§1. Experimental Study on Performance of Multi-column Pressure Swing Adsorption System for Hydrogen Isotope Separation

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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 for 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.

PSA systems are generally made to perform continuous adsorption process by scheming out alternative combination among twin or triple adsorbent-packed columns. We have studied the PSA process using a single column, however, because a multi-column process makes its experiment and analysis to be complicated with troublesome procedure. From the single column PSA process, the experimental and analytical results obtained till now have convinced us of the PSA process system available for practical use.

In the last two years, on optimization of the PSA process, we clarified the influence of the longitudinal dispersion in packed-beds with spherical zeolite particles on the over-all mass transfer volumetric resistance, and then, verified the performance of successive deuterium enriching process and successive purified-hydrogen producing process systems using a single column packed with synthetic zeolite 5A (SZ-5A) at 77.4 K.

In this fiscal year, the work was continued investigating the system performance using a SZ-13X packed-bed column, following the last work. As an example of results, Figs 1 and 2 show the efficiency factors performing in the successive volume reduction of a H_2-D_2 mixture by PSA process using the SZ-13X column under the operation conditioned at an overall decontamination factor of 27. In these figures, solid-white circles indicate the enrichment factors or the volume reduction factors evaluated in individual PSA processes, and the half-and-half circles show each of the overall efficiency factors, where the jumping-up and the declined values at the final cycle are evaluated by taking in account the sample obtained from the ending operation recovering an adsorbed volume of residual after pressure swing desorption by heating up to room temperature.

In comparison to the results of SZ-5A reported in the last report, SZ-13X demonstrates advantages for the successive volume-reduction operation.

Based on this result, we started the experimental study on the performance of a multi-column PSA process system for hydrogen isotope separation. Employing the twin columns packed with SZ-13X, an experimental series was carried out in this fiscal year. Its result verifies the performance of twin-column PSA process available for H_2-D_2 isotope separation.

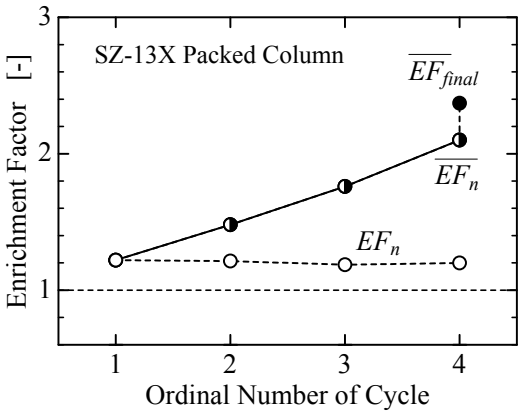

Fig. 1 Individual operation and overall enrichment factors evaluated in successive volume reduction by PSA process using SZ-13X column, under the operation conditioned at an overall D_2 decontamination factor of 27.

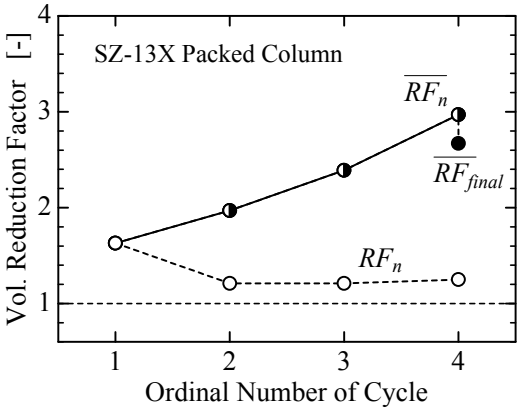

Fig.2 Individual operation and overall reduction factors in successive volume reduction by PSA process using SZ-13X column, under the operation conditioned at an overall D_2 decontamination factor of 27.

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