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Strategy of mercury removal from the environment in Europe

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Abstract

The departure from technologies using mercury and the surplus of mercury resulting therefrom have prompted the European Commission to determine a strategy concerning mercury. The minimisation of use of mercury and the study of behaviour of mercury should lead to the minimisation of its effects on the environment.

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Acquaintance with the Vlora site

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Abstract

This paper informs the reader about the situation of the site, where the rock environments is heavily contaminated. The former PVC-SODA factory in Vlora produced a large amount of mercury as one of its wastes. Decontamination of the rock environment was the subject of the aid of the Czech state in Albania. The reader will find in the text a short introduction to the issue and a set of photographs and maps which will give a certain idea of what the situation looked like at the site. The author does not set out to acquaint the readers with all problems in detail, but this text is to serve as the general introduction to all of the other papers.

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The use of atomic spectrometer RA 915+ and experience with its use

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Abstract

Portable atomic spectrometer RA 915+ with attachments was used in a wide range during a survey of an area contaminated by mercury. Mercury was analysed in air, soil gas, sea water, marine sediments and soils. The Zeeman background correction used and high frequency modulation of light polarization cause a high sensitivity of analyses and an excellent selectivity of the spectrometer. The demanding character of analyses increases in the row gaseous samples – solid samples – liquid samples.

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Forms of mercury appearance in the environment

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Abstract

The forms of mercury appearance in the environment have not yet been explained, even though mercury is environmentally a very harmful element. The reason is the lack of data on the qualitative and quantitative abundance of individual species of mercury in environmental components. Environmental impact of mercury is done by possible methylation. The most common products of methylation are monomethyl mercury (CH_3-Hg^{+1}) and dimethyl mercury ($CH_3-Hg-CH_3$). The way of selection of the remediation technology depends on the remediation target, which means on the establishment of the maximum acceptable residual contamination content in soil and on the remediation completion time. A combination of ex-situ chemical and physical separation of mercury from excavated soils – gravity separation of mercury – and bacterial reduction and subsequent separation of mercury from the water medium has been proved best. The ex-situ technology of chemical and physical separation - mercury recovery by gravity separation – is an environmentally friendly method using soil washing; it does not change any chemical by-products. If extremely toxic compounds are present in soil, such as monomethyl mercury (MMHg), dimethyl mercury (DMHg) or phenyl mercury, this will be solved during soil washing – these substances will be extracted from water by means of microbiological reduction.

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Geologic structure of the Vlora area of interest and its survey

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Abstract

At the beginnings of work on the project, sufficient data on the geologic structure of the area of study had been unavailable. Therefore, at the initial stage, the survey was chosen as a combination of remote sensing and the application of geophysical methods (resistivity sounding and shallow refraction seismic). A LANDSAT7 satellite scene enabled to obtain an idea of the tectonic structure of the area of concern and the geophysical measurement made possible to develop a physical model of the area of study. Another step was the transformation of the physical model into a concrete idea of the geologic structure of the area of interest. At this stage of work, applied were the results of direct survey work (shallow hydrogeological holes and dynamic penetration) and all available archive materials.

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Hydrogeological conditions at the PVC-SODA site

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Abstract

The hydrogeological conditions and hydrogeological regime of the site are the factors which indisputably have a marked influence on the migration of mercury contamination in the rock environment. When investigating the site of interest, great emphasis was laid on the detection of seawater flow. Simplified images ("quicklook") from the LANDSAT7 satellite were studied for this purpose. The detection has shown that the Vlora Bay is a closed system. A hydrogeological survey proceeded from the results of a geophysical measurement and comprised the drilling of short boreholes, including a reduced set of measurements and analyses carried out directly in the boreholes and on the cores and samples. Such a conduced hydrogeological survey has shown the possible flow of groundwater from the PVC-SODA plant eastwards.

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An atmogeochemical survey of the PVC-SODA site in Vlora, Albania

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Abstract

Mercury concentrations in ambient air and in soil gas in the formar PVC - SODA factory in the City of Vlora in Albania were monitored by methods of an atmogeochemical survey. Mercury in ambient air was measure at two height levels above ground, 0.15 m and 1.0 m. Mercury concentrations in soil gas were measured at a depth of 0.3–0.5 m below ground. A single purpose portable atomic absorption spectrometer RA-915+ of the company LUMEX was applied for measurement.

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Distribution of mercury in saturated and unsaturated zones at the PVC-SODA site in Vlora and its vicinity

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The extent of mercury contamination of the former PVC-SODA factory in the City of Vlora in Albania was investigated at depth levels of 0.0–2.0 m at 0.5 m intervals. In some places mercury concentrations were surveyed up to a depth of 8.0 m. The AAS method with Zeeman background correction (single-purpose portable atomic spectrometer RA 915+) was applied to determine mercury concentrations. Also, the other heavy metals were monitored, but they did not exceed the criteria of soil contamination. Massive contamination is bound to the unsaturated zone and sharply drops with depth. Mercury concentrations exceeding 20 $\mathrm{g\,kg^{-1}}$ were detected on the surface in the vicinity of an electrolysis building. Based on the accomplished survey, the amount of soils with concentrations higher than 20 $\mathrm{mg\,kg^{-1}}$ was quantified at 32 750 $\mathrm{m^3}$.

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Mercury distribution in sediments of the Vlora Bay

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Abstract

The assessment of the area distribution of mercury in sediments of the Vlora Bay of the Adriatic Sea was made within the survey of contamination of the site of the former PVC-SODA plant in Vlora, Albania. The total concentration of mercury in the sediment was monitored by the method of atomic absorption spectrometry (ZAAS-HFM). The sediments are formed by fine sands. Hg concentrations in sediments about 600 m away from the coastline vary around 40 $\mu g\,kg^{-1}$. The gradient of drop is high to a distance of about 150 m from the coast and then sharply decreases.

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Technology for mercury removal from soils

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Abstract

The issue of remediation of contaminated places in Europe has lead the company GEOtest Brno, a.s. to design and test technology for decontamination of soils polluted by mercury. The principle of the technology is based on the gravitation separation of mercury in one of the technological phases which also solves the preparation of material for processing and the potential presence of ion forms of mercury in the separation medium and their reduction through bacteria. The technological unit does not change the chemical and physical composition of soil.

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Technology for microbial mercury removal from technological waters

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Abstract

Several conventional technologies are available for demercurizing water streams down to legislative limits (precipitation, adsorption and ion exchange). The processes used presently have their specific advantages and disadvantages. As an alternative to conventional chemical technologies a process based on microbial mercury resistance (reduction of Hg(II) to Hg (0)) has proven its technoeconomical superiority. Various reactor configurations can in principle be used but the best and most simple solution is the application of a fixed bed reactor. This biological mercury remediation technology (BIOMER) has exhibited excellent performance and robustness in treating wastewater from chlor-alkali factories. The soil wash plant operated by GEOtest at the Hg contaminated Vlora site in Albania produces technological water with relatively high Hg concentrations. The BIOMER system can be a good opportunity to remove, on cheap and environmentally way, the Hg from the technological water, when the Hg will be oxidised before.