Selective Adsorption of Aquatic Strontium Using Monosodium Titanate Species

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1. Introduction

The most uprising issue of nuclear safety is how to decontaminate and decommission expired nuclear facilities effectively and economically. During the decontamination and decommissioning process, hazardous mobile radionuclides can be discharged through air and streams. ^{90}Sr and ^{89}Sr are most abundant contaminants in radioactive waste owing to their high specific radioactivity, high mobility, high water solubility, and long half-life [1]. Selectively adsorption of strontium in mixed solution using monosodium titanate synthesized by Hobbs's method was performed [2]. Physical characteristics of sodium titanate and strontium adsorption rate were also examined for effective aquatic strontium adsorption by sodium titanate.

2. Experimental Results

2.1 Properties of Synthesized Sodium Titanate

The structure and morphology of the synthesized monosodium titanate (MST) was analyzed by using SEM. Synthesized sodium titanate showed amorphous and aggregated structures with microporous property. (Fig. 1)

Stoichiometry of synthesized MST was also examined by using EDAX. Chemical composition of synthesized MST was verified as $NaTi_2O_7$. (Fig. 2)

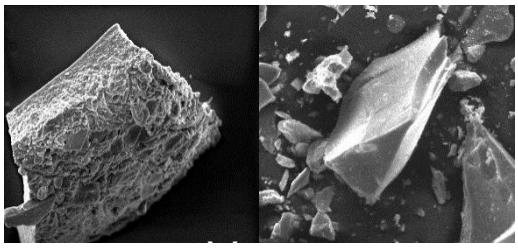

Fig. 1. SEM picture of synthesized sodium titanate (Left: vacuum dried form; right: grinded from vacuum dried form).

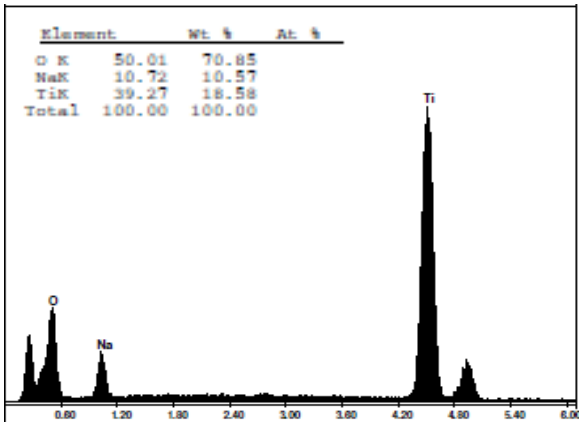

Fig. 2. EDAX result of synthesized MST.

Physical characteristics of MST such as surface area, mean pore diameter and pore volume were calculated via Brunauer-Emmett-Teller (BET) experiments, as summarized in Table. 1

Table 1. Physical characteristics of MST by BET

Sample	MST
BET total surface area (m^2/g)	244.17
BJH mean pore diameter (nm)	10.344
BJH total pore volume (cm^3/g)	0.0563

2.2 Strontium Adsorption rates

Aquatic strontium adsorption experiments from

1mM strontium and cesium containing solution using synthesized MST were conducted. 99% of 1mM strontium was adsorbed in MST within 3 hours. Otherwise, about 40% of 1mM cesium was adsorbed in MST during 24 hours.

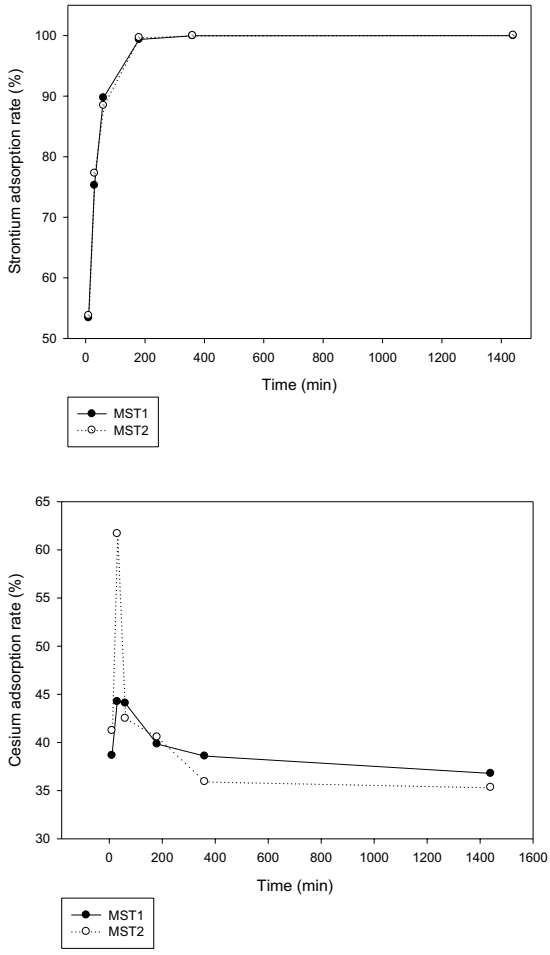

Fig. 3. Strontium and cesium adsorption rate by MST during 24 hours (conditions: temp = 25˚C, initial strontium and cesium concentration = 1 mM; weight of adsorbent = 0.1 g; volume of solution = 0.1 L; shaking speed = 200 rpm; duplicate).

3. Conclusions

Monosodium titanate $NaTi_2O_7$ were successfully synthesized by a simple hydrothermal method. Synthesized MST got high surface area, pore diameter, and pore volume which affect high strontium adsorption capacity, and its amorphous, microporous structures also affect high strontium adsorption ability. Synthesized MST showed good selectivity for strontium ions in the presence of cesium which means selective strontium adsorption in mixed radionuclide solution. Although various sodium titanate species were synthesized and utilized in nuclear industries [3], our MST can be good method to adsorb strontium selectively during decontamination and decommission of nuclear facilities.

ACKNOWLEDGEMENT

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