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PHYTOREMEDIATION TECHNOLOGY FOR COAL DUMPS

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Purpose. To study possible phytoremediation techniques to improve the condition of coal dumps.

Methodology. To study the physical-and-chemical parameters of soil substrates used for coal dump reclamation in Western Donbas, in particular black soil and red-brown clay; to investigate the Bioconcentration Factors, Translocation Factors and Tolerance Index of indicator plants; to compare the different additions to soil substrate in order to increase the phytostabilization by testing in model laboratory experiments examples of different biosorbents and biomeliorants.

Methods. Mining is a process, which produce a lot of waste with high concertation of heavy metals and toxic elements [1-4]. These lands have a low pH, low concertation of organic and low vegetation. However, there are many solutions for this problem [5]. It is very important to choose correctly method for decision of this problem. The right way depends of the next factors, such as: 1) physical structure; 2) chemical and 3) biological function [6].

One of the promotion method of reclamation of coal dumps is phytoremediation. Phytoremediation – the treatment of pollutants or waste (as in contaminated soil or groundwater) by the use of green plants that remove, degrade, or stabilize the undesirable substances (such as toxic metals). There are different kinds of phytoremediation: phytoextraction; phytostabilisation; phytodegradation; rizofiltration and etc.

Phytostabilisation is one of the perspective method and will be considered in this scientific work. Soil from coal dumps from Western Donbas have a low concertation of organic, low pH and high concertation of heavy metals such as: Pb, Co, Cd, As, Cr [7].

Biochar and biocompost are solutions for this soil. It prognoses that pH and concertation of organic will increase and this substrate can immobilize heavy metals [5].

When organic substance (biocompost) will added it expected to change physical parameters of the soil, to increase organic components for instance: C and Ca, by improving ion exchange reaction [8]. An important factor is to choose the right organic substance that can increase the oxidation-reduction reactions in the substrate, increase soil moisture and stimulate biological activity [9].

Immobilization of heavy metals, increasing of pH level, increasing of ion exchange, change of physical structure of soil, water balance of substrate, and increase of level of carbonates and phosphates is predicted at addition of biochar [10].

For analyzing the obtained results, it is planned to conduct a general analyze physicochemical parameters of soils such as: pH, specific electrical conductivity of the soil (EC), gross test, test on the concertation the toxic elements and liquid metals in plants and soil. For the intact soil sample will determine the content of nutrients for plants, namely ions: NO3-, NH4 +, PO43- (spectrophometrically) and the concentration of mobile forms of the elements, by obtaining a water extraction with ammonium acetate buffer (pH=7) and ammonium acetate solution with the addition of citric acid (pH=4).

It is important to choose the right phytoindicator that will improve the biological component of the substrate. Among the plants for phytostabilization, the following options are considered: Polygonum aviculare L.), Artemisia vulgaris, Achillea millefolium, Ambrósia, Triticum L., as these plants are pioneers in the steppe zone of Ukraine and typical for this region. These plants are not capricious to the substrate, they easily take root in degraded areas. These phytostabilizers are acclimatized to this region, and there is no need for an adaptive period for these plants.

The general content of microelements in soils and plant tissues is planned to be determined on the basis of the method of inductively coupled plasma mass spectrometry (ICP-MS).

Findings. The different methods for decreasing concentration of heavy metals and toxic elements has been considered. Scientific performance of such phytoremediation with substance such biochar and biocompost or without have been proposed. The obtained results will be the basis for the development of a technology for phytostabilization of heavy metals at the coal dumps of Western Donbas. Presented research was supported in the frame of the DAAD project "Biotechnology in Mining – Integration of New Technologies into Educational Practice" and cooperation between Technische Universität Bergakademie Freiberg, Germany, and 1Dnipro University of Technology, Dnipro, Ukraine.

Key words: coal, dump, Western Donbas, heavy metals

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