§9. Development of Tritium Cleanup System with Nonvolatile Getter Material for the Large Helical Device

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Based on the new concept shown in our previous reports of this series, the tritium cleanup system have been developed. A laboratory scale cleanup system, as well, designed to demonstrate its practical validity. Tritium is one of radio-nuclides and will be generated through a D-D fusion reaction in the large helical device(LHD) in the future experiments. The tritium cleanup system is a processing device employed to remove the tritium from exhaust gas generated in LHD. Before the end of the last fiscal year, a part of the laboratory scale cleanup system was assembled. And using this system, various performance tests have been started.

The tritium cleanup system is shown in Fig.1, consisting of a buffer tank, a palladium-hydrogen separator, a decomposition process vessel stuffed with nonvolatile getter material, dual hydrogen absorbing alloy vessels and others. This system has two distinctive features. One is that hydrogen isotopes including tritium in the exhaust gas are directly fixed to the hydrogen absorbing alloy, and the other, impurities such as methane and water in the exhaust gas are decomposed into their respective elemental forms, as hydrogen, carbon and oxygen, then hydrogen is finally absorbed in the hydrogen absorbing alloy, whereas the other elements remain tightly on the getter material in the decomposition process vessel.

The partly assembled laboratory scale system is shown in Fig.2, which is composed of a buffer tank, a decomposition process vessel and a vacuum chamber integrated with exhausters(combination of a rotary pump and a molecular turbo pump). In the future, the palladium- separator and the hydrogen absorbing alloy vessels will be appended to complete the laboratory scale system.

Stuffing granular ZrNi alloy of some 5g as the nonvolatile getter material into the decomposition process vessel, performance tests of methane decomposition has been carried out with helium gas containing 1.26% methane under the experimental conditions of 873K and 30cc/min in gas flow rate. In the experiment, changes of concentration of methane and hydrogen at the inlet and outlet of the decomposition process vessel were observed using a gas chromatograph.

As shown in Fig.3, the present result says that fairly good decomposition rate of methane is realized in a few hours after the start of the process. This rate is maintained for over ten hours after that, subsequently gradually decreased. After roughly 200 hours, the decomposition of methane does not advance any longer. At the plateau of the curve of methane found around 10 hours, more than 2% hydrogen was observed but methane was not detected at all, which means almost all methane ingredient was decomposed.

We may conclude that ZrNi alloy must be promising one for our purpose. Next year, we are going to carry out further performance tests of Zr-Ni alloy system. Furthermore, the performance tests using different types of alloy containing Zr-Ti system as getter materials are in the planning state.

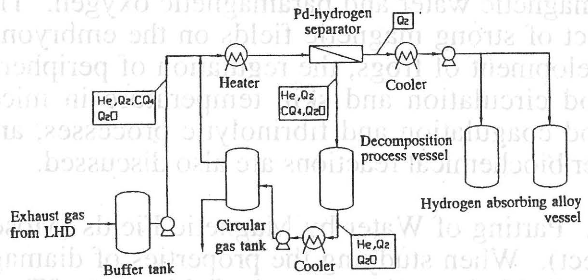

Fig.1 Tritium cleanup system conceptually developed

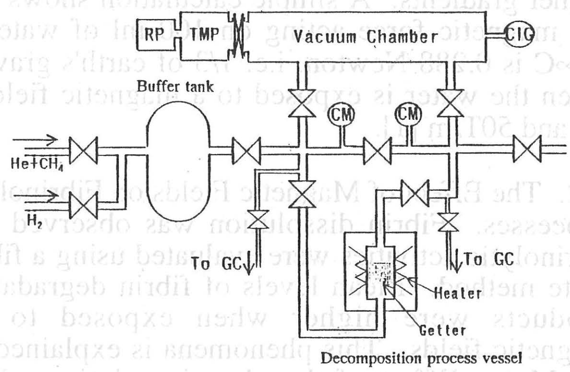

Fig.2 Laboratory scale cleanup system partly assembled

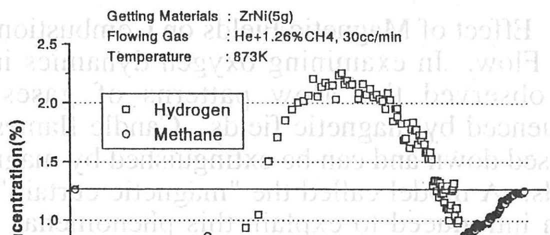

Fig.3 Methane decomposition on ZrNi getter