoning after prolonged breathing for 5 to 8 hours per day [12]. Despite the large number of laboratories involved in polarographic/voltammetric work, sensible and proper handling has ensured that not one single case of mercury poisoning has been reported to date. The real Hg concentrations measured in the laboratory atmosphere are consistently far below the TLV.

- **Organic mercury compounds** are very toxic. Dimethylmercury is an extremely toxic form of organic mercury, and very small exposures can cause severe and irreversible delayed neurotoxicity, including death. Dimethylmercury is thought to be metabolized to methylmercury prior to crossing the blood-brain barrier. Dimethylmercury is quickly absorbed through intact skin, and it will penetrate latex or polyvinyl gloves. It is highly volatile, will readily evaporate, and can be inhaled [5].

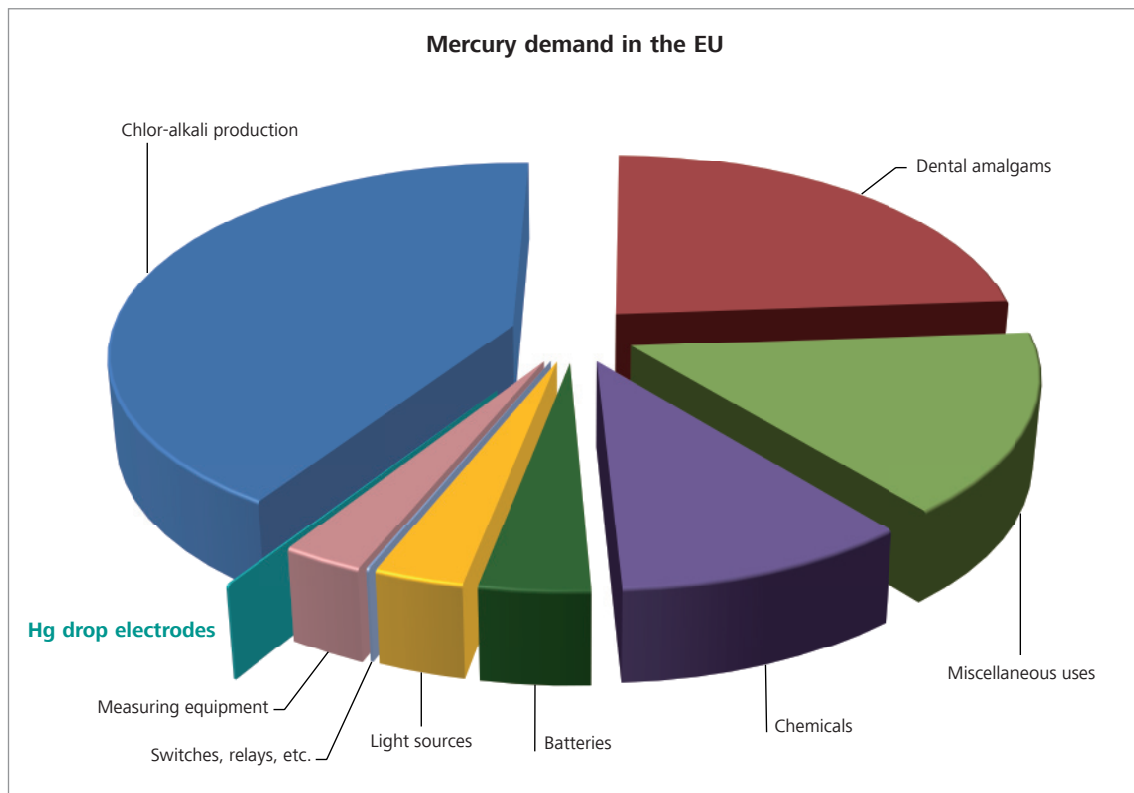


Applications with mercury

Most of the mercury is used in the chloralkali process. While other important applications are using huge amounts of mercury, the European demand for mercury used in polarography is rather small and can be easily kept in a closed material cycle.

Application	Mercury consumption (tons/year)	Percentage
Chlor-alkali production	160 - 190	41.2%
Dental amalgams	90 - 110	23.5%
Miscellaneous uses	15 - 114	15.2%
Chemicals	28 - 59	10.2%
Batteries	7 - 25	3.8%
Light sources	11 - 15	3.1%
Measuring equipment	7 - 17	2.8%
<i>Mercury drop electrodes</i>	<i>0.1 - 0.5</i>	<i>0.1%</i>
Switches, relays, etc.	0.3 - 0.8	0.1%

Source: (COWI – Consultancy within Engineering, Environmental Science and Economics, 2008) [8]



2. Handling of mercury in the laboratory

Several safety rules, described in detail below, must be observed in the handling of mercury owing to its toxicity.

Working in a fume cupboard

The handling of mercury should, if possible, always be carried out in a fume cupboard (fume hood). It must be ensured that no mercury drops are spilled on the floor or the lab bench and that no mercury evaporates.



Working over plastic trays

Vessels containing mercury must be carried in, or at least above, rigid seamless trays made of plastic or enamelled metal. The supplied 6.2711.030 drip pan made of polystyrene is eminently suitable for this.



Collecting spilled mercury drops

Single mercury drops in this drip pan or any other spilled mercury can be bound in a simple manner by amalgamation:

- With silver (Ag): Mercury drop catcher type 6.2406.000 which is included in the scope of delivery of the 797 VA Computrace.
- With tin (Sn): e.g., the thin tin foil supplied by Merck, Darmstadt/Germany [1]
- With special laboratory aids: e.g., Mercurisorb-Roth™ from Roth, Karlsruhe/Germany [9]
e.g., Mercury Spill Clean-up kit™ from J. T. Baker, Phillipsburg, N. J./USA [10]

Do not use a vacuum cleaner or a broom!



Collecting mercury from the measuring vessel

If the MME is used, mercury gathers on the bottom of the measuring vessel at the end of the determination, which must be collected for later disposal. This can be done by collecting the analysis solutions in a large vessel and then decanting.

Do not use the mercury catcher in the measuring vessel!



Empty reservoir of mercury drop catcher regularly

The storage container of the 6.2406.000 mercury drop catcher should be emptied regularly and rinsed thoroughly several times. If the mercury drop catcher is used outside the fume cupboard, keep a minimum safety distance of 50 cm between your head and the mercury trap.



Never leave mercury in open vessels

Mercury must never be left in open vessels. An upper layer of water or supporting electrolyte in no way suppresses or reduces mercury evaporation.



Store mercury container in fume cupboard

The tightly closed, small, unbreakable mercury container as well as all parts that come into contact with mercury must be stored in a fume cupboard, which is always switched on.



Ventilate laboratory areas well

Rooms where work with mercury is being carried out should be thoroughly aired from time to time.



Mercury and jewelry

Do not wear jewelry when working with mercury. Precious metals will amalgamate when getting in contact with metallic mercury. This will irreversibly damage your jewelry!

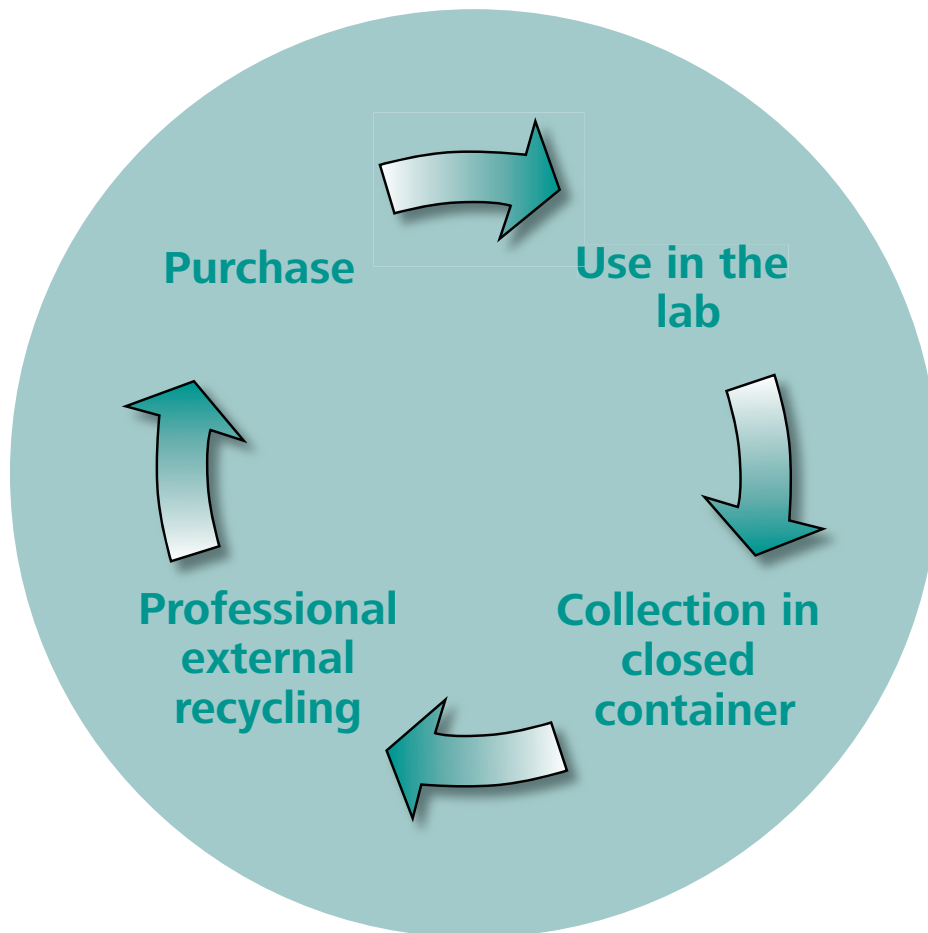


3. Mercury life cycle

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Goal

- No loss of mercury during use
- 100% recovery
- Occupational health and safety
- Environmental protection



Purchase of mercury for polarography

High-quality and high-purity mercury is needed for polarography. Examples of suppliers for mercury are:

Sigma-Aldrich Fluka [7]

- 99.9995%, for polarography, Fluka no. 83359
- 99.9999%, electronic grade, Aldrich no. 294594

Merck [1]

- 99.6%, for polarography, no. 104403
- $\geq 99.9999\%$, suprapur, no. 10440

NQR Nordische Quecksilber Rückgewinnung [10]

- 99.999999%, minimum order 500 g
- Shipment only within European Union (EU)

Disposal of used mercury

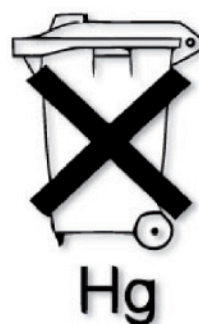
Mercury can be purified, but extensive laboratory setup is required and considerable time needed. For this reason, we recommend to collect waste mercury in a closed container and then send it for disposal or recycling to the responsible authorities or authorized companies in accordance with the particular national regulations.

- Do not reuse mercury.
- Only fresh, clean, and dry mercury can be used in polarography.
- Separate mercury from a black oxide layer prior to use if necessary.

Options to dispose used mercury from the lab:

- Recyclers for fluorescent lamps
- Recyclers for batteries
- Suppliers for mercury

Important: Mercury must never be disposed with the regular municipal waste!



4. General recommendations

General handling rules

- Work under a fume cupboard.
- Do not inhale mercury vapors.
- Avoid contact with the skin.
- Avoid generation of vapors or aerosols.
- Avoid spillage.

General storage rules

- Keep mercury in tightly closed vessels.
- Keep mercury in a well-ventilated place.
- Keep mercury locked up or in an area accessible only to qualified and authorized persons.

Personal protective equipment

- Hand protection
 - Glove material: Nitrile rubber
 - Glove thickness: 0.11 mm
 - Break through time: > 480 min
- Safety glasses
- Protective measures
 - Lab coat
- Hygiene measures
 - Immediately change contaminated clothing.
 - Apply skin-protective barrier cream.
 - Wash hands and face after working with mercury.
 - Do not eat, drink, and smoke when using mercury.

5. Literature dealing with mercury

[1] Merck Chemicals

<http://www.merck-chemicals.com/>

[2] Falbe, J. und Regitz, M. 1992

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[3] Euro Chlor – Code of Practice Mercury Housekeeping

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<http://www.chem.unep.ch/mercury/Sector-Specific-Information/Docs/ENV%20Prot%2011%20Edition%205.pdf>

[4] Mutschler, E. 1970

Arzneimittelwirkungen. Stuttgart: Wissenschaftliche Verlagsgesellschaft 1970. S. 379

[5] John Risher, Ph.D., Rob DeWoskin, Ph.D. 1999

Agency for toxic substances & disease registry. Toxicological Profile for Mercury. 1999.

<http://www.atsdr.cdc.gov/toxprofiles/tp46.pdf>

[6] Strong, L. E. 1972

Mercury Poisoning. J. Chem. Educ. 1972, Bd. 28, 49

[7] Sigma Aldrich

<http://www.sigmaaldrich.com/>

[8] COWI – Consultancy within Engineering, Environmental Science and Economics, 2008

European Commission. 12 2008

http://ec.europa.eu/environment/chemicals/mercury/pdf/study_report2008.pdf

[9] Carl Roth GmbH + Co KG

<http://www.carlroth.com>

[10] Avantor Performance Materials formerly Mallinckrodt Baker Inc.

<http://www.avantormaterials.com/>

[11] Nordische Quecksilber Rückgewinnung

<http://www.remondis-industrie-service.de/en/ris/spektrum0/produktion/quecksilber/>

[12] OSHA

Occupational Safety and Health Guideline for Mercury Vapor.

<http://www.osha.gov/SLTC/healthguidelines/mercuryvapor/recognition.html>

[13] Mercury(II) chloride

Material Safety Data Sheet Mercury(II) chloride.

<http://www.sigmaaldrich.com/>

www.metrohm.com

