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Research Note

A Case Study of Performance Evaluation of Adsorbent for Cs Enrichment from Radioactively Contaminated Fly Ash Washing Solution

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● Summary ● The volume of combustible materials contaminated by radioactive Cs released into the environment due to the accident at the TEPCO's Fukushima Daiichi NPS can be reduced by heat treatment, and the Cs can be concentrated as water-soluble salts in heat-treated fly ash, which further concentrates by fly ash washing and ion exchange chromatography. The performance of the adsorbent used in ion exchange chromatography was evaluated in this study. The adsorbent was iron ferrocyanide (Prussian blue) granulate (PB), which is an ion exchanger, and its adsorption behavior under various solution conditions can be predicted from its ion exchange capacity (CEC) and Cs^+ ion selectivity coefficient. Then, the adsorption behavior was theoretically predicted from the chemical composition of the fly ash washed solution, and compared with the experimental results. For simplicity, only K^+ ions were assumed to be adsorbed in competition with Cs^+ ions, and the composition of the simulated fly ash washed solution was set to $[K^+]/[Cs^+] = 20{,}000$. Experimental conditions were set based on theoretical calculations, and Cs^+ ion adsorption experiments were conducted using PB from the simulated fly ash washing solution. As a result, the Cs^+ ion selectivity was as high as 25,000 when the amount of Cs adsorbed was small, but when the amount of Cs adsorbed exceeded 5% of the CEC, the Cs^+ ion selectivity was constant at about 3,000. When the radioactivity concentration of the stabilized material was 10 million Bq/kg, the liquid-solid ratio of the adsorbent to the simulated fly ash washed solution was 900, and the saturated adsorption amount at maximum volume reduction was estimated to be 0.55 mol/kg, about 1/5 of the CEC measurement value. Based on these results, the procedure for evaluating the basic properties of the adsorbent was discussed.

Key Words: Cs adsorbate, ion exchange, performance evaluation, selectivity coefficient, ion exchanging capacity

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