

## **The leaching of chemical elements from soils with biological agents and chemicals**

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The characteristics and properties of soils depend on numerous factors and can considerably change under technogenic impact. Microbiological processes are a substantial but insufficiently studied factor affecting soil properties. Intensification of soil microbiota's activity could lead to a transformation of solid, liquid and gaseous phases of soil.

We studied the issue related to soil mineral composition transformation under the influence of microbiological processes and potential products of microbial vital activity.

The experiments were conducted using loam samples taken from depths of 9.8-12.0 m. The sampling wells were located in the territory of Perm (Russia). The following agents were used as extractants for soil treatment: nutrient broth to activate microbiota in the soil, humic acids extracted from peat, and organic acids, which are potential waste products of microorganisms (citric and acetic acids).

We found that soil treatment with organic acids led to the largest leaching of chemical elements from the soil. The highest leaching was observed for Fe ions which amounted up to 54-78% or more of the total iron content in the soil.

The amount of the Fe ions leaching from soils with activated microbiota was lower and averaged from 0.7% to 4% and treatment with humic acids averaged to 3.7%.

Additionally, soil treatment with organic acid led to the increasing of migration ability and to the leaching from the soil sample following trace elements: Ni, Sr, Mn, Te – up to 10%, Ag, Se – up to 20%, Cu – up to 30%, etc.

Thus, the entering of organic substances into the soil body stimulates the aboriginal microorganisms. Microbiological processes and products of microbial vital activity could affect the mineral component of the soil and promote the substantial leaching of chemical elements from it. Moreover, these phenomena could adversely influence to physical and mechanical properties of the soil (*i.e.* density, compressive strength, shear strength, etc.). Such changes of geotechnical properties occurring in the soil as a result of the activation of microorganisms should be taken into account at any stages of the construction and operation of engineering facilities. The reported study was funded by RFBR according to the research project № 18-35-00042.