

SUMMARY

The association of trace elements with colloids in leachates from closed and active municipal solid waste (MSW) was studied using the cascade filtration/ultrafiltration method. A study was carried out after long-term monitoring of seasonal variations of the leachate quality. Both landfills are situated in the vicinity of Prague and the closed landfill site represents a serious environmental risk for part of this city.

In the first step, the evaluation of the long-term seasonal changes in the main and trace element contents in leachate from the closed landfill was performed and supplemented by investigation of precipitation/dissolution processes in the solid phases. It was shown that the quality of the leachate is strongly influenced by rain events, which are responsible for the dissolution of calcite and Fe oxides in the landfill body. This process leads to the release of Cu, Zn and Cd bound to these solid phases and to an increase in their concentrations in the leachate. The contents of the other element are significantly decreased by simple dilution. Therefore, the mobility of all the studied elements increases substantially during rain events. Monitoring of the seasonal variation in the leachate quality enabled us to determine the appropriate conditions for isolated sampling for studying the colloid fraction. These conditions occur during periods with average precipitation rate (max. \pm 20 % of the long-range precipitation average) and outside isolated rain events.

Individual fractions of the studied leachate were differentiated by filtration membranes with nominal pore diameter 3.0 μm , 0.8 μm , 0.45 μm , 0.1 μm , 10 kDa and 1 kDa. The solid phase retained on the filtration membranes and also the individual fractions of the leachate were analyzed using the FAAS, ICP MS, HPLC, COD and TOC techniques. The data were analyzed statistically and formed the basis for thermodynamic modeling using PHREEQC-2. The results show that the elements with the highest mobility in the leachate are As, Se and Rb (> 70 % in the dissolved fraction). Other trace elements are associated with colloids partly (20-50 %; Co, Cr, Ni, Zn, Sr, V, Sb, Cu) or even exclusively (> 70 %; Pb, Ba, Al, Fe, Mn). As was confirmed by TEM-EDS-SAED, the dominant colloid phases are calcite (at the closed as well as at the active landfill site) and Fe-oxides associated with clay minerals (closed site).

It was shown that the key phases for binding most of the trace elements are calcite and Fe-oxides. According to the analysis of the solid phase retained on the filtration membranes, under certain conditions these solids would also be capable of binding highly mobile arsenic. On the basis of the results of the present study, several processes were suggested to enhance the formation and aggregation of the colloidal phase in the leachate.