ENVIRONMENTAL APPLICATION OF CATION-EXCHANGED BENTONITES

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One of the important goals of the 21st century is to improve the environment. The emission of pollutants can have adverse effects on the environment and public health. Therefore, it is necessary to develop treatment processes that isolate and remove contaminants from their environment. Thus, our aim is to sorb anionic pollutants (phosphate and arsenite ions) and long-lived radioactive isotopes ($^{36}Cl^-$, $^{129}I^-$, $^{99}Tc^-$ isotopes as pertechnetate ions, TcO_4^-) on modified bentonite clay. Since these pollutants are anions, they do not sorb onto natural clays to a significant extent and therefore they can relatively quickly migrate with water in the environment. The modifications create sorbing sites in the clays where anions can also be sorbed or precipitated in the form of weakly soluble salts, thereby reducing migration. The sorption of phosphate (BUZETZKY *et al.*, 2017) and arsenite ions (BUZETZKY *et al.*, 2019a) was studied on bentonites modified with rare earth (REE) ions and Fe(III) ions. The sorption of $^{36}Cl^-$, $^{131}I^-$ isotopes was investigated on Ag-bentonite (BUZETZKY *et al.*, 2020), while the sorption of ^{99m}Tc isotopes as pertechnetate ions (TcO_4^-) was studied on Mn-, Cr-, Sn-bentonites (BUZETZKY *et al.*, 2019b).

The successful cation exchange was confirmed by X-ray fluorescence spectroscopy and X-ray diffraction. Kinetic studies were carried out to determine the rate constants and the activation energy. The equilibrium relationship between the sorbed and the dissolved phosphate and arsenic concentration was described by Langmuir isotherm. The mechanism of phosphate ion sorption is different in the case of REE- and Fe-bentonites.

The sorption of iodide ions on Ag-bentonite is rapid and the equilibrium is reached within a few minutes so the rate constant could not be determined by the batch technique. In the case of iodide ion, the sorption was influenced by iodide carrier solution. Increasing the concentration of the inactive iodide ion reduces the sorption due to the formation of a soluble silver diiodide complex.

The modified bentonites can sorb ^{99m}Tc ions fast and in a high degree. On the basis of the redox potential and the relative sorption values, it can be stated that the Cr-, Sn-modified bentonites showed the most effective sorption, the removal of Tc was 100% after 5 minutes.

These results show that modified clays could play an important role in the treatment of eutrophication processes in the aquatic environment and can be used for removing arsenic ions from water. Moreover, modified bentonites can be suitable for the construction of waste containers as anion sorbents.

References

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