Geophysical Research Abstracts
Vol. 18, EGU2016-485, 2016
EGU General Assembly 2016

Perspectives of humic substances application in remediation of highly heavy metals contaminated soils in Kola Subarctic

Polina Tregubova, Valeria Turbaevskaya, Andrey Zakharenko, Maksim Kadulin, Irina Smirnova, Andrey Stepanov, and Galina Koptsik

Faculty of Soil Science, Moscow State University, Moscow, Russian Federation (tregubova.polin@gmail.com)

Northwestern part of Russia, the Kola Peninsula, is one of the most heavy metals (HM) contaminated areas in the northern hemisphere. The main polluters, mining-and-metallurgical integrated works “Pechenganikel” and “Severonikel”, are surrounded by heavily damaged barren lands that require remediation. The main contaminating metals are Ni and Cu.

Using of exogenous humic substances could be possible effective and cost-efficient solution of HM contamination problem. Rational application of humates (Na-K salts of humic acids) can result in improvement of soil properties, localization of contamination and decreasing bioavailability through binding HM in relatively immobile organic complexes.

Our research aim was to evaluate the influence of increasing doses of different origin humates on i) basic properties of contaminated soils; ii) mobility and bioavailability of HMs; iii) vegetation state and chemistry.

In summer 2013 a model field experiment was provided in natural conditions of the Kola Peninsula. We investigated the Al-Fe-humus abrazem, soil type that dominates in technogenic barren lands around the “Severonikel” work. These soils are strongly acid: pHH_2O was 3.7–4.1; pHKCl was 3.4–4.0. The exchangeable acidity is low (0.8–1.6 cmol(+)/kg) due to the depletion of fine particles and organic matter, being the carriers of exchange positions. The abrazems of barrens had lost organic horizon. 12 sites were created in 1 km from the work. In those sites, except 2 controls, various amendments were added: i) two different by it’s origin types of humates: peat-humates and coal-humates, the last were in concentrations 0.5% and 1%; ii) lime; iii) NPK-fertilizer; iv) biomates (organic degradable cover for saving warm and erosion protection). As a test-culture a grass mixture with predominance of Festuca rubra and Festuca ovina was sowed.

As a result we concluded that humates of different origin have unequal influence on soil properties and cause decreasing as well as increasing of HMs mobility in the conditions of 6-weeks field experiment.

Peat-humate application causes insignificant enrichment of soil by organic matter, has low influence on pH and microbiological activity. Nevertheless, in combination with lime, it raises pH and immobilizes Ni and Cu and shows best results by vegetation state. Ni and Cu mean concentrations in soil water extract of control sites are 3.7 μg kg-1 and 12.3 μg kg-1, and of sites with combination of peat-humate and lime - 0.2 μg kg-1 and 1.1 μg kg-1 respectively.

Coal-humate application attended with high enrichment of soil by organic matter and it’s soluble forms, changes in molecular-mass distribution, decreasing of acidity, and growth of microbe biomass (also due to using of biomates). That involves relatively HM soluble forms mobilization in variants with highest concentration of coal-humate (1%). Ni and Cu mean concentrations of those variants are 2.1 μg kg-1and 10.2 μg kg-1.

Promising results obtained in short-term experiments should be supported by further investigations. Proper evaluation of humates efficiency and selection their optimal doses for remediation of contaminated soils require long-term field experiments under the influence of multicomponent contamination and diverse physical, chemical, and biological factors.