ADSORPTION OF CESIUM AND COBALT ONTO NANOCOMPOSITE BASED ON CLAY, GRAPHENE OXIDE AND MAGNETITE/MAGHEMITE

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Nuclear weapons tests, man-made disasters, for example, at the Chernobyl [1] and Fukushima-Daiichi nuclear power plants [2], as well as unintentional leaks, spills during the operation of nuclear facilities lead to environmental pollution with radionuclides and, as a consequence, a violation its integrity and negative impact on human health [3-5]. It is assumed that clay minerals and their composites play an important role in protecting the environment from the negative effects of radionuclides. Nowadays, clay minerals in terms of adsorption efficiency are not inferior to commercial adsorbents, and in some cases even surpass them. Clays are actively modified in order to increase their efficiency and selectivity in relation to pollutants. Combinations with clays, in the composition of the composite, other potential adsorbents, makes it possible to increase the efficiency of adsorption due to a synergistic effect, in addition, clays reduce the toxic effect of other components in the composition of the composite, for example, graphene oxide [6].

The aim of this study was to develop a Clay-Graphene Oxide (GO)-Magnetite (MG)/Maghemite (MGH) nanocomposite, as well as to study the adsorption behaviour of Cs(I) and Co(II) on this nanocomposite. The first step of preparation of the nanocomposite included the synthesis of individual components – GO and MG/MGH, the GO was obtained by the Hummers method, the MG/MGH by a co-precipitation reaction of ferrous and ferric ions. The synthesis of the nanocomposite included dispersing GO and MG/MGH in an ultrasonic bath for 2 h, followed by the addition untreated triassic clay (Šaltiškiai in North Lithuania) to the solution, keeping the mixture under constant stirring in a flow of argon for 1.5 hours, at 60 °C. Then this mixture is centrifuged, the resulting nanocomposite is taken and dried in vacuum for 24 hours. These nanocomposites were characterized using X-ray diffraction analysis (XRD), X-ray fluorescence analysis (XRF), scanning electron microscope (SEM), transmission electron microscope (TEM) and fourier-transform infrared spectroscopy (FTIR). To study the adsorption behaviour of Cs(I) and Co(II), various tests were carried out, depending on the concentration of the adsorbent and adsorbate, pH, temperature, contact time, as well as the adsorption of these metals in a binary system. The resulting nanocomposite proved to be effective in adsorption of Cs(I) and Co(II), where the maximum adsorption capacity was 2165 mg/g and 627 mg/g.

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