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Modern approaches to remediation of coal industry waste

Currently, the coal industry is one of the environmentally unfriendly industries of the world economy.

Industrial activity of coal mining enterprises leads to pollution of the atmosphere and other life environments most strongly associated with the atmosphere, especially the soil, causing considerable damage to natural ecosystems.

Atmospheric pollution occurs in several ways: gaseous emissions, suspensions of heavy metals accumulating in the soil.

Soil structure as a result of coal pulverization is also violated. This leads to new structures being created: ravines, abandoned quarries, and tailings (piles of rocks).

The tailings contain rocks consisting of the following minerals: vivianite $Fe_3(PO_4)_2 \cdot 8H_2O$; olivine Fe_2SiO_4; pyrolusite MnO_2, chalcopyrite $FeCuS_2$, and many others.

The main toxic substances entering the soil are heavy metals, as they form the basis of a mineral.

The primary risk of heavy metals is their toxicity, combined with their accumulation in the soil. Some metal gets into groundwater, some accumulates in plants leading to agricultural products becoming biologically unsafe [2].

Reclamation of industry dumps accelerates the process of soil formation.

Overburden generated during coal mining is exposed to weathering processes. At first, the substrate gets colonized by different types of microorganisms, which gradually create conditions for better interaction of chemicals with the mineral surface and dissolution of the toxic metal.

This property of microorganisms is the basis for bacterial and chemical leaching of metals that can be applied in order to remediate the dumps of coal industry.

At the basis of leaching lies the oxidation of minerals and transfer of heavy metals from insoluble to soluble state.

The most studied microorganisms that are actively applied in bacterial leaching of metals are representatives of the Acidithiobacillus genus, capable of oxidizing heavy metals from sulphide ores.

Investigation of ore deposits by different researchers has shown that the number of bacteria cells in the oxidation zone reaches 1 million to 1 billion per 1gram of ore [1].

In this context, the aim of this study was the isolation of autochthonous acidophilic chemolithotrophic microorganism associations for the possibility of application of these associations in the remediation of coal industry waste dumps.

Sources for the isolation of microorganisms were coal dumps in the area of the actively developing coal deposit "Cheremhovsky" (Irkutsk region, Cheremhovo).

As the gathering of microbial cultures went on, within a month of cultivation, the investigated samples of coal ore from "Cheremhovsky" highlighted various representatives of microbial associations represented by species: A. ferroxidans (motile, gram-negative, single and in chains, asporogenous rods, aerobic, moderate thermophiles (upper temperature limit of 40^0C), pH tolerance range of 2.0 to 4.0) and A. thiooxidans (mobile, gram-negative, small nonsporogenous sticks, aerobic, mesophiles (optimum temperature of 30 - 37^0C), optimum pH for development: 2.0-4.0.

List of literature

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