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Assessment of pedological impacts of Hungary's Red Mud Disaster

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Almost a million cubic meters of caustic industrial waste spilled from the storage reservoir of the Hungarian Aluminium (MAL) Ltd bauxite processing plant in Ajka, western Hungary, on October 4, 2010. Lower parts of the settlements of Kolontár, Devecser and Somlóvásárhely villages were flooded. In addition to the very serious human injuries the red mud flooded 800 hectares of surrounding areas. The most severe devastation was caused in the villages of Devecser and Kolontár, which are located near the reservoir. The disaster is one of the worst environmental catastrophes in Hungarian history.

Apart from the fact that Red Mud Disaster should be considered as natural hazard or technological disaster (most probably a specific mixture of the two), one of its most important environmental impact, the effects on soil, had to be assessed.

4 days after the disaster specialists of the Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences and Szent István University Faculty for Agriculture and Environmental Studies arrived into the area to carry out soil survey and examinations related to the rehabilitation of residential and non-residential areas. The affected soils were sampled down to 1 meter at Kolontár and Devecser in sample taking spots to determine whether the pollutants from red mud had already been leaked to the deeper soil layers. The purpose of the sampling and laboratory analysis was quick data supply for risk assessment, which had to be carried out as soon as possible.

A fortnight after the disaster agricultural plots were investigated. During the survey averaged soil samples were collected from the upper 90 cm of the soil (0-30, 30-60, and 60-90 cm). Four representative parcels were selected including areas both covered by vegetation (corn and clover) and cultivated. Thickness of red mud layer on the soil surface was determined. Basic and nutrient examinations were conducted and the amounts of the most important toxic elements were measured.

The field measurements as well as the laboratory analysis results of soil samples clearly prove earlier assumptions, that is, the heavy metal content of the soil does not reach the pollution limit value of soils and the pH level did not increase significantly in the examined 100 cm deep soil layer.

The mobile and dangerous heavy metals from red mud did not infiltrate deeper into the soil profile than 5-10 cm. The heavy metal concentrations are below the limit values. The mobility of these metals is very small. After 2 months of the disaster the soil alkalinity decreased down to near 9 pH (from 13 pH), meaning the remediation was operative. The soil biological activity seems to be increased so quickly, the self regeneration of soil is really fast.
It can be concluded that the damages in non-residential areas are less significant than it had been assumed based on the damage witnessed in residential areas.

The arable land can be made suitable even for food raw material production in a short time (a couple of years). In spite of this, it is necessary to alter soil use completely due not so much to habitat damage but to market conditions and psychological impacts. The potential use of the affected areas is suggested to produce energy plants with the role of soil regeneration and as a secure solution in the following couple of years. For this, a recommendation for arable land rehabilitation was elaborated on the basis of site specifics, soil surveys and laboratory examinations.