§3. Experimental Study on Optimization of Pressure Swing Adsorption Process for Hydrogen Isotope Separation

Kotoh, K. (Kyushu Univ., Eng.),
Takashima, S., Tsuge, T. (Kyushu Univ., Eng.),
Nishida, T. (Kinki Univ., Ind. Eng.),
Sugiyama, T. (Nagoya Univ., Eng.),
Tanaka, M., Asakura, Y., Uda, T.

We have been developing a Pressure Swing Adsorption (PSA) process for successive hydrogen isotope separation using synthetic zeolites, for the purpose of applying it to an environmental tritium safety system such as of removal of tritium from LHD exhaust gases during D-D experiments or of volume reduction of tritiated-hydrogen waste gas storage by extraction/release of tritium-purified hydrogen volume. The experimental/analytical results obtained till now have convinced us of this PSA process available for practical use.

In the last year, we started this study on optimization of the PSA process, and then, clarified the influence of the longitudinal dispersion in packed-beds with spherical zeolite particles on the over-all mass transfer volumetric resistance. In addition to this investigation, we verified the performance of PSA process under successive operation using synthetic zeolite 5A (SZ-5A) at 77.4 K. The last work is continued in this fiscal year.

In this fiscal year, we carried out works investigating the performance of successive deuterium enriching process and successive purified-hydrogen producing process systems. From an experimental series of the former process using SZ-5A, a successive increase in overall enrichment-factor (*EF*) was observed as shown in Fig. 1, where the jumping-up value at the final cycle was obtained from the operation of recovering a adsorbed volume of residual after pressure swing desorption by heating up to room temperature. This result endorses that deuterium condense in the residual of adsorbed phase during evaluating desorption. In this figure, solid-white circles indicate the enrichment factors evaluated in individual PSA processes.

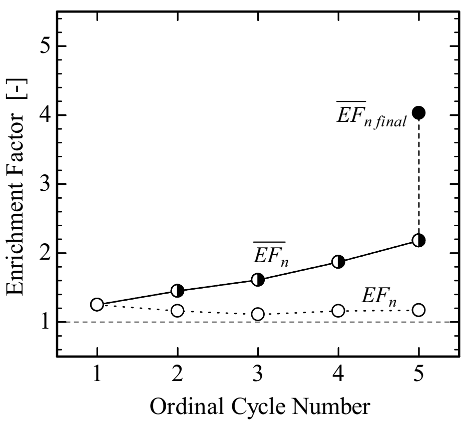

Fig. 1. Successive Increasing Enrichment Factor with increase in Ordinal Cycle Number.

Figure 2 shows the volume reduction factor obtained from the experimental series of successive purified-hydrogen producing process, of which the main aim is at reducing a volume of hydrogen waste storage contaminated with such as tritium. As shown in Fig. 2, the overall volume reduction factor is increased successively with progress in the PAS cycling process, where solid-white circles are plots of the factors in individual process. The final value was obtained from the temperature swing desorption.

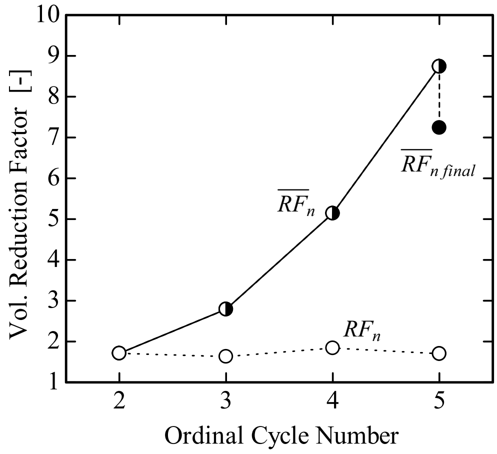

Fig. 2. Successive Increasing Volume Reduction Factor with increase in Ordinal Cycle Number.

Knowledge obtained from the study on optimization of PSA process for hydrogen isotope separation, carried out in the last fiscal year, contributed to verifying the performance of multi-cycling PSA process systems in this work.

1) Kotoh, K., *et al.*(6), *Fusion Sci. Technol.*, **56**, pp.184-189 (2009).
2) Kotoh, K., *et al.*(7), *Fusion Sci. Technol.*, **56**, pp.173-178 (2009).
3) Kotoh, *et al.*(3), *Fusion Sci. Technol.*, **56**, pp.179-183 (2009).
4) Kotoh, K., *et al.*(2), *Fusion Sci. Eng. Des.*, **84**, pp.1108-1112 (2009).
5) Kotoh, K., *et al.*(6), 9th *ISFNT*, P2-40, Dalian, China, Oct. (2009).
6) Kotoh, K., *et al.*(3), 9th *ISFNT*, P2-41, Dalian, China, Oct. (2009).
7) Kotoh, K., *et al.*(3), 9th *ISFNT*, P2-42, Dalian, China, Oct. (2009).
8) Kotoh, K., *et al.*(6), 9th *ISFNT*, P3-91, Dalian, China, Oct. (2009).
9) Takashima, S. *et al.*(3), 2009 *Autumn Meeting of AESJ,* Sendai, Jpn., Oct. (2009).
10) Takashima, S., *et al.*(7), 28th *Kyushu Branch Meeting of AESJ*, Fukuoka, Jpn., Dec. (2009).
11) Tsuge, T., *et al.*(7), 28th *Kyushu Branch Meeting of AESJ*, Fukuoka, Jpn., Dec., (2009)
12) Moriyama, S., *et al.*(4), 28th *Kyushu Branch Meeting of AESJ,* Fukuoka, Jpn., Dec., (2009).