Lysimeter experiments with soil substitutes made from red mud

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An increase in the amount of waste produced by humans is one of the main consequences of consumer society. Disposal and treatment of waste materials is one of the actual problems to be solved worldwide. An ideal solution would be turning waste into remunerative material or energy. The aim of our experimental work presented in this paper was to examine the possibility of using red mud, the by-product of the alumina industry, to create soil substitute for land recultivation. For this purpose scaled up lysimeter experiments were performed at laboratory and pilot scale to examine the chemical and biological properties of the leachate seeping through the red mud and the poor quality subsoil mixed with red mud at different weight%. At the laboratory scale, five soil columns were set up as follows: red mud, poor quality subsoil, red mud-mixed into the subsoil at 5and 10 weight%. Pilot-scale field lysimeters were constructed according to a similar set up. The quality of the leachate from the lysimeters was assessed by an integrated methodology including chemical and ecotoxicological measurements. Short-term ecotoxicological tests were performed by testorganisms from two trophic levels: *Daphnia magna* (water flea) and *Aliivibrio fischeri* (sea bacterium). The monitoring of pilot-scale lysimeters was complemented with an initial and a final soil sampling and analysis. Results of the laboratory column experiment indicated that none of the leachates from the soil substitutes were toxic to the testorganisms and the toxicity of the subsoil column leachate to *D. magna* decreased when mixing red mud into it. The environmental toxicity tests on the red mud leachate from the field lysimeter showed that the red mud inhibited both the *D. magna* and the *A. fischeri* testorganisms, however, the former showed higher sensitivity. The Cr, B, Se, Mo concentrations in the red mud leachate only in the first fraction and the Al, As, Na concentrations throughout the experiment were above the Hungarian limit values for groundwater. Chemical analysis showed that the boron concentration of the soil substitute leachate from the laboratory columns - and the field lysimeters was 3 times above the limit value and the molybdenum concentration increased with the increasing amount of red mud. However, red mud proved to have a high capacity to immobilize Zn. Soil analysis indicated that the total metal content of the soil substitute does not exceed the Hungarian limit value for soil, except for As, Cr, Ni, Se. Mixing of 2 and 5 weight% red mud into the subsoil proved to be slightly or non-toxic to *A. fischeri*. The presence of red mud in the subsoil – at up to 10% – has favorable effects on the activity of the soil microflora.