MERCURY INVENTORY USING THE UNEP TOOLKIT LEVEL II: A CASE STUDY OF SOUTH AFRICA

by

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GENERAL OBJECTIVES

- The main objective of the exercise was to develop a mercury inventory for South Africa using the United Nations Environment Programme (UNEP) Toolkit level II to identify and quantify mercury from different source categories.

- This was to enable South Africa to ratify the Minamata Convention on mercury for relevant affected sectors and industries.

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UNEP TOOLKIT LEVEL II

- **STEP 1** - Apply screening matrix to identify main source categories present in the country or region investigated and identify existing descriptions of mercury sources in the country (e.g., Extraction and use of fuels/energy sources);

- **STEP 2** - Classify main source categories further into sub-categories and gather additional qualitative information to identify existing activities and sources of mercury releases in the country; and if feasible, the relative importance of each (e.g., Coal combustion in large power plants);

- **STEP 3** - Gather detailed quantitative information on the identified sources, and quantify releases with source specific data or default mercury input and output distribution factors from this Toolkit;

- **STEP 4** - Apply nation-wide to establish full inventory and report results using guidance given in the standard format.

BASIC QUANTIFICATION EQUATION

Estimated mercury release to pathway X = activity rate * input factor * output distribution factor for pathway X

Where:

Activity rate = amount of feed material processed or product produced per unit of time (e.g. tons or pieces per year);

Input factor = mercury content (e.g,. in grams of Hg) per unit of feed material processed;

Output distribution = fraction or part of the mercury input that is released through the particular pathway (air, water, land, product, general waste, or sector specific waste treatment)

EXTRACTION AND USE OF FUELS AND ENERGY SOURCES

The total Hg (kg/yr) input from different fuels are as follows:

- Coal (36,083);
- Coke (696),
- Oil (48); and
- Gas (650).

In terms of distribution of Hg into various environmental compartments from coal, the releases of Hg (kg/yr) are as follows:

- Air (16,371);
- Water (271.2);
- Sector specific treatment/disposal (19,449.7).

Other coal use (Coke production/combustion/sub-bitmous coal): For coke production, the mercury input amounted to **696 kg Hg/yr** and this is emitted only into the air (696 kg/yr). The mercury input from sub-bitmous coal amounted to **19 kg Hg/yr**. The total mercury releases from other coal uses amounted to **715 kg/yr** distributed into air (714 kg/yr) and 1 kg/yr for sector specific.

Oil: The total mercury input from this subcategory amounted to **48 kg Hg/yr** distribution into different environmental compartments as follows: 36.1 kg/yr (air), 4.81 kg/yr (water) and 7.22 kg/yr (sector specific. For gas, the total mercury releases amounted to **650 kg/yr** distributed into various environmental compartments are as follows: air (130 kg Hg/yr); water (130) kg Hg/yr; products (325 kg Hg/yr); sector specific (65 kg Hg/yr).

The total Hg releases from this source category amounted to **31%** of the national releases

PRIMARY (VIRGIN) METAL PRODUCTION

Gold production without mercury amalgam

The calculated mercury inputs from the formal gold sector are: **1,390 kg Hg/yr** (0.05 g Hg/ton of ore input factor); **4,169 g Hg/yr** (0.15 g Hg/ton reviewer recommended default input factor). The extraction of gold per reprocessing of old tailings produced per calculated mercury input of **37,008 kg Hg/yr** based on the data provided by some mining companies.

Gold extraction with mercury amalgam (Artisanal)

A total mercury releases of **6,654 kg Hg/yr** distributed into air (4,991 kg/yr), water (865 kg/yr), land (799 kg/yr) was calculated from this subcategory.

Zinc production

The calculated mercury inputs amounted to **340 kg Hg/yr** (10 g Hg/ton of Zn produced) and **4,197 kg Hg/yr** (using reviewer recommended input factor of 65 g Hg/ton of Zn concentrate). The distribution of mercury releases using the sector report input factor of 10 g Hg/ton are into air (68 kg Hg/yr), water (136 kg Hg/yr) and land (136 kg Hg/yr); while the distribution of mercury into different environmental compartments are into: air (3777 kg Hg/yr) and 419.7 kg Hg/yr (sector specifics)

Copper production

Mercury input calculated amounted to **93 kg Hg/yr** using the input factor of 1.0 g Hg/ton obtained from the sector report studies. However, mercury input using the reviewer recommended default factor of 30 g Hg/ton of Cu concentrate amounted to **9,939 kg Hg/yr.** With respect to distribution into different environmental compartments, the releases are into air (83.7 kg Hg/yr), and sector specific (9.3 kg Hg/yr) for recommended default factor of 30 g Hg/ton.

PRIMARY (VIRGIN) METAL PRODUCTION

Lead

479 kg Hg/yr was calculated using the sector input factor of 10 g Hg/ton and **3,592 kg Hg/yr** was obtained using the recommended default factor of 30 g Hg/ton. Mercury input of 479 kg Hg/yr is distributed into air (431.1 kg Hg/yr) and sector specific (47.9 kg Hg/yr) and 3,592 kg Hg/yr distributed into air (1760 kg Hg/yr), water (72 kg Hg/yr), and sector specific (1760 kg Hg/yr).

Other non-ferrous, extraction and processing (chrome, nickel, PGMs and others)

The calculated mercury input amounted to **2,350 kg Hg/yr** using the input factor of 0.5 g Hg/ton. Distribution is into air (2,350 kg Hg/yr) only.

Primary ferrous metals production

Mercury input of **70 kg Hg/yr** was obtained based on sector input of 0.05 g Hg/ton. And this is distributed into air (66.5 kg Hg/yr) and sector specific (3.5 kg Hg/yr).

Aluminium production from bauxite

Mercury input amounted to **1,518 kg Hg/yr.** The distribution to environmental compartments are as follows: 228 kg Hg/yr (air); 152 kg Hg/yr (water); 987 kg Hg/yr (general waste) and 152 kg Hg/yr (sector specific treatment).

Production of other minerals and materials with mercury impurities

For cement, the amount of mercury released is as follows: **946 kg Hg/yr** for which 568 kg Hg/yr and 189 kg Hg/yr for air, products and sector specific respectively. For pulp and paper, a total of 153 kg Hg/yr was released and distributed as follows: 138 kg Hg/yr and 15 kg Hg/yr for air and general waste respectively.

CONSUMER PRODUCTS WITH INTENTIONAL USE OF MERCURY

- Thermometer:**100 kg Hg/yr** (10 kg Hg/yr –air; 30 kg Hg/yr –water; 30 kg Hg/yr –general waste and 30 kg Hg/yr –sector specific);
- Electrical switches:**6731 kg Hg/yr** (673 kg Hg/yr –air; 673 kg Hg/yr –land; 5385 kg Hg/yr –general waste);
- Relays:**1097 kg Hg/yr** (55 kg Hg/yr –air; 1042 kg Hg/yr – general waste);
- Light sources:**3647 kg Hg/yr** (912 kg Hg/yr –air; 912 kg Hg/yr –land;
- Batteries:**1823 kg Hg/yr)** and 151 kg Hg/yr (7 kg Hg/yr –air; 3 kg Hg/yr –water;
- Cosmetics:**67 kg Hg/yr** –land; 67 kg Hg/yr –general waste; 7 kg Hg/yr –sector specific) respectively.

OTHER INTENTIONAL PRODUCT/PROCESS USE/WASTE INCINERATION

OTHER INTENTIONAL PRODUCT/PROCESS USE

A total mercury releases from dental amalgam amounted to **2,723 kg/yr** distributed as follows: 53 kg/yr (air); 1,228 kg/yr (water); 214 kg/yr (land); 160 kg/yr (by-product), 534 kg/yr (general waste) and 534 kg Hg/yr (sector specific).

WASTE INCINERATION

A total of **8 kg Hg/yr** was released from municipal waste and it is only distributed into air (8 kg Hg/yr). For hazardous waste mercury input amounted to **42314 kg Hg/yr** emitted into air only (42314 kg Hg/yr.

PRODUCTION OF RECYCLED METALS ("SECONDARY" METAL PRODUCTION)/CREMATORIA AND CEMETRIES

PRODUCTION OF RECYCLED METALS ("SECONDARY" METAL PRODUCTION)

The release of mercury from the production of recycled ferrous metals exhibited a total of **1,335 kg Hg/yr** distributed as follows: 444 kg Hg/yr (air), 457 kg Hg/yr (land) and 444 kg Hg/yr (general waste). To produce other recycled metals, the total mercury releases amounted to **250 kg Hg/yr** with air, water, general waste and sector specific accounting for 75 kg Hg/yr, 25 kg Hg/yr, 75 kg Hg/yr and 75 kg Hg/yr respectively.

CREMATORIA AND CEMETRIES

The calculated mercury input from crematoria and cemeteries are 125 kg Hg/yr (air) and 1125 kg Hg/yr (land) respectively and this amounted to a total of **1250 kg Hg/yr**.