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HEAVY METAL RETENTION IN POLYMINERAL CLAYS

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Heavy metal pollution of groundwater endangers not only areas of mining activities (acid mine waters, mine wastes), chemical industry, municipal landfills, but also those of intense agricultural production etc. However, the geological environment is able to retard the migration of heavy metals and to reduce the leachate concentration, especially in porous media like soils and partly soft rocks as well. The reliability of such groundwater protection depends on one hand on solution parameters, on the other hand on rock specific parameters. Among them, mineralogical composition plays a crucial role, influencing directly not only the physical and chemical interaction of the leachate with the soil particles, but also other rock specific parameters often used in prediction of pollutant mobility: cation exchange capacity, specific surface, soil pH and grain size (CZURDA & WAGNER, 1990).

The last effect is most evident in clays that represent the best pollution barriers. The small sized platy clay mineral particles are responsible for the low hydraulic conductivity of clays. Expandable clay minerals ensure the closing of cracks in the clay liner. Due to the "inner surface", their sorption capacity is very high. Moreover, they are able to exchange their primary cations for other ones. That is why the properties of pure clays have been studied for years (GRIM, 1968; NEWMAN, 1987). Today they are quite well known and they are successfully used also in mineral liners and geocomposites in the construction of landfills.

However, it is not easy to predict the final retention effect in polymineral clays. There, heavy metal retention is a complex of very different chemical and physical processes that cannot be studied separately. Manifold competitive reactions and clay selectivity determine the result.

The retention of lead, copper and zinc in 12 natural polymineral clays (soils in geotechnical terms) was studied using a mixture of heavy metal solutions in batch tests. A comparison of the sorption isotherms and the mineralogical composition of the clays indicated the affinity of individual metals to certain minerals in the soil. But the behaviour of every metal was quite different. Therefore, a new term "summary heavy metal sorption" was used in order to assess the whole sorption capacity of the soils. Because these results are very conditions-dependent, another way of more universal evaluation was searched for. When forming the sequence of best sorbing soils based on the batch tests and looking at their specific parameters, the cation exchange capacity together with the content of carbonates yielded the best correlation. Later these parameters were used in a simple graph for a qualitative prediction of the heavy metal retention properties of natural clayey soils.

References

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