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USE OF POLYMER-BASED NANOMATERIALS FOR ENVIRONMENTAL RESTORATION

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As a result of military activity, cities, villages, plants and factories are destroyed, and the environment is affected. A number of toxic substances accumulate in water and soil, and their removal and disposal require significant material costs. Nanocomposites are one of the most promising materials for solving today's environmental problems. Today, nanocomposites are being introduced into commercial products at a faster pace. However, the occurrence of aggregation, nonspecificity and low stability limits the use of nanotechnology products due to insufficient functionality.

Polymers are generally used to detect and remove chemical pollutants (manganese, nitrate, iron, arsenic, heavy metals), gases (CO, SO_2, NO_x), organic pollutants (aliphatic and aromatic hydrocarbons, pharmaceuticals, volatile organic compounds, biological agents (bacteria, parasites, viruses). Polymeric bases (surfactants, emulsifiers, stabilising agents and functionalised surface ligands) are used to improve stability, overcome the limitations of pure nanoparticles and provide desired properties, increased mechanical strength, thermal stability and recyclability, among other things.

Amphiphilic polyurethane nanoparticles recover multinuclear aromatic hydrocarbons from soils. Polyamidoamine is capable of encapsulating cations dissolved in water (Cu^{2+}, Ag^{+}, Au^{+}, Fe^{2+}, Fe^{3+}, Ni^{2+}, Zn^{2+}, U^{6+}) and is used as an antibacterial/antiviral agent. Polymers containing metal and metal oxide nanoparticles are used for environmental remediation. The use of polymeric nanomaterials for the specific capture of gas mixture compounds of non-target pollution is described. Carbon nanofibres based on chitosan have been developed that effectively adsorb Cr^{6+} from water. The impregnation of SiO_2 nanoparticles in an acrylamide hydrogel improves the adsorption capacity for the removal of cationic dyes.

Biocompatibility and biodegradability are key elements in the use of polymer nanocomposites. In particular, a green hybrid adsorbent removes dyes as a magnetic hydrogel. Another composition of Fe_3O_4 with magnetic nanoparticles was used to remove Cu^{2+}, Cd^{2+}, Pb^{2+}, and Zn^{2+} from water. It is obvious that polymeric nanoparticles effectively remove several pollutants by different mechanisms, performing a critical function in environmental remediation.

It is worth noting other models of nanoparticles that effectively remove environmental pollution. Ag-doped TiO_2 successfully removes 2,4,6-trichlorophenol, Ag-doped TiO_2 nanofibres – methylene blue dye. Cu/Fe/Ag-doped TiO_2 binds nitrate (NO_3^-). Silica nanoparticles contribute to the removal of polycyclic aromatic hydrocarbons and Pb^{2+}, Hg^{2+}, Cd^{2+}, $Cr_2O_7^{2-}$ from contaminated water. Cr6+ is removed by the Fe^0 polymer matrix. Gold coated with chitosan polymer and a multi-walled carbon nanotube adsorb Zn^{2+} and Cu^{2+}. Th^{4+} from wastewater and industrial water is purified by chitosan/bentonite material with polymethacrylic acid.

Thus, the use of polymer-based nanomaterials will contribute to the effective restoration of the environment, which will significantly improve the environmental situation in Ukraine, especially in overcoming the consequences of the ongoing war in the country.