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Damian PANASIUK[1]

INVENTORY OF MERCURY EMISSION TO AIR, WATER AND SOIL IN POLAND FOR YEAR 2013

INWENTARYZACJA EMISJI RTĘCI DO POWIETRZA, WÓD I GLEBY W POLSCE W 2013 ROKU

Abstract: Poland is one of major mercury emitter to air in Europe but this emission is constantly decreasing from level 33.3 Mg in 1990. Newest official inventory defined mercury emission to air from industrial processes and fuel combustion in residential sector on level 10.4 Mg annually. Additionally estimation of emission from the use of mercury-containing products was based on model for distribution and emission (0.46 Mg). Dental practice (0.29 Mg) and bodies cremation (0.06 Mg) are next sources of mercury emission to air. Totally 11.2 Mg mercury annually is emitted to air. According to E-PRTR data for 2013, mercury discharge to water was 2.99 Mg with majority of 2.75 Mg from large and medium industrial facilities as well as rest from municipal waste water plants in large towns. Sewage sludge from waste water plants transferred to agriculture is source of mercury emission to soil (0.31 Mg). Mercury discharges to water and soil from dental amalgam in buried bodies (0.16 Mg) are other emission source. In sum mercury emission to air, water and soil in Poland in year 2013 can be estimated on level 14.7 Mg annually. Significant load of 10.4 Mg mercury annually is safely stored in wastes from the use of mercury-containing products and from dental practice.

Keywords: emission, mercury, air, water, soil

Introduction

Poland is one of major mercury emitter to air in Europe. There are two countries in official EMEP inventory for year 2013 [1] with annual emission on level 10 Mg: Germany and Poland. Next countries are Italy (8.1 Mg), Ukraine (6.8 Mg), the United Kingdom (6.1 Mg), Spain (5.4 Mg) and France (3.8 Mg). The Russian Federation not report own mercury emission but its last available data on emission was 14 Mg in 2006.

This ranking mainly is result of coal combustion in power and heating plants with mercury emission in countries: Germany (6.6 Mg), Poland (5.9 Mg), Spain (2.5 Mg), the Czech Republic (1.7 Mg) and the United Kingdom (1.6 Mg), not data for Ukraine. Industry and other stationary combustion are next important sources of mercury emission to air in Europe.

Historical inventories of mercury emission

Mercury emission in Poland is constantly decreasing from 1990. Inventories for EMEP are prepared with delay of 2 years, for example in March 2015 for year 2013. In first inventories prepared until 2008, officially reported annual mercury emission decreased from 33.3 Mg for 1990 to 19.8 Mg for 2002 and increased to 21.3 Mg for 2006 (36% decrease in 16 years), see Figure 1. In 2009 mercury emissions for period 2005-2007 were recalculated to level 15.4-16.1 Mg [2]. Next inventories for years 2008-2010 maintained reported emission on level 14.5-15.7 Mg.

[1] Faculty of Biology and Environmental Sciences, Cardinal Stefan Wyszyński University in Warsaw, ul. Wóycickiego 1/3, 01-938 Warszawa, Poland, phone +48 22 569 68 37, email: d.panasiuk@uksw.edu.pl
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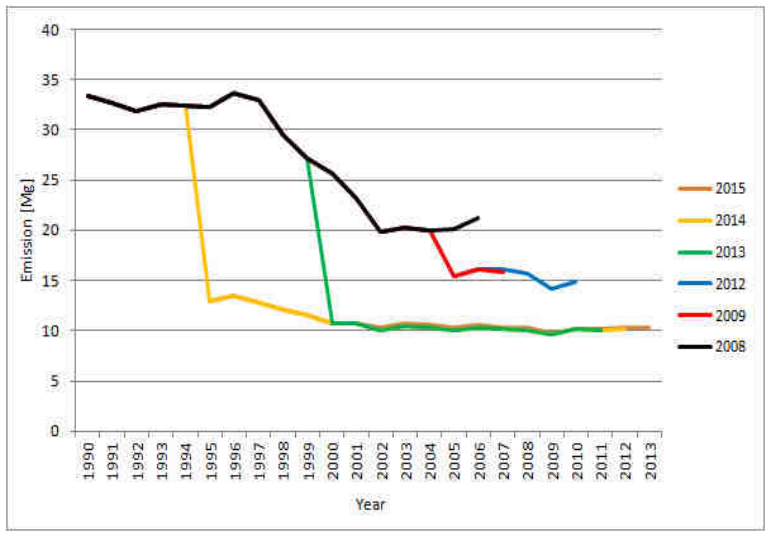

Fig. 1. Changes of inventories of mercury emission to air in Poland for years 1990-2013

In 2013 Polish National Centre for Emissions Management (KOBIZE) [3] decided to change reported emissions from year 2000 for data completeness and consistency. Applied emission factors for public power sector have been based on a country study conducted by Polish energy group PGE. Mercury emissions were recalculated to level 9.6-10.7 Mg. In next year inventories from year 1995 were additionally recalculated. Reported emission decreased from 13.0 Mg for 1995 and 13.4 Mg for 1996 to 11.6 Mg for 1999. In future recalculations for period 1990-94 are also expected but there are significant lacks of statistical data. Now only inventories for period 1995-2013 are comparable [4]. Due to new assumptions mercury emission in Poland decreased by 20% in last 18 years. Comparison of inventory for 1990 and 2013 shows bigger 3-times decrease of this emission.

Emission to air

Newest official inventory for 2013 [5] estimated mercury emission to air on level 10.4 Mg annually. National inventory covers emissions from following SNAP sectors: energy industry (5.8 Mg), commercial and residential combustion plants (1.7 Mg), other industries (2.9 Mg) and incineration of municipal wastes (0.1 Mg). Detailed data for emissions from industrial branches are available for NFR sectors [4]: non-ferrous metals production (1.4 Mg), iron and steel production (0.5 Mg), cement production (0.3 Mg) and chemical industry (0.2 Mg). E-PRTR database [6] is incomplete source. It reported only emission 3.3 Mg of mercury to air with majority from energy sector (2.6 Mg).

Estimation of additional mercury emissions to air was prepared by Panasiuk and Glodek [7]. Mercury is intentionally used for production of batteries, measuring and control equipment, light sources as well as other electrical and electronic equipment. Emission from the use of these products was assessed [8] on the basis of model for distribution and emissions [9]. Consumption of mercury for production of mercury-containing products

launched annually to Polish market (9.4 Mg) was based on data for EU-25 [10] with assumptions of population proportion and smaller batteries consumption in Poland. Mercury emission to air from one year's mercury consumed in products (initial and later within 10 years) was estimated on level 0.46 Mg. The biggest emission originates from steel scrap and landfills. Smaller shares are released by breaking and waste incineration. The other 2.90 Mg Hg contained in products is re-collected and stored safely. Mercury stream in wastes of mercury-containing products transported to municipal landfills was estimated on level 4.84 Mg. Remaining 1.20 Mg of mercury is still accumulated in products used to 10 years after production [11].

Dental practice and bodies cremation are next sources of mercury emission to air. Amount of mercury in dental materials launched annually to Polish market (10 Mg) was estimated on the basis of the Polish Ministry of Health data (13 million of amalgam fillings per year) and Maxson's study [10]. It was assumed that 2.2 Mg of mercury is accumulated in society as new dental fillings and 7.8 Mg is passed to solid waste. From this amount, the excess of prepared mixture (2.0 Mg) is recollected as hazardous waste. Remaining 5.8 Mg of mercury in old amalgam wastes is in half collected and later treated as hazardous waste. However second half (2.9 Mg) is transported to infectious wastes and incinerated with average 90% emission reduction (currently only in industrial plants, earlier also in hospital plants without proper equipment). These process causes emission of 0.29 Mg mercury to air.

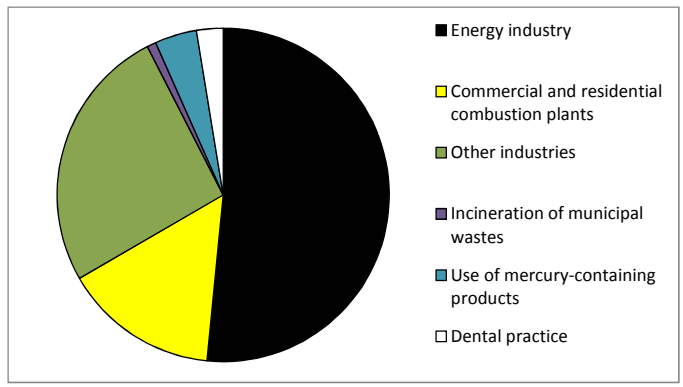

Fig. 2. Main sources of mercury emission to air in Poland in 2013

Mercury emission to air from bodies cremation in Poland was reported by EC [12] on level 0.06 Mg. It was assumed that 9% of corpse was cremated in Poland in 2011, there are 3 crematoria applying mercury removal techniques (with 50% Hg capture) and 10 crematoria not applying these techniques. Totally 11.2 Mg mercury is annually emitted to air from industry, products and dental practice.

Emission to water and soil

Data on mercury discharges to water was used from E-PRTR database [6] for year 2013. These direct and non-direct discharges (releases and transfers) from Poland were

2.99 Mg. Majority of mercury discharge (2.75 Mg) originates from large and medium industrial facilities. The biggest discharges to water in Poland were from production and processing of metals (1.82 Mg), landfills (0.51 Mg) and mining (0.23 Mg). Among smaller sources of releases and transfers are independently operated industrial waste water treatment plants (0.10 Mg), industrial scale production of basic inorganic chemicals (0.05 Mg) and basic organic chemicals (0.02 Mg) as well as energy sector (0.01 Mg).

In Europe chlor-alkali industry was using mercury cell electrolysis for many years. This process was source of mercury emission to air and water. Last Polish electrolyzer for chlor-alkali production was working in PCC Rokita factory in Brzeg Dolny. For year 2013 this factory reported release of 0.06 Mg mercury from independently operated industrial WWTP. This electrolyzer was closed in the beginning of 2015.

Mercury discharges to water were also reported for municipal waste water plants in 20 Polish large towns. These discharges from residential sector, hospitals and dental clinics as well as small industrial facilities in 2013 were 0.25 Mg. The biggest mercury releases were reported for plants in Poznan (78 kg), Gdansk (35 kg), Sosnowiec (27 kg), Szczecin (22 kg) and Lodz (21 kg).

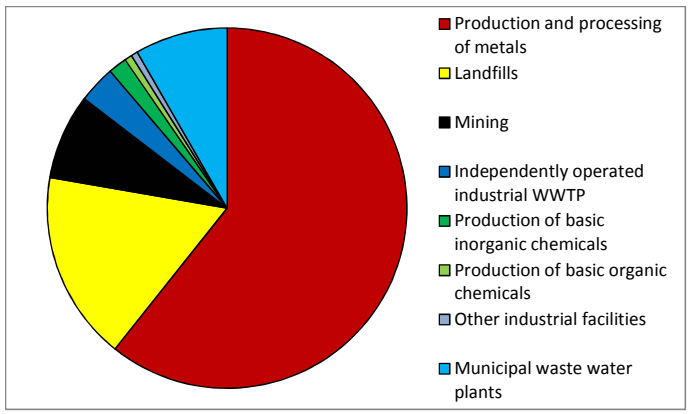

Fig. 3. Main sources of mercury discharges to water in Poland in 2013

Sewage sludge from municipal waste water plants transferred to agriculture is source of mercury emission to soil. This emission was estimated on level 0.31 Mg [13]. Mercury discharges to water and soil from dental amalgam in buried bodies are other emission source. These discharges was calculated on level 0.16 Mg on the basis of burial data, assuming that 20% of Hg is reaching groundwater and the rest is chemically bounded. Any releases to soil from Polish industry are reported in E-PRTR.

Conclusions

In sum mercury emission to air, water and soil in Poland in year 2013 can be estimated on level 14.7 Mg annually. The biggest inventoried load of mercury is emitted to air, see Table 1.

Table 1

Main mercury flows in Poland in 2013

	Emission/storage [Mg/year]
Emission to air	11.2
Discharges to water	3.0
Identified emission to soil	0.5
Safe storage of hazardous wastes	10.4

Significant load of 10.4 Mg mercury annually is safely stored in hazardous wastes. This load covers 2.9 Mg contained in recycled wastes of batteries, measuring and control equipment, light sources as well as other electrical and electronic equipment and from dental practice, 4.9 Mg collected in dental clinics and 2.6 Mg captured from incineration of dental wastes.

Acknowledgments

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INWENTARYZACJA EMISJI RTĘCI DO POWIETRZA, WÓD I GLEBY W POLSCE W 2013 ROKU

Wydział Biologii i Nauk o Środowisku, Uniwersytet Kardynała Stefana Wyszyńskiego w Warszawie

Abstrakt: Polska jest jednym z głównych emitorów rtęci do powietrza w Europie, ale emisja ta stale spada z poziomu 33,3 Mg w 1990 r. Najnowsza krajowa inwentaryzacja określiła emisję rtęci do powietrza z procesów przemysłowych i spalania paliw w sektorze mieszkaniowym na poziomie 10,4 Mg rocznie. Dodatkowo oszacowanie emisji z użytkowania produktów zawierających rtęć zostało oparte o model dystrybucji i emisji (0,46 Mg). Kolejnymi źródłami emisji rtęci do powietrza są praktyka dentystyczna (0,29 Mg) i kremacja zwłok (0,06 Mg). Łącznie 11,2 Mg rtęci rocznie jest emitowanych do powietrza. Na podstawie danych E-PRTR dla roku 2013 zrzuty rtęci do wód wyniosły 2,99 Mg z większością 2,75 Mg z dużych i średnich zakładów przemysłowych oraz resztą z komunalnych oczyszczalni ścieków w dużych miastach. Osady ściekowe z oczyszczalni ścieków przekazywane do rolnictwa są źródłem emisji rtęci do gleby (0,31 Mg). Innym źródłem emisji są uwolnienia rtęci do wód i gleby z wypełnień amalgamatowych w grzebanych zwłokach (0,16 Mg). W sumie emisja rtęci do powietrza, wód i gleby w Polsce w 2013 r. może być oszacowana na poziomie 14,7 Mg rocznie. Znaczący ładunek 10,4 Mg rtęci rocznie jest bezpiecznie składowany w odpadach z użytkowania produktów zawierających rtęć oraz z praktyki dentystycznej.

Słowa kluczowe: emisja, rtęć, powietrze, woda, gleba