

Environmental risk assessment from historical and recent mining and smelting contamination the Odra River System with selected metals

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Introduction: Metals contamination of the aquatic environment is an important indicator of processes occurring in the basin. Extensive investigations of trace metals concentrations in water, suspended particulate matter (SPM) and bottom sediments were carried out in Odra River system. Significant levels of metal contamination were found. Median concentrations respectively in the SPM and sediments were (mg kg⁻¹) for Cd 7.1 and 8.9, Pb - 128 and 146, Cu - 81 and 119, Zn - 1198 and 1204, As - 48 and 54. The results of studies of the Odra River system carried out through 4 years were used to identify potential risk of heavy metal pollution in the Odra catchment area.

Methods: In order to estimate metals contamination and its variability during different seasons about 50 samples of water, suspended matter and bottom sediments were taken in each of five sampling campaigns along Odra River [1]. The metals concentration in sediment was determined in the bulk and size fraction <20 µm samples. Sediment and suspended matter were digested according to DIN 38414. The heavy metals concentration was determined by AAS and ICP-MS.

Ecological risk was assessed using the PEC/PNEC quotient. Predicted Environmental Concentration (PEC) were concentrations of analyzed metals in water, SPM, and sediments. Predicted No Effect Concentration (PNEC) was calculated as quotient of EC₅₀ values from short term toxicological tests on particular aqueous and sedimentary organisms and modifying factor MF equal to 1000 [2, 3, 4, 5]. When values of calculated PEC/PNEC quotient are 1 there is no environmental risk for the environment at the moment. In case when PEC/PNEC quotient is >1 environmental risk exists and further action are needed [6].

Results: Concentration of analyzed metals in water are below permissible levels specified in Polish legal acts for drinking water. SPM and sediments are highly and very highly contaminated (LAWA class III and III-IV) with Cd and Zn. These metals are of particular concern because of its high concentration and mobility. Additionally, results were compared to the Turekian and Wedephol's geochemical

background levels [7]. Locally higher concentrations of Cu and Pb were detected.

Range of ecological risk calculated for selected metals is very wide, this range is: for As - in water 0,13-50,63 with average value 13,13, in SPM 104-25026, average 1032, in sediments 38-2493, average 1013; for Cd - in water 0,09-11 with average 1,5, in SPM 0,83-200, average 28, in sediments 0,03-307 average 32; for Cu - in water 30-3028 average 432, in SPM 17-6764, average 352, in sediments 41-3505, average 374; for Pb - in water 0,05-4,11 average 0,94, in PSM 3594-200540, average 29459, in sediments 5189-92703, average 31351; for Zn - in water 700-48637 average 4427, in SPM 2485-461308, average 24823, in sediments 1794-398809, average 14426.

Discussion: Analyzing results of the five sampling campaigns metal pollution decreased, especially for Zn, Pb and Cu. However Cd contamination remains on high level. The metal distributions in the river system indicates a variety of sources that might be responsible for the contamination; historical and current mining and smelting activities probably are the most important ones. Calculated environmental risk values exceed permissible level practically in case of all samples, thus it is recommended to take actions that will minimize risk posed by metals in the Odra river system.

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