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OIL PRODUCT DEGRADATION IN THE POLLUTED SOIL

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Abstract

Petroleum hydrocarbon contamination is one of the main environmental concerns. At present, in situ oil- and oil product-remediation strategy is based on two main approaches: a) agricultural methods (addition of fertilizers and mechanical cultivation of polluted soil) and b) microbiological technologies (addition of hydrocarbon-degrading microorganisms). Our previous investigations and literature data showed that the application of the active forms of Si can benefit the soil remediation by the both methods. However, the mechanism by which active Si impacts oil hydrocarbon-polluted soil is not clearly understood. The greenhouse studies were conducted with Grey Forest Soil polluted by mixture of diesel and used motor oil at the concentration of 3%. The following treatments were applied: control with and without pollution, NPK, NPK+Si, Si, microbial commercial product, microbial product + Si. The diatomite mined in the Central Volga region was used as a source of active Si at the rate 10 t ha^{-1}. Fertilizers and microbial product were applied at the rates accordingly recommendations. During 3 months, the dynamic of CO_2 emission from soil surface and biomass of the barley was examined. The emission of the CO_2 is correlated with soil breathing and microbial activity. In the end of the experiment, the total hydrocarbon content in the soil was analyzed. The obtained data showed that the application of all treatments enhanced the microbial activity and reduced the content of hydrocarbons. A maximum effect was examined for NPK+Si treatment and microbial product+Si. The content of hydrocarbons was decreased from 3% to 0.2 and 0.25%, accordingly for NPK+Si and microbial product+Si. The microbial activities at these treatments were increased 2.5 and 2.2 times as compared with contaminated control. The following mechanisms of the active Si action in hydrocarbon-polluted soil were supposed. Firstly, active Si can partly adsorb hydrocarbons thus reducing their negative influence on the soil-plant-microorganism system. The second mechanism is connected with increasing resistance of soil microorganisms and plants against stresses, including toxic impact of oil-products. By this means, the active Si forms can increase the efficiency of the technologies used for purification of oil- and oil product- contaminated soils.