

“Breaking the Mercury Cycle: Long Term Management of Surplus & Recycled Mercury & Mercury-Bearing Waste”,  
Hynes Convention Center, Boston, MA, May 1-3, 2002

**Current Global Conditions that are Forcing the Debate on Mercury Retirement**

## **European Perspectives on Management of Mercury Stockpiles and Mercury-Bearing Waste**

*Lars Hylander,  
Uppsala University, Sweden  
E-mail: <lars.hylander@ebc.uu.se>*

Anthropogenic emissions of mercury (Hg) have since pre-industrial times raised atmospheric Hg deposition rates by 2-3 times globally and up to 10 times in and around the most industrialised regions. A significant part of the emissions originate from Hg mined and used in a variety of applications. Detailed inventories of Hg production and Hg consumption patterns are valuable when estimating historical emissions, the size of present Hg stocks in the technosphere, and potential future emissions. More than half of globally mined Hg has been mined in European mines. The mines in Almadén, Spain, have contributed one third of globally mined Hg. The mines in Almadén, Idrija (Slovenia), and Monte Amiata (Italy) have contributed more than 99% of Hg mined in Europe. Today, about 40-50 tonnes of Hg are yearly received at production of zinc in Finland.

Mining of mercury (Hg) increased substantially five centuries ago, when the amalgamation method was introduced for silver mining in Spanish America. The exchange of Spanish Hg for American silver continued for more than three centuries. In the second half of the 19<sup>th</sup> century, the amalgamation method was used in the gold rush in North America, which further increased quantities of Hg mined. The onset of industrialization put the use of Hg to new heights. Mercury was used in a variety of applications such as catalytic processes, electro lysis, electrical rectifiers, batteries, and also in medicine and dentistry, despite its toxicity. Pigment (vermilion) was produced from Hg. Different inorganic and organic Hg compounds were used to hamper growth of fungi and microorganisms in paint and in several industrial and agricultural applications. The use of Hg fulminate in triggers for cartridges and explosives resulted in a large demand for Hg during World War I and II. Another reason for increased demand during wartime was the use of corrosive sublimate (HgCl<sub>2</sub>) as an antiseptic.

The wide use of Hg led to large emissions to the environment and subsequent problems. The use of methyl Hg for seed dressing resulted in the 1960's in toxic symptoms, reduced fertility, and mortality of grain-eating field animals and top predators of the food chain. The use of phenyl Hg acetate, added

to paper pulp as a slimicide and Hg emissions from chlor-alkali plants or from their contaminated products used in pulp and paper factories resulted in high Hg levels of fish in waters around the factories, e. g. over 10 ppm w.w. in Kyrksjön, Sweden. Actions from the authorities saved Sweden from severe health effects such as crippled babies and deaths of grown ups reported from factories emitting Hg in e.g. Japan. The actions included ban to sell fish from contaminated waters and forcing industrial leaders to reduce Hg emissions against their will.

The price of Hg dropped drastically as an effect of the re-awakened insight on the toxicity of Hg and realizing that Hg emissions from most uses of Hg were not possible to eliminate. It was also clear that metallic Hg was in many environments transformed to the several times more toxic methylated form. Nevertheless, the production of Hg was only marginally effected by the low price and continued at a high level, because the European Hg mines in Spain, Italy, and Yugoslavia dominating the market were state owned and produced Hg at economic losses, favoring short-sighted local opinions rather than a global, sustainable development.

Much of the Hg used has left the technosphere and contaminated the environment. In addition to several cases of human poisoning, Hg in the environment is a constant threat to human health in large parts of the world, demanding caution when consuming fish. There are still large stocks of Hg in society at risk to contaminate the environment. The Swedish Environmental Protection Agency (EPA) has estimated the "hidden" stock of Hg in goods and products used in the Swedish society with 9 million inhabitants to 60-100 tonnes at beginning of the 1990's (Hg in chlor-alkali industry not included). More than half is Hg in dental fillings. About 6 tonnes of Hg in this stock has so far been collected in projects supported by the Swedish EPA.

Considerable amounts of Hg are continuously lost or stored in waste in and around the chlor-alkali plants. The fate of 90 tonnes or nine tenth of Hg yearly bought by West European chlor-alkali plants is not reported. 12 000 – 15 000 tonnes of metallic Hg are used as electrodes in West European chlor-alkali plants, still using Hg cells. This corresponds to more than 50 years production at Almadén, given a yearly production of 236 tonnes Hg reported for 2000. There are also considerable stocks of Hg at Almadén, demonstrated by sales of about 800 tonnes Hg in 2000, which is three times the production. The two Swedish chlor-alkali plants still in operation have together 400 tonnes metallic Hg, which will be regarded as hazardous waste and handled accordingly when the plants are proposed to stop using Hg cells at the end of 2009. This implies a ban on exporting the Hg (SFS, 1991, 1998).

The Swedish mining industry has large quantities of waste containing Hg. Waste containing more than 1% Hg amounts to 5000 tonnes, which corresponds to 280 tonnes Hg. Mining waste with 0.0001 – 1% corresponds to about 800 tonnes Hg. Waste

from the steel industry contains about 0.0004% Hg, which corresponds to about 8 tonnes Hg. Waste from the paper and pulp industry contains about 0.0007% Hg, which corresponds to about 7 tonnes Hg. In addition, deposits at earlier chlor-alkali and paper pulp factories contain 13 tonnes Hg. (SOU, 2001). Figures for other parts of Europe are scarce. Mining waste containing considerable amounts of Hg are abundant in the region of the mercuriferous belt between the western Mediterranean and central Asia. At the Idrija Hg mine in Slovenia, an estimated 40 000 tonnes of Hg have been left in waste. Large but not quantified amounts have been left around mines extracting Hg, copper, gold and other metals in Italy and Spain, and also in other mining regions including most European countries, the Netherlands being a noteworthy exception. However, the Netherlands have large quantities of Hg contaminated sludge and sediment, and large stocks in industry and products. If per capita amalgam fillings in other European countries are in parity with in Sweden, the amount of Hg in dental fillings in Europe is about 2 300 tonnes. 15 000 - 20 000 tonnes of Hg are estimated to be in products and goods in use in the West European technosphere, another 5 000 - 10 000 tonnes in East Europe excl. former USSR countries. This stock must be dealt with in a proper way to counteract damages on health and environment on a global scale.

### **Conclusions and prospects**

One possibility of disposing the large quantities of Hg and Hg bearing waste in Europe is to return them back to its main origin, the mine of Almadén. In this way, the flow of Hg would be reversed at the turn of the millennium, about 500 years after that anthropogenic activities initiated the large-scale release of Hg from the earth crust, thereby making it to a significant global pollutant. The European chlor-alkali industry has already taken the first step and sent 860 tonnes of Hg back to MAYASA, the Hg mining company in Spain. Reselling this Hg is a threat to the environment and health. Another 450 tonnes of Hg will be sent back in 2002. Actions should be taken to hinder the export of this Hg to developing countries, which otherwise will result in degraded environment and health problems. In addition it would be unethical. Therefore, the Hg should be disposed off at site in Almadén in a safe and responsible way.