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Microbial reduction of ferric iron oxyhydroxides as a way for remediation of grey forest soils heavily polluted with toxic metals by infiltration of acid mine drainage

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The abandoned uranium mine Curilo is a permanent source of acid mine drainage (AMD) which steadily contaminated grey forest soils in the area. As a result, the soil pH was highly acidic and the concentration of copper, lead, arsenic, and uranium in the topsoil was higher than the relevant Maximum Admissible Concentration (MAC) for soils. The leaching test revealed that approximately half of each pollutant was presented as a reducible fraction as well as the ferric iron in horizon A was presented mainly as minerals with amorphous structure. So, the approach for remediation of the AMD-affected soils was based on the process of redoxolysis carried out by iron-reducing bacteria. Ferric iron hydroxides reduction and the heavy metals released into soil solutions was studied in the dependence on the source of organic (fresh or silage hay) which was used for growth and activity of soil microflora, initial soil pH (3.65; 4.2; and 5.1), and the ion content of irrigation solutions. The combination of limestone (2.0 g/ kg soil), silage addition (at rate of 45 g dry weight/ kg soil) in the beginning and reiterated at 6 month since the start of soil remediation, and periodical soil irrigation with slightly acidic solutions containing CaCl2 was sufficient the content of lead and arsenic in horizon A to be decreased to concentrations similar to the relevant MAC. The reducible, exchangeable, and carbonate mobile fractions were phases from which the pollutants was leached during the applied soil remediation. It determined the higher reduction of the pollutants bioavailability also as well as the process of ferric iron reduction was combined with neutralization of the soil acidity to pH (H_2O) 6.2.