§8. Application of Membrane Dehumidifier for Gaseous Tritium Recovery in LHD

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In order to realize the planned deuterium plasma experiments using the Large Helical Device (LHD), the National Institute for Fusion Science (NIFS) is planning to install a system for tritium recovery from exhaust gas.

While adopting typical tritium recovery systems, NIFS has also made plans for the development of a compact reduced-waste recovery system by applying a membrane type dehumidifier [1]. The applicability of a commercially available membrane dehumidifier has been evaluated experimentally, with the results indicating such a membrane is feasible for practical application [2].

Based on performance test results, the optimum specifications of the membrane dehumidifier are also evaluated quantitatively [3].

As the next step, we have carried out the basic design of the actual tritium recovery system for LHD.

1. Basic Design of Detritiation System in LHD

In the LHD, two types of tritium recovery systems are planed for installation. One system will be used to recover tritium generated during the plasma experiments (Vacuum Pumping-Gas Treatment Sys.) and the other to enable inspection and maintenance of the LHD vacuum vessel (Vacuum-Vessel Purge-Gas Treatment Sys.) [1].

We are planning to apply a membrane dehumidifier to the Vacuum-Vessel Purge-Gas Treatment System having the treatment capacity of 300 m^3(STP)/h. The applied configuration and process flow are shown in Fig. 1.

Table 1 summarizes the design conditions at present.

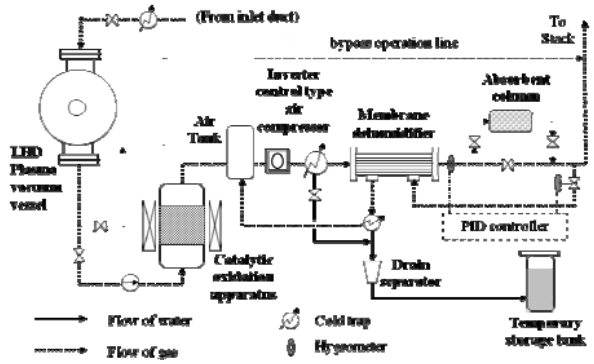

Fig.1 Design of the detritiation system for LHD.

Table 1 Design conditions

Treatment flow rate (m^3(STP)/h)	300(Max.)
Operation time (h/yr)	4,000
Tritium generation amount (GBq/yr)	55.5
Tritium conc. in treatment gas (Bq/cm^3)	0.05
Tritium recovery rate (%)	≧95
Humidity of treatment gas (ppm)	1000(Min.)

2. Construction of Test Apparatus for Verification of Continuous Recovery of Tritiated Water

In this system, the wet outlet air (purge gas) of the membrane dehumidifier is returned to the inlet of the feed pump and dehydrated under compressed condition.

Continuous wet purge gas recycling operation between the membrane dehumidifier and the feed pump under various flow conditions is the key function in this tritium recovery system.

So, we have just constructed the small test apparatus having the capacity of 1/10th (30m3/h) and applying the same flow control system as the actual tritium recovery system. The system flow of the test apparatus is shown in Fiq.2. The outer view of the constructed apparatus is shown in Fig.3. The verification tests are scheduled to be begun from the coming year under various operating conditions.

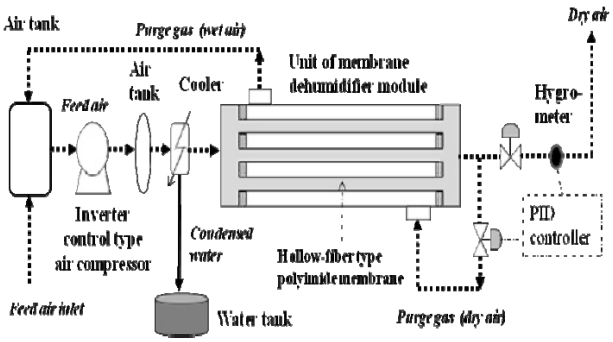

Fig.2 System flow of test apparatus

Fig.3 Outer view of test apparatus

[1] Y. Asakura, et al., Fusion Sci.Technol.,Vol.48,401(2005)
[2] Y. Asakura, et al., Fusion Sci.Technol.,Vol.54,75(2008)
[3] Y. Asakura, et al., J. Nucl. Sci. Technol., Vol.46, 641 (2009)