Physicochemical Properties of Cation Exchange Resin and Binary Cation Exchange Selectivity

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1. Introduction

Ion exchange resins are being used to remove impurities thro at industries, such as water treatment, chemicals, and power plants. In the de-ionizer of the secondary system of the nuclear power plant, ion exchange resin is used to remove impurities.

In the secondary system of the nuclear power plant, a pH control agent (amine) is used to reduce the corrosion of metallic components. The pH control agent currently used at industries saturates the ion exchange resin of the secondary system de-base early. Therefore, it is difficult to maintain the pH of the secondary system at a high level. In order to solve this problem, the de-base operation can be changed to an amine saturation operation. However, the impurities trapped in the ion exchange resin may be released.

In this study, the physicochemical properties of cation exchange resins and the ion - exchange selectivity of amine - saturated resins were investigated in order to characterize the amine saturation operation under systemic conditions.

2. Test methods and results

2.1 Physicochemical Properties of Cation Exchange Resin in Nuclear Power Plant Secondary System Condition

The water retention capacity, backwashed and settled density, particle size distribution and total cation exchange capacity of the cation exchange resin were experimented by the ASTM D2187-17[1] method in the secondary system conditions of the nuclear power plant (Table 1).

Table 1. system conditions

Temperature (℃)	25, 60
Impurities (ppm)	50(Fe, Cu, Cl^-)
Deterioration time (day)	5
Stirring speed (rpm)	250

Experimental results showed that water retention capacity, backwashed and settled density, particle size distribution and total cation exchange capacity of cation exchange resin did not affect the deterioration. Table 2 shows the difference in the characteristics of cation exchange resins.

Table 2. Cation Exchange Resin Type (water content, sedimentation density, cation exchange capacity, effective diameter, homogeneity factor)

		A	B	C	D
water retention capacity (%)		34.36	41.57	51.89	36.24
backwashed and settled density (g/ml)		0.866	0.870	0.858	0.814
Cation exchange capacity	meq/g wet	3.32	3.31	2.66	3.41
	meq/g dried	4.16	4.62	4.42	4.28
Particle size distribution	Effective diameter(μm)	602	520	545	429
	Homogeneity coefficient	1.07	1.23	1.24	1.07

2.2 on exchange selectivity of amine saturated resins

Figures 1 to 6 show the results of binary cation exchange selectivity experiments.

Figure 1 shows the selectivity of cation exchange resin in H-Na. The selectivities of cation exchange resins were B > C > A > D.

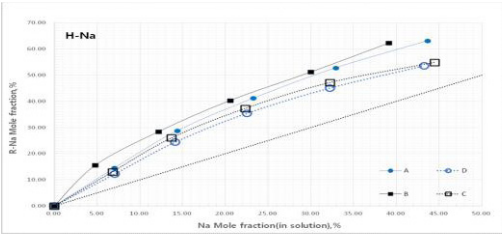

Fig. 1. H-Na Binary cation exchange.

Figure 2 shows the selectivity for ETAH-Na, Figure 3 for H-NH_4, Figure 4 for ETAH-NH_4, Figure 5 for H-ETAH and Figure 6 for ETAH-H. The selectivity varied with mole fraction.

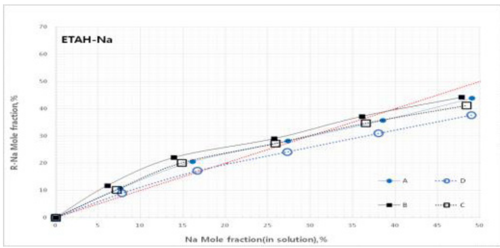

Fig. 2. ETAH-Na Binary cation exchange.

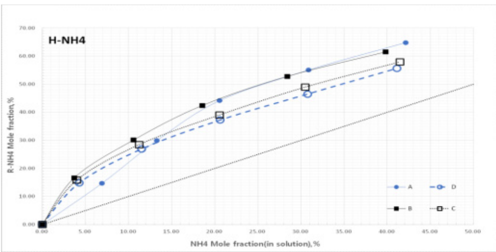

Fig. 3. H-NH_4 Binary cation exchange.

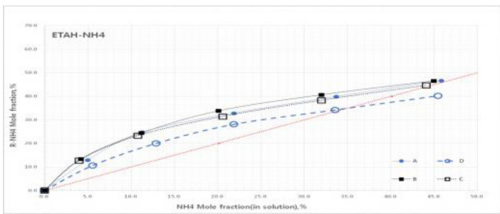

Fig. 4. ETAH-NH_4 Binary cation exchange.

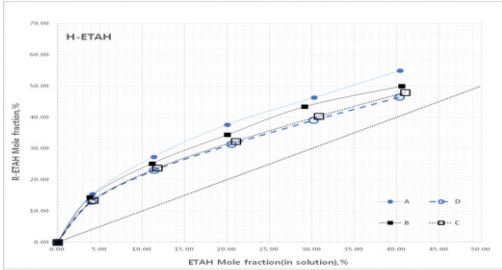

Fig. 5. H-ETAH Binary cation exchange.

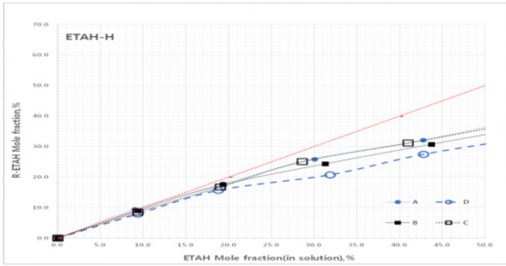

Fig. 6. ETAH-H Binary cation exchange.

3. Conclusion

There were no significant differences in physicochemical properties between resin products in the second system condition of the nuclear power plant.

The selectivity of cation exchange resin varied with the molar fraction, but the selectivities of products B and A were high. Product D showed the lowest selectivity. Productivity of products B and A will be high if we select cation exchange resins.

ACKNOWLEDGEMENT

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REFERENCES

[1] Standard Test Methods and Practices for Evaluating Physical and Chemical Properties of Particulate Ion-Exchange Resins1, ASTM D2187-17.