PREVENTION OF THE WIND MIGRATION OF SEMIPALATINSK TEST SITE CONTAMINATED TOPSOIL BY INTERPOLYMER COMPLEXES

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It is well known that Semipalatinsk Test Site (STS) has been contaminated by radionuclides mainly as a result of atmospheric, aboveground and underground intensive nuclear tests during more than 40 years. Survey of residual radioactivity in the soil at ten STS areas showed that a great number of Plutonium-239, 240, Strontium-90 and Cesium-137 are concentrated in the depth of soil layer 0-8 cm. The residual radioactivity within the STS is tightly bound to the topsoil as a result of extreme heating and melting of the soils during the tests. The maximal amount of radionuclides is accumulated on the fine soil particles having 0.1-1.0 mm size. Wind erosion is responsible for suspension of contaminated soil particles in the air and further spreading of contamination far away. For instance, dust particles of diameter 0,05-0,1 mm are dropped within a couple of kilometers of the erosion site, while particles of about 0,005-0,01 mm diameter can move hundreds and thousands of kilometers. According to the results of the Institute of Radiation Safety and Ecology, Kazakhstan, in “Degelen” massive, where the intensive nuclear tests were carried out, the concentration of radionuclides in air increases for Sr-90 up to 5 times, for Pu-239,240 up to 100-250 times during the elevation of thin dust from the ground surface. In this connection agglomeration of thin dust containing radionuclides is of primary importance to protect the population from inhalation of re-suspended dust. Interpolymer complexes (IPCs) are water-insoluble, moisture and gas permeable substances that form a “cobweb” on the surface of soil particles and consequently leading to formation of protective crust (Fig.1).

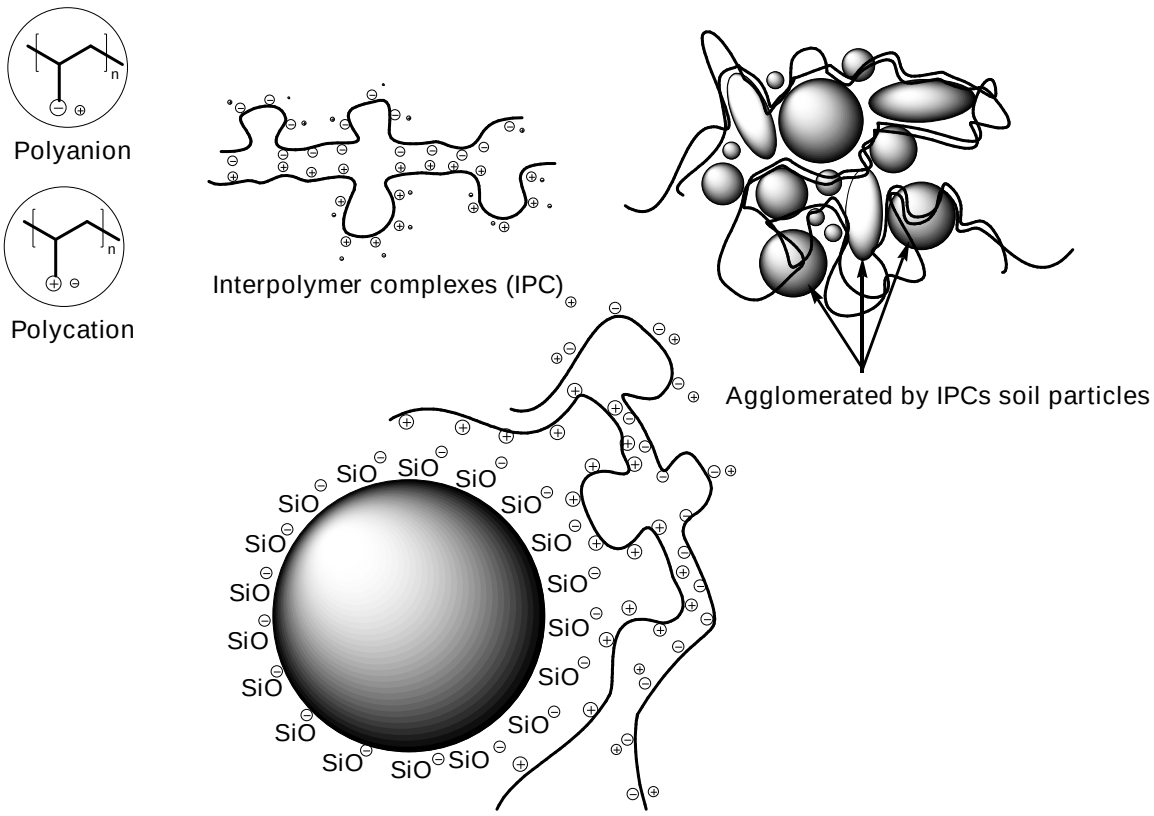

Fig.1. Formation of polymer-binded soil particles

IPCs enhance the intrusion of water into the soil, resulting in increased soil moisture to promote seed germination and plant growth. IPCs are also able to accumulate radionuclides via inclusion of metal ions into the IPCs with formation of ternary polymer-metal complexes. The laboratory experiments demonstrated that the treatment of the topsoil by dilute aqueous solutions of IPCs leads to effective aggregation of the topsoil particles with diameter of 0.01-0.1 mm from 38% (control) to 91%. The average value of wind erosion of aggregated soil becomes less than 1% at the velocity of wind 5 $m \cdot s^{-1}$ in comparison with the value of 74% in case of untreated soil. It was also found that the formed ultrathin crust on the surface of soil particles is able to accumulate the radioactive strontium 4 times higher in comparison with untreated ones. The activity of ^{238}Pu in the topsoil after treatment by solutions of IPCs increases up to 10000-12000 Bq/kg in comparison with the untreated soil particles (5156 Bq/kg). These results clearly show the potential applicability of IPCs as effective soil remediation materials. The

so-called “Koshkar-Ata Lake” located 3 km far from Aktau city and 7-8 km from the Caspian Sea also contains the waste of uranium mining industry. Today the dried area of “Koshkar-Ata Lake” is more than 58 sq. km. In Summer time the thin dust with average diameter 0,01-0,1 mm constantly migrates from the dried part of “Koshkar-Ata Lake” to Aktau city as a result of wind erosion (16-17 m/sec). The developed technology can protect the wind migration of thin dust containing highly toxic heavy metals. It can also be applied to combat against the migration of salted dust from the dried bottom of Aral Sea.

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