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Organoclays as Adsorbents for Anions: Selectivity and Ion-exchange Processes

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Organoclays are modified clays in which the natural inorganic interlayer cations have been replaced by organic cations like quaternary alkylammonium ions. The net amount of organic cations adsorbed to the clay can exceed the cation exchange capacity (CEC) of the clay, thus providing binding sites for exchangeable anions.

In the context of engineered barrier systems for nuclear waste repositories, some fission products, such as iodine, selenium and technetium, are anionic in aqueous environments and their long-lived isotopes pose high health risks.

Previous studies have shown that organoclays like HDPy-modified bentonite are able to retain anions like iodide and pertechnetate. However, little is known about the selectivity of the organoclay if competing anions - e.g. deriving from the ground water - are present in the solution. Our studies aim at understanding the sorption processes of anions by organoclays in competitive situations.

In this study, we used a smectite-rich bentonite (MX-80) and the cationic surfactant hexadecylpyridinium (HDPy+) to prepare an organoclay as adsorbent for five different anions. The anions included iodide, selenite, perrhenate (as chemical equivalent of pertechnetate), nitrate and sulphate. They were chosen to represent those most hazardous anionic substances in nuclear waste repositories and common anions in ground or pore water.

Sorption experiments were carried out using the batch technique, with anion concentration determined by ion chromatography. Results show a clear selectivity of the organoclay, with the adsorption of iodide and perrhenate being preferred to the adsorption of nitrate, sulphate, and selenite.