Status of the experimental research for vapor adsorption in gas flow using molecular sieve

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1. Introduction

The coolant purification system (CPS) is one of the important ancillary system of the nuclear fusion reactor which removes permeated tritium and gas impurities from the blanket and prevents the outflow of tritium to external environment. An ambient molecular sieve bed (AMSB) is the main component which captures oxidized tritium, Q_2O. RAVAD (Research Apparatus for Vapor Adsorption and Desorption) was established to confirm the AMSB for the gas cooling reactor. The main purpose of this study is to design optimized AMSB of CPS. Test batches have been conducted with various AMSBs under different conditions.

2. Test facility and methods

Figure 1 shows the adsorption process of the RAVAD. Adsorption test was conducted with the air with vapor instead of helium. Nine different AMSBs were manufactured as shown in table 1. While the actual operation is under high pressure, tests with a scaled-down condition were planned and conducted [3]. The AMSBs were analyzed for the effects of the column length and diameter under various air flow rate and vapor concentration. An operation range is derived and the design criteria are confirmed through the experiment. Using the bed depth service time model, methodology for prediction of AMSB performance can be established [4].

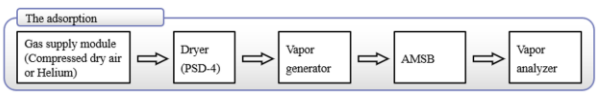

Fig. 1. Adsorption process schematic diagram of the AMSB

Table 1. Geometry of AMSB for adsorption test

module number		Height [mm]			
		24	44	64	84
Diameter [mm]	16	#1	#7	#4	
	20	#2		#5	
	24	#3	#8	#6	#9

The previous experimental data was obtained from the test in air flow under the assumption that the adsorption performance changes drastically depending on the vapor partial pressure, and that the effect of the gas type is low. To support this assumption, the adsorption properties were tested in an argon environment. The test conditions are shown in Table 2

Table 2. Condition for gas effect test with air and argon

Parameter	Value
System pressure	0.32 MPa
Temperature	25 ℃
Vapor concentration	100 PPM
Superficial velocity	0.05 - 0.3 m/s

3. Conclusion and further works

Verification experiments were conducted with RAVAD to confirm the design and adsorption characteristics of the AMSB under various test conditions: vapor concentration, flow rate and geometry of AMSB. While conducting the experiment, air was used instead of helium under the assumption that the effect of the gas type is not significant. In order to support this, several cases were tested with argon and compared, and time difference was within 1% - confirming that the assumption is appropriate. Currently, experiments using helium are being conducted, which are expected to increase the reliability of the accumulated experimental data.

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