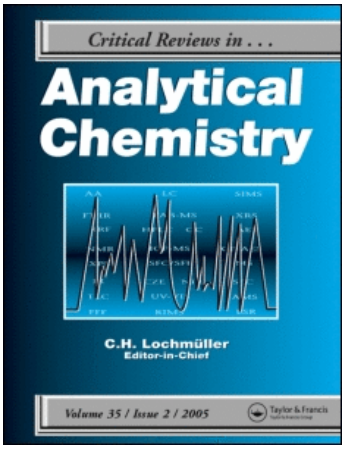

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Environmental risks associated with a contaminated freshwater sediment exposed to a coal-mine drainage water

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Our study examined freshwater contaminated sediment that has been receiving water from an open-pit lignite quarry since 1960. The site is located in Europe's "Black Triangle" – the northern part of the Czech Republic. Mine drainage water was characterised by low pH values (3.6), high concentrations of mobile sulfate (390 mg/l), high concentrations of iron (9.5 mg/l) and concentrations of toxic metals (Mn, Cd and Zn) higher than their Czech legal limits for surface water.

Anaerobic sediment exposed to mine drainage water accumulates a pollution due to various chemical and microbial processes, especially sulfate reduction. Prolonged exposition to contaminated water leads to increasing levels of pollution (sulfurous compounds, toxic metals) in the sediment. Therefore, such a sediment gets a character of chemical time bomb, since only slight changes of environmental conditions may trigger rather dramatic and non-linear response, i.e. mobilization of previously accumulated pollution. The mobilization is usually initiated when air is introduced into the sediment, e.g. during a temporary draught period, by changes in hydrological situation or during floods when sediment is transported out from the bottom of water bodies.

Our work was initiated by the North-Bohemian Mining Company, which was searching for a proper treatment of contaminated sediments and needed an assessment of environmental risks associated with aeration of such polluted sediments.

The black colour of our sediment sample indicated that it was located in the anaerobic zone. Its original value of oxidation-reduction potential and pH was –124mV and 6.7, respectively. The sediment contented high levels of zinc and manganese, i.e. 550.5 and 59.2 mg/kg (dry mass), respectively.

A suspension shaking experiment at 30°C in the dark simulated intensive aeration of the sediment in practical conditions. Our experiment revealed that within the first 50 hours of aeration the oxidation-reduction potential raised steeply from its original value (-124 mV) up to +412 mV. Afterwards, it increased only slowly and reached its final value of +663 mV by the end of our experiment (362 hours). Parallel, pH values dropped from the original value of 6.7 down to 3.3 within the first 50 hours and reached the final value of 2.7 by the end of our experiment. Changes of oxidation-reduction potential and pH values were accompanied with high sulfate production and a fluctuation of iron concentrations. Up to 97037.8 mg of sulfate was released into the solution from 1 kg of sediment by the end of our experiment. The concentrations of total iron produced from 1 kg of the sediment varied from 3240 to 16727 mg/kg. Fluctuations reflected combined effect of ferrous iron desorption and, at the same time, its oxidation and precipitation of resulting ferric form.

The decrease of pH values was followed with an intensive mobilization of zinc (up to 99% from its total concentration in the sediment) and manganese (up to 69%). The experiment showed that the sediment presents environmental risks upon aeration. We recommended the North-Bohemian Mining Company to treat this material very carefully and to consider sanitation after any manipulation with the sediment.

Based by this study, our research team was awarded by a "TALENT98" prize by the Minister of Education of the Czech Republic.

Our poster and this abstract are also available in the internet: http://home.zf.jcu.cz/~fajtl/wokshop1.html

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