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MASTER'S THESIS IN

ENVIRONMENTAL ENGINEERING

IMPACT OF CHANGING pH AND WASTE WATER ON REMOBILIZATION OF TOXIC METALS FROM CONTAMINATED SEDIMENT OF URBAN RESERVOIR

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ABSTRACT

Due to accelerated industrialization and urbanization, environment has been highly modified by mankind. Pollution processes have not spared the water bodies, especially those in urban areas. Metallic pollutants especially deserve specific attention because of their wide diffusion and potential harmfulness. Moreover, being not biodegradable, they can be accumulated in living tissue, becoming available for human beings. For these reasons, toxic metals issues, their mobility in aquatic ecosystem and their toxicological impact on organisms are very important to understand.

The ability of sediment to accumulate toxic metals make this one of the most important environmental compartments to assess the level of contamination of aquatic environments. The sediment particles may act as carriers and possible sources of pollution: metals deposited in the bottom sediments are not bonded permanently. Therefore, a change in geochemical and physical parameters may cause their release into the water environment.

Thus, to protect the environmental quality of aquatic systems, it is necessary to make an accurate assessment of the mobility of the toxic metals.

The main goal of the thesis is to study the mobility of toxic metals from contaminated sediment. In detail, the aim is to determine the impact of changing pH and wastewater on remobilization of selected metals (Pb, Ni, Cd, Cu, Zi, Cr). This approach made it possible to investigate the ability of metals to pass into water under changing environmental condition.

The goal has been achieved through the implementation of laboratory activities. Sediments were collected from Hostivar Reservoir, the largest reservoir in Prague. Total metal concentrations in the sediment samples were determined by microwave digestion; sequential extraction was used to fractionate metals in the sample. Batch leaching tests were conducted to assess the mobility of the metals. The effect of overlying water pH on metal release from sediments was investigated at different pH values and at different time. The impact of wastewater was studied using water samples collected from the outlet of WWTP in Hostivice.

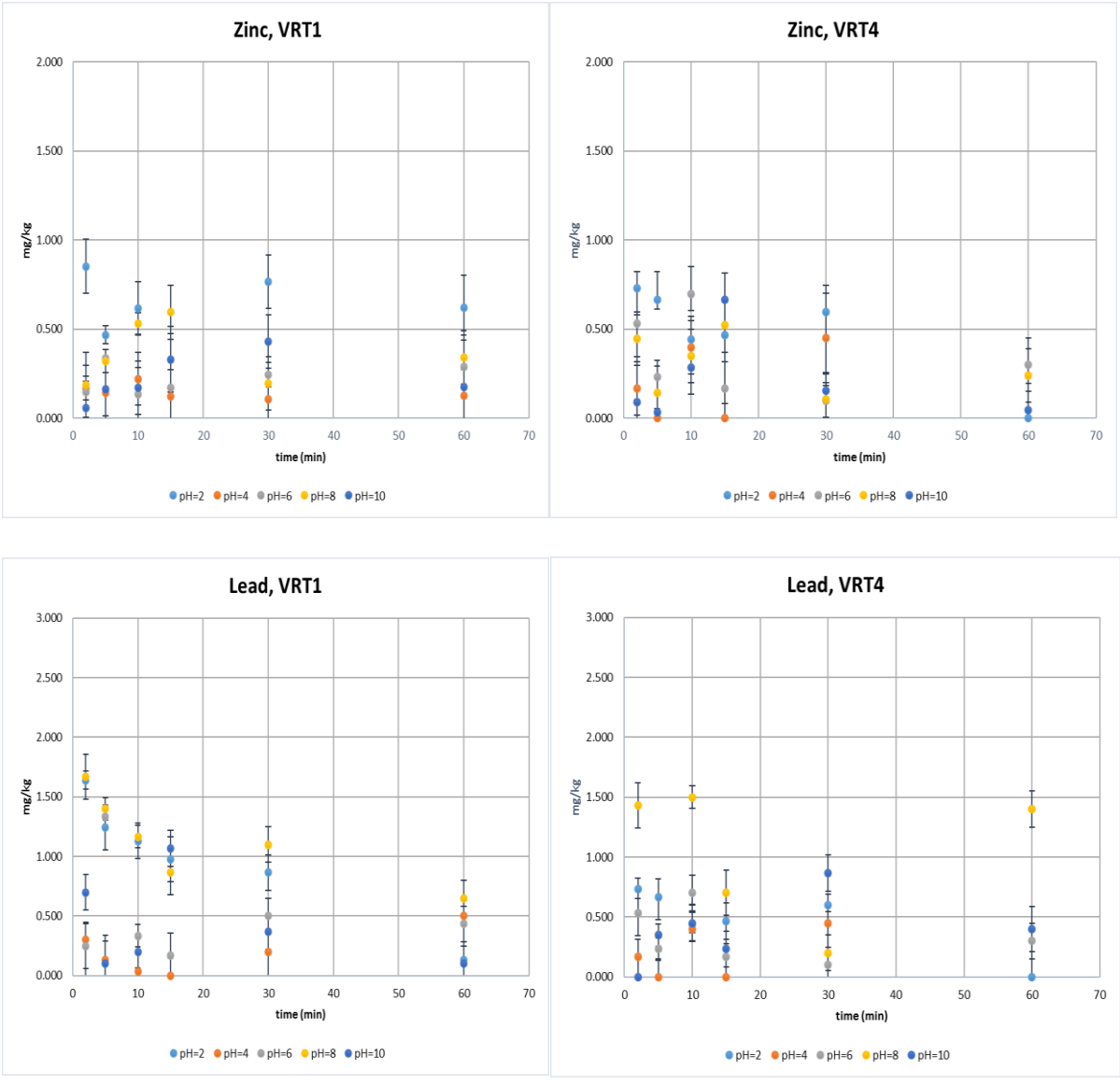
The results of the remobilization test with different pH values confirm that the pH is an in important factor controlling the behaviour of toxic metals in sediment. A change in pH

causes an increase or a decrease in solubility of sediment-associated toxic metals. The leachability is related to their distribution between chemical fractions of the sediments.

In summary, the mechanisms that allow the release are:

- Cation exchange
- Dissolution of metal hydr/oxides and carbonates
- Complexation with OH- and DOC
- Dissolution of sulphide minerals.

Figure 1 reports the concentration of Zn, Pb, and Ni leached from the sediment at different pH value. The results for Cu and Cr are not reported because the concentration is less significant.



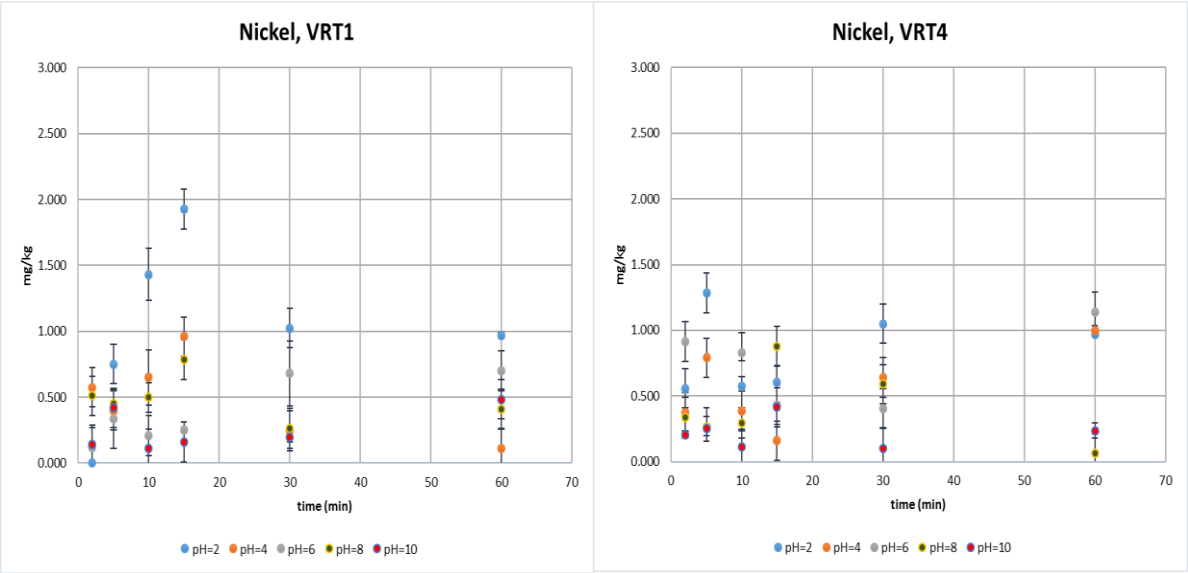
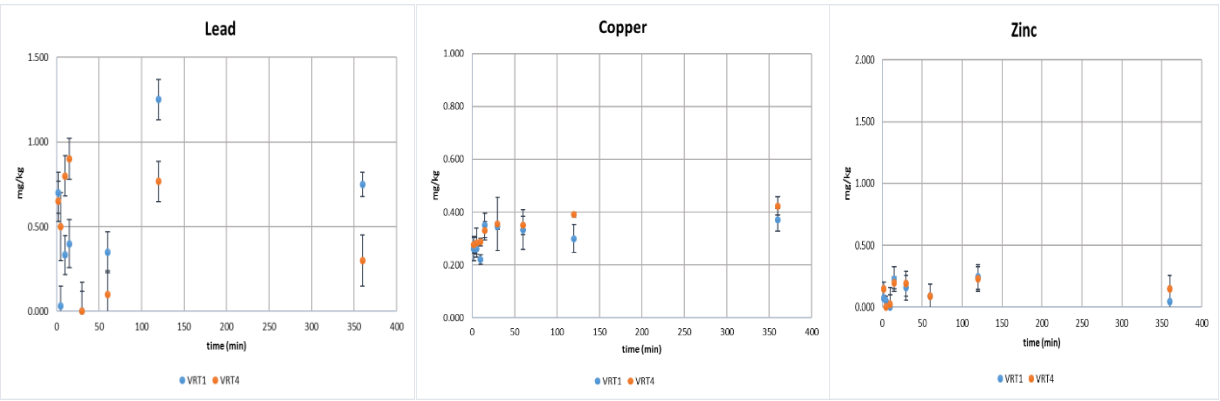


Figure 1 Result of pH remobilization test

Remobilization test with wastewater represents an originality in the experimental field: only a few studies have examined its influence on toxic metals mobility. Particularly, dissolved organic matter originating from wastewater treatment plant presents unique features that make it different from natural organic matter. Evidence suggests that it is essential to consider the binding capabilities of dissolved organic matter through complexation reactions.

The results show that the DOM complexation is generally more significant for Cu and Pb than for Cr, Zn and Ni (Figure 2).



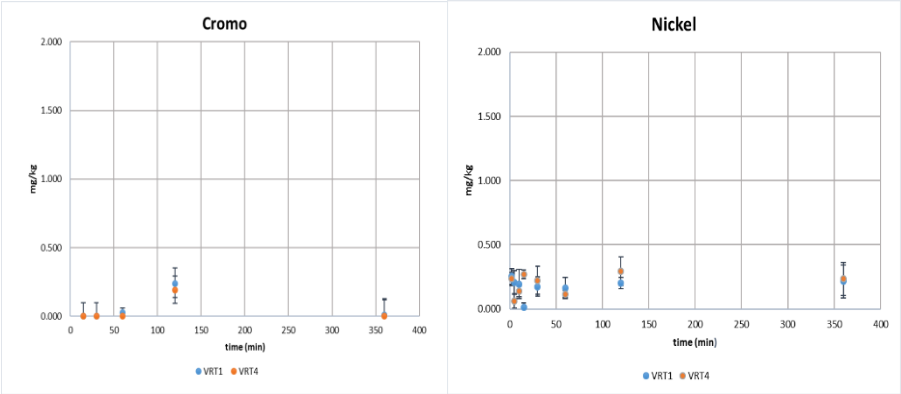


Figure 2 Results of WWTP remobilization test

In our experiments, for all elements differences in order of magnitude are observed between the maximum concentration leached in both tests and the total amount. This implies that just a minimal part of the contaminants is available for leaching. On this basis, the determination of total metals contents in sediments could greatly overestimate the metal fractions which are effectively available for release from the solid matrix. This result confirms the importance of remobilization analysis. In fact, if one side taking in account the total amount of these contaminates provide a better safety measure, on the other side this assumption can overestimate the effectively fraction of metals available to release and so toxicological relevant.

The results of the study are undoubtedly interesting: they emphasize the importance of knowledge all factors that affect mobility, not only to understand the diffusion in the environment but also, and especially, to improve the remediation techniques.

More work should be done: there is a need for further research to fully understand all involved phenomena.