Stabilization and Solidification of Mercury

Background

The Minamata Convention on Mercury has placed various restrictions on usage, import and export, and transboundary movement of mercury. The demand for mercury is expected to decrease in the future as the usage of mercury will only be allowed for certain uses specified in the Convention. Article 11 of the Minamata Convention calls for each Party to take appropriate measures to manage mercury waste in an environmentally sound manner. Hence, mercury that has become surplus will become waste and will require environmentally sound management (ESM). Furthermore, the Minamata Convention requires the phase out of Chlor-Alkali production facilities using mercury by 2025 and a lot of excess mercury is expected to be generated as a result. The paragraph 5 (b) of the Article 3 of the Convention specifically requires the environmentally sound disposal of excess mercury from the decommissioning of chlor-alkali facilities. Hence it is expected that the ESM of waste elemental mercury will become a very important issue and a common challenge for many Parties in the future.

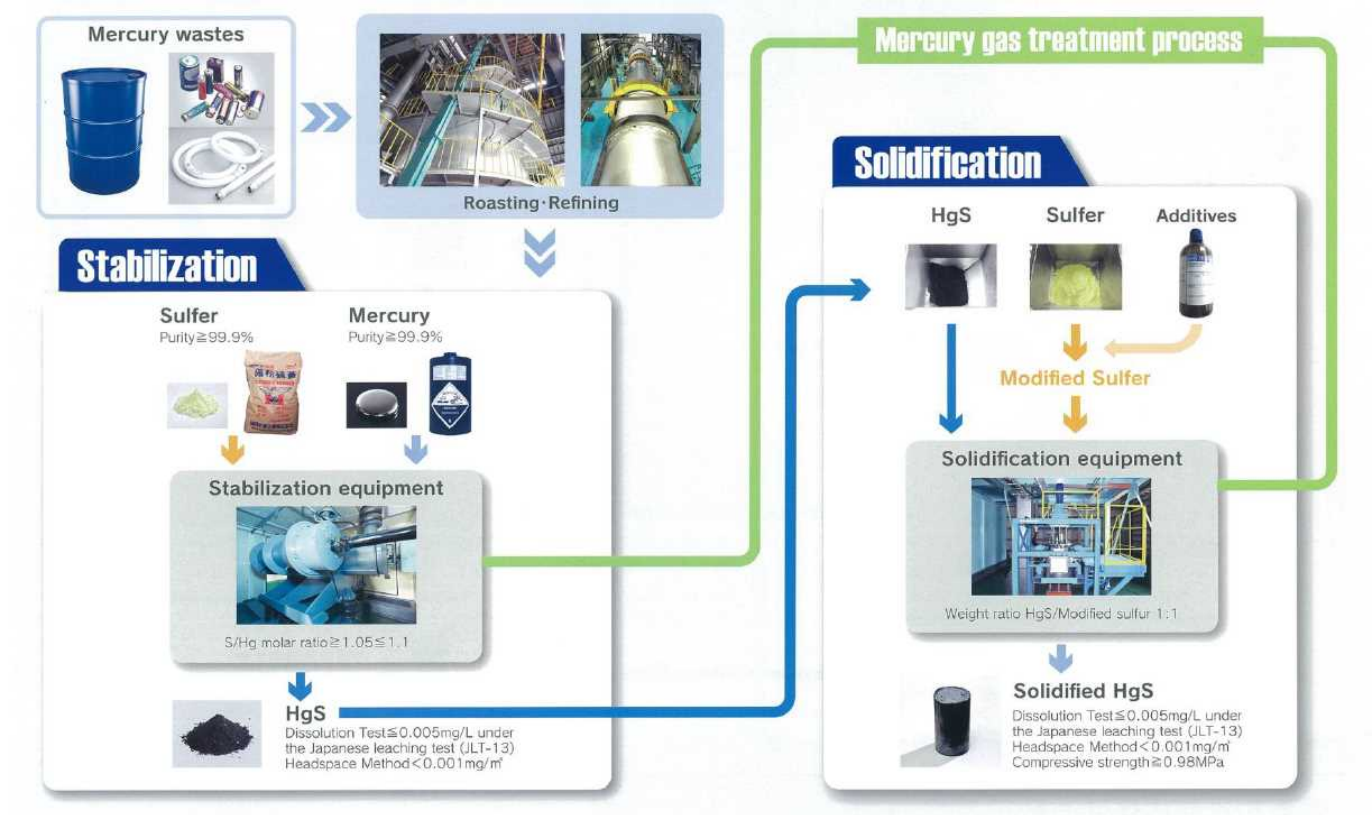
Overview of the Technology

Technology includes the process of stabilization using sulfur and subsequent solidification of the stabilized product.

Stabilization of elemental mercury is carried out by mixing mercury with pure sulfur (purity >99.9%) and treatment in a specialized equipment. The end product is Mercury Sulfide (HgS).

The stabilized mercury can also be treated through a solidification process if required by national regulations. This involves the mixing of the treated HgS with sulfur and special additive in a fixed ratio in a controlled environment of a specialized device. The end product is solidified HgS that can be safely disposed in a landfill or in an underground mine (Dissolution test =< 0.005mg/L, Headspace method < 0.001mg/m^3, Compressive strength >= 0.98 Mpa).

Overview of Stabilization and Solidification process



Source: Nomura Kohsan Co., Ltd

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Advantages/Strengths

Environmentally Sound Treatment

Majority of mercury in nature exists in the form of mercury sulfide (HgS) and hence this form of mercury is very stable with very little risk of volatilization and elution of mercury. Dissolution tests conducted on Mercury Sulfide produced using this method have shown mercury concentrations to be less than 0.005mg/L

Black Mercury Sulfide after stabilization

Photo provided by Nomura Kohsan Co., Ltd

Reliable method for Stabilization

Other methods of stabilization like Vapor-Phase synthesis method require sophisticated equipment and have a risk of leakage/release of mercury. Mechano-chemical method controls physical reaction of mercury and sulfur and does not use any chemical. It results in a low risk of leakage/release of mercury as mercury is not vaporized.

Solidified Sulfur Polymer

Photo provided by Nomura Kohsan Co., Ltd

Improved method of Solidification

Using sulfur for solidification produces a product that is of higher density, higher strength, higher salinity tolerance and higher acid resistivity than using traditional method of concrete solidification.

Applicability

The requirement of the degree to which excess mercury needs to be treated depends on the legal requirement as described in the standards or guidelines developed in each country. Countries that do not yet have legal stipulations need to develop guidelines , taking into account the country`s existing environmental and safety laws and regulations.

The legal requirement will determine whether stabilization of mercury alone is sufficient , or whether a further step of solidification may be required after stabilization. Package units for stabilization of waste mercury that can be installed and used onsite is now under development. Export of these mobile units from Japan are planned which can then be set up in the countries where ESM of the waste mercury presents significant challenges.

Stabilization and Solidification plant

Photo provided by Nomura Kohsan Co., Ltd

Final storage in controlled landfills

Source: Nomura Kohsan Co., Ltd

Further Reading

Nomura Kohsan Co., Ltd, Development of Stabilization and Solidification Technology
(http://nkcl.jp/research/stabilization-solidification-processes/)

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