Nanocomposites and nanomaterials

Pectin-silica hybrid materials as sorbents of lead(II) ions

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The aggravation of the environmental problems and intensive industrial development increase the importance of the problem of water pollution with lead, which is connected with its high toxicity and bioaccumulation in living organisms. One of the priority targets of modern science is to develop novel highly efficient and relatively inexpensive sorbents for the removal of Pb^{2+} ions from aqueous solutions. The combination of the properties of natural polymers with nanoporous silica is a perspective direction for the development of new hybrid sorbents with potential application in biotechnology, medicine, and ecology.

The aim of this research was to develop methods for the synthesis of pectin-silica hybrid materials, to study the nature, structural and adsorption characteristics of derived materials, and their sorption capacity to ions of Pb^{2+}. Sol-gel synthesis of pectin-silica materials included the reaction of hydrolytic polycondensation of TEOS (98%, Aldrich) with addition of citrus pectin (GalA≥74,0%, Aldrich) to the system. Moreover, the polymer was introduced in polysiloxane network in various ways: in the form of solutions with different percentage of pectin, in dry form, in the form of calcium pectate, and after previous modification of the polymer.

The complex of physical and chemical methods was used to analyze the structure and sorption properties of synthesized hybrid materials. It was determined, that due to the weak interaction between the mineral and organic components, silica matrix does not improve the thermal stability of pectin, but has a significant impact on its hydrolytic stability. It was shown, that increasing pectin content in the composite decreased the specific surface area and increased sorption capacity of samples to Pb^{2+} ions. However, when the sorption capacity was recalculated regarding the concentration of the active component, the increasing content of pectin in the composite reduced sorption capacity of pectin itself to lead(II) ions, which could be explained by the blocking access to the carboxyl groups. Consequently, further research will be aimed at finding the optimal ratio of the components for more efficient removal of heavy metals from water environment.