Recovery Rate of Fe, Nb, Ni, Re, Sr According to Elution Speeds in the Column Examination for the Pretreatment of Spent Resin

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1. Introduction

Ion-exchange resins are widely used for the purification of various water streams [1]. In addition, spent resins are contain activation products generated by irradiation of structural materials in the reactor core, along with fission products and isotopes of uranium and transuranium elements that escaped from the irradiation nuclear fuel or have been generated by irradiation of the slight surface contamination of nuclear fuel elements [2].

The management of spent ion-exchange resins demands the determination of their radioactive inventory as a first and fundamental step. The activity concentration of some typical radionuclides contained in spent ion-exchange resins can be measured directly by gamma-ray spectrometry of samples or gamma-ray scanning. However, many other radionuclides commonly found in spent ion-exchange resin are pure alpha, pure beta or low-energy photon emitters not amenable to direct measurement. The chemical separation technique of their radionuclides in spent ion-exchange resins were developed [3].

Pretreatment methods of spent ion-exchange resin for chemical separation were commonly used elution method using the column and microwave digestion method. The present work describes the chemical recovery of the metallic ions in elution method with elution speed change.

2. Experimental

2.1 Preparation

For evaluating the chemical recovery, we used IRN-150. IRN-150 (Amberite^{TM}) is 1:1 mixtures of IRN-77 and IRN-78. The IRN-77 is a strongly acidic cation resin and IRN-78 is a strongly basic anion resin. The resins were put in a beaker containing 250 mL DI water and filtered using vacuum pump. Approximately 1 g of the sample was weighted that was dried in an oven at 60℃ for 24 hr in a beaker. 2 ml of 10 mg/L Fe and Nb solution, 0.2 ml of 10 mg/L Ni solution, 0.3 ml of 10 mg/L Re and Sr solution were added. After adsorbing for 12hr, the precipitate was separated by filter paper with 25 um pore size. The effluent solution made a determination to ICP-AES.

2.2 Elution method

Elution system is present in the picture below. About 1 g of the prepared resin was placed in 8 ml plastic column and packed with separation membrane for prevent of sample loss. 10 ml of DI water was added to remove air bubbles in resins and then added 50 ml of 4 mol HCl, 50 ml of 10 mol HNO_3, 50 ml of 5 mol HNO_3 + 0.2 mol HF in regular sequence. The elution speed of system was controlled within the range of 0.5 ml/min and 2.0 ml/min.

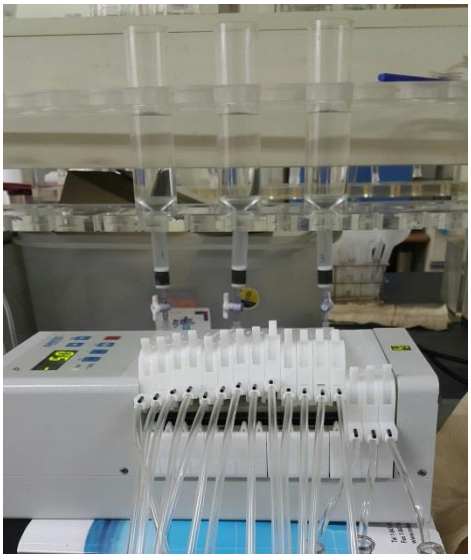

Fig 1. Elution system for evaluation of chemical recovery rate according to eluting speed.

3. Result

The adsorption rate of metallic ions in prepared resin was observed above 99.99 percent. Chemical recovery of metallic ions according to elution speeds is shown in Fig. 1. In 1 ml/min for the elution speed, chemical recovery were 98.2% for Fe, 49.3% for Nb, 69.3% for Ni, 86.2% for Re, 73.1% for Sr. The chemical recovery in 2 ml/min for elution speed were 85.8% for Fe, 43.4% for Nb, 62.9% for Ni, 80.1% for Re, 60.2% for Sr.

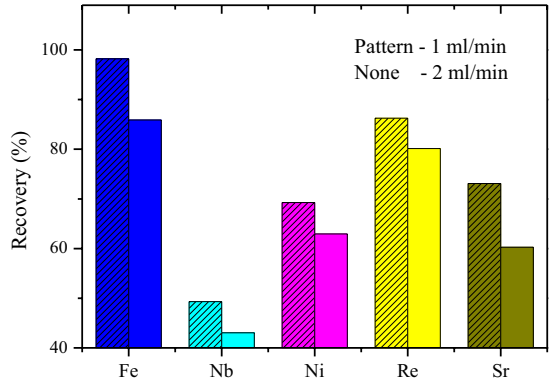

Fig. 2. Recovery of metallic ion according to eluting speed.

4. Conclusion

For evaluation of chemical recovery, we investigated the effect of the eluting speed in elution method for pretreatment of spent resin. The recovery rate decreased as increasing the eluting speed.

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