

Mercury in Surface Sediments Associated with Shipyard Activity in the City of Gdańsk

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Abstract

The aim of the present work is to elucidate whether the long tradition of shipyard activity has had an influence on the status of mercury contamination of the surface sediments and port watercourse of the city of Gdansk. Concentrations of total mercury (Hg) were determined in surface (0-10 cm) sediments collected from the area of the shipyard canals in the city of Gdansk in 1996. Only relatively small variations in spatial distribution of mercury in surface sediments were found, and the range of concentrations was from 300 to 1300 ng/g dry weight. Despite relatively high mercury concentrations in surface sediments, the overall range of values was of the same order of magnitude as indicated earlier in samples collected from the Old Motława River and the Dead Vistula River Channel (Martwa Wisła) from the administrative area of the city of Gdansk in 1993-1995. The results did indicate that shipyard activity doesn't have any impact on mercury load of the sediment in surrounding canals. The source of pollution with mercury in the canals investigated could be storm water washing out various surfaces both from urbanized areas and the shipyards of the city of Gdansk.

Keywords: Mercury, surface sediment, pollution, shipyard

Introduction

From the first disastrous episode of poisoning with methylmercury compounds in Minamata [1], environmental pollution by mercury and anthropogenic sources of that element on a local and global scale are a matter of continuous scientific interest worldwide [2-7]. In several studies contamination by mercury of inland freshwater systems in Poland and coastal Baltic waters has been investigated, including speciation analysis of total mercury (Hg), methylmercury and Hgll in freshwater and marine surface sediment [8-14]. The present study provides baseline data on the concentrations of total mercury in surface sediment in the canals under the direct influence of activity of the Gdansk shipyards, and to elucidate sources of pollution with that element at the area of study.

Materials and Methods

Surface sediment samples (0-10 cm) were collected with an Ekman-Brige sampler in various sites in the canals at the area of the Stocznia Gdanska, Stocznia Remontowa and Stocznia Potnocna shipyards (Fig. 1) in the city of Gdansk in 1996. The sediments were muddy and black, and of very fine grain size. Wet samples were mixed, air dried and further homogenized in an agate mortar. For determination of mercury, the sub-samples (~ 0.5 g) were wet-digested with concentrated nitric acid in a glass apparatus consisting of a round-bottom flask, partial condenser (30-cm long) and a water cooler. Five millilitres of 65% HNO₃ were added to the samples and the mixture was allowed to stand for 24-48 h. The flask was then gently heated for 1.0 h. After the flask had cooled, 10 ml redistil-

led water was added and the flask was again heated for 0.5 h. After cooling, the water cooler and condenser were rinsed with 5 ml of redistilled water. The digest was filtered and diluted with redistilled water up to 25 ml. Final determination of mercury content was by cold-vapour atomic absorption spectroscopy (CV-AAS) using a fully automated 3200 Mercury monitor Thermo Separation Products, USA. SD-N-1/2 (IAEA) marine sediment was analyzed routinely as a laboratory reference material and the value for total Hg ($1.60 \mu\text{g/g}$; $n = 3$) was in agreement with the certified concentration of $1.51 \mu\text{g/g}$. Procedural blanks were run with each set of sample analysis.

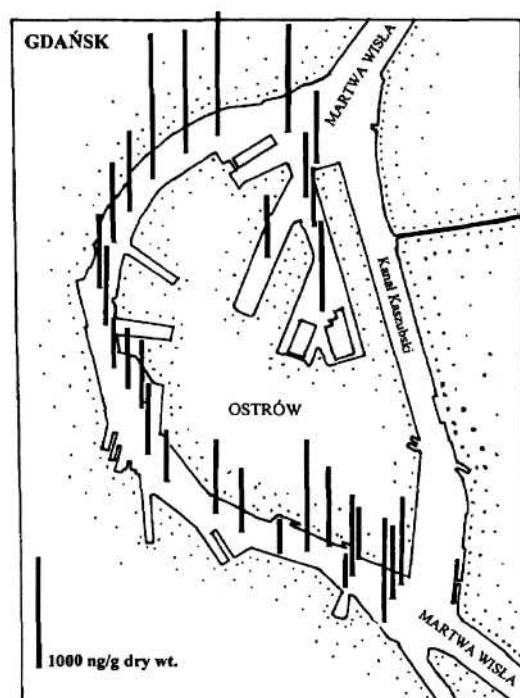


Fig. 1. Sampling sites and concentration of total mercury in surface sediment.

Results and Discussion

Figure 1 shows spatial distribution of total mercury concentrations in surface sediment at 29 sites from the area of the shipyard. Spatial distribution of mercury seems to be uniform in sediments collected from the western part of the Dead Vistula River Channel (Martwa Wisła) surrounding from the left side the Island Ostrów, which is totally occupied by shipyard complexes. The concentrations are slightly higher at the sites both north and south of Ostrów Island, when compared to the central western side of that segment of the canal (Fig. 1). Unfortunately, at the time of sampling no sediment samples could be collected from the Kaszubski Canal situated east of Ostrów Island. The middle part of the Dead Vistula River Channel surrounding Ostrów is the deepest part of the canal and seems to be a site of preferable sediment accumulation. The surface sediment samples collected at two sites located south of Ostrów show higher concentrations of mercury in the middle part of the canal than at its edges, and only at the site called Hak Polski, which seems to be a mixing area at the cross of the watercourse of the Dead Vistula River Channel, Mottawa River and Kaszubski Canal; the concentrations seem to be uniform. There is no earlier records on mercury concentration in surface sediment associated with shipyard activity in Gdańsk. The range of mercury concentrations was from 300 to 1300 ng/g dry weight, and the mean was 700 ± 230 ng/g dry weight.

A recent survey of total mercury concentrations in surface sediment from selected sites at the Gdańsk Coast and in the town of Swinoujście is compiled in Table 1. The results clearly suggest that the concentration of total mercury determined in the sediments in the current study are similar to those reported from several other sites in the city of Gdańsk, such as three arms of the Motława River or Dead Vistula River Channel east of the site Hak Polski. Apart from the sediments from selected areas in the city of Gdańsk relatively high concentrations of total mercury were also noted in localities such as the seaport canals in the city of Gdynia and in the town of Swinoujście. Small differences in total mercury concentration between surface sediments collected from the shipyard area and several

Table 1. Comparison of total mercury concentrations in surface sediments collected from the Motława River and some industrialized or urbanized sites in northern Poland.

Site	Year	No.	Mean and range ng/g dry weight		Reference
<i>Mottawa River</i>					
Optyw Motławy	1994 – 95	11	360	140 – 570	10
Nowa Motława	1994 – 95	11	320	96 – 890	10
Stara Motława	1994 – 95	16	290	68 – 600	10
Motława (upper part)	1994 – 95	7	40	14 – 67	10
<i>Other sites</i>					
Dead Vistula River Channel	1993 – 94	18	500	44 – 1800	9
Seaport Gdynia	1994	3	330	230 – 380	9
Seaport Gdynia	1994	4	160	75 – 310	11
Świnoujście	1994	1	940		9
Seaport Hel	1994	2	37	25 – 49	9
Seaport Hel	1994	3	44	37 – 48	11
Gdańsk Shipyard	1996	29	700 ± 230	300 – 1300	This work

other Gdansk sites, (plus locations such as Gdynia Seaport and Swinoujscie) do indicate that shipyard activity has no influence on mercury status of sediments in watercourses of Gdansk. Various surfaces in the city of Gdansk washed out by storm water are suggested as a main source of mercury in sediments examined, and also small differences of mercury concentrations noted between surface sediment from various locations of the watercourses of the city.

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