§4. Development of More Sophisticated Tritium Recovery System of Fusion Power Plant

Munakata, K., Inoue, K., Sinozaki, Y., Katekari, K.
(Interdisciplinary Graduate School of Engineering Sciences, Kyushu Univ.),
Uda, T., Tanaka, M.

Recovery of tritium released into the working area of fusion power plants or tritium-handling facilities is an important technique to establish the safety of the fusion technology. The catalytic oxidation and adsorption is the most conventional and reliable method for removing tritium that is accidentally released into the working area of these facilities. The catalysts used for these purposes need to have high catalytic performance for low temperature combustion of tritium and tiritated methane. Up to now, the authors have worked on the development of such catalysts. However, if the actual process is considered, there are further demands for catalyst and catalytic process. For example, if accidental tritium releases take place, large amounts of air should be processed by the air cleanup system. Therefore, the air cleanup system needs to be designed to be able to deal with the air with high volumetric velocity. Other than this, compactness and simplicity, efficient heating and endurance in long term use and repeated use are also required. With this background, the authors tested the applicability of honeycomb catalysts, which is considered to be effective for the treatment of high throughput process gas and efficient heating, for catalytic oxidation of tritium tritiated methane. The results indicate that the use of honeycomb type of catalysts is effective for oxidation of hydrogen isotopes and methane. The pressure drop along the honeycomb catalysts is much smaller than packed bed catalysts, as well. With regard to the recovery system of tritium in the fusion power plant, the volume of the adsorption bed could be much larger than that of the catalyst bed. Therefore, the use of honeycomb adsorbents needs to be considered to fully utilize the merit of honeycomb with low pressure drop. Thus, the purpose of this study is to investigate the applicability of honeycomb adsorbents to the tritium recovery system of fusion power plants. For this purpose, the test fabrication of honeycomb of A-type of zeolite was carried out, and the adsorption capacity of water vapor on the honeycomb adsorbents was examined.

In the experiments, the adsorbents were charged in a reactor made of quartz. The temperature of the reactor was varied in the range of 30 to 120 °C. The argon gas containing water vapor was introduced to the reactor. Water vapor was generated by introducing an argon gas containing hydrogen to a copper oxide bed of which temperature was maintained at 350 °C. The concentration of water vapor at inlet and outlet stream of the reactor was measured with a hygrometer. The flow rates were controlled with conventional mass flow controller. The adsorbents used in the experiments are pebble adsorbents of MS4A and MS5A manufactured by Aldrich Co., Ltd., honeycomb adsorbents of MS4A and MS5A manufactured by Nagamine manufacturing Co., Ltd and honeycomb adsorbent of MS4A manufactured by Kankyo Ceramics Research Co., Ltd. The adsorbents were dried under the stream of argon gas at the temperature of 300 °C before the experiments.

Figure 1 compares the adsorption amount of water vapor as function of the partial pressure of water vapor on various adsorbents at the temperature of 40 °C. As seen in the figure, the adsorption amounts of water vapor on the honeycomb adsorbents by Nagamine manufacturing Co., Ltd. are about 1/2 as large as those of pebble adsorbents by Aldrich Co., Ltd. This is considered to be due to larger contents of clay used as a binder in the honeycomb adsorbents by Nagamine manufacturing Co., Ltd. Difference in the adsorption capacities of water vapor on MS4A and MS5A adsorbents is not large. The adsorption amount of water vapor on the honeycomb MS4A adsorbent by Kankyo Ceramics Research Co., Ltd. is comparable to that of the pebble type of MS4A and MS5A adsorbents by Aldrich Co., Ltd. Thus, the honeycomb MS4A adsorbent by Kankyo Ceramics Research Co., Ltd. is considered to be a promising honeycomb adsorbent from the view point of adsorption capacity. It is also necessary to investigate the adsorption rate of water vapor on the honeycomb adsorbents.

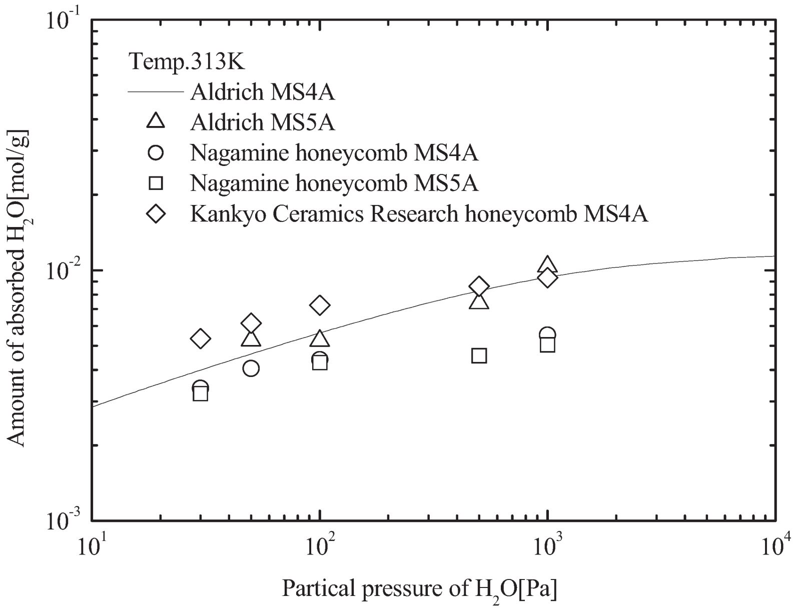

Fig.1 Adsorption amount of water vapor on various adsorbents