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ROZPRAWA DOKTORSKA

Otrzymywanie i charakterystyka hybrydowych sorbentów na bazie polisacharydów

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Abstract

In this doctoral dissertation, a method for synthesis of two types of hybrid inorganic-pectin sorbents was proposed, as well as the properties of obtained materials were examined.

The first type was a hybrid pectin-nano titanium dioxide sorbent for the removal of Cu(II), Zn(II), Cd(II) and Pb(II) ions. The proposed synthesis method provided a hard, non-crumbling bead-shaped sorbent that can be easily separated from the purified solution. The sorbent was characterized by scanning electron microscopy (SEM) and infrared spectroscopy (FT-IR). The best sorbent dose was determined as well as the effect of pH on the sorption properties was studied. Conducted experiments proved that the addition of TiO_2 nanoparticles improves the sorption kinetics of Cu(II), Zn(II), Cd(II) and Pb(II) ions, especially in its first period (before reaching equilibrium). The Cu(II), Zn(II), Cd(II) and Pb(II) ions sorption equilibrium studies proved that the obtained sorbent shows very good sorption properties.

The second type of sorbents tested were pectin-transition metal hexacyanoferrates for the Cs(I) ions removal. In this studies, a procedures for the synthesis of prussian blue (PB) and copper(II) hexacyanoferrate(II) (CuHCF) powders as well as hybrid pectin sorbents with these powders were developed. Sorbents with 10, 30 and 50% PB, and a sorbent with 50% CuHCF were selected for detailed studies. The obtained sorbents were bead-shaped, hard and non-crumbling, and were easily separated from the purified solution. It was found that these sorbents exhibit very good sorption properties and are stable over a wide range of pH (4 - 8) and temperature (12 - 32°C). The maximum sorption capacities of the obtained materials were determined based on the Langmuir isotherm model and were similar to or higher than sorption capacities of other sorbents proposed for Cs(I) ion removal. It was also proved that the proposed sorbents exhibit high removal efficiency of Cs(I) ions in a dynamic system and good sorption properties in high salinity solutions such as seawater. In addition, it was proved that the proposed sorbent synthesis method results in materials with reproducible sorption properties, and that the obtained sorbents are stable over time and can be stored in an air-dry state for a long time.