§5. Memory Effect of Tritium Compounds in Ion Chamber (3)

Ohta, M., Uematsu, K. (Fac. of Eng., Niigata Univ.), Asakura, Y., Kawano, T., Tanaka, M.

1. Introduction

Tritium compounds produce in nuclear fusion reaction between deuterium and deuterium. Tritium compounds contained in exhaust gases in nuclear fusion and nuclear power generation facilities are tritium gas (HT), tritiated water vapor (HTO), tritiated methane (CQ_4), etc. Radiation effect of tritium is considerably different in the chemical form of tritium compounds; that is, HT is predominant in these tritium compounds and is least effective on human body among tritium compounds. Therefore, it is necessary to separate tritium compounds for each chemical form to maintain reasonably the safety and environment in a nuclear fusion facility. Tritium compounds in atmosphere were usually detected by ion chamber, which is able to measure tritium compounds in coexistence of air. But ion chamber is believed to be contaminated by tritium compounds in the field of fusion science.

In this study, the memory effect of these tritium compounds was investigated in ion chamber used for the continuous monitoring system of tritium concentration for each chemical form.

2. Experimental

HT and HTO were supplied from Caisson Assembly for Tritium Safety Study (CATS) of the Tritium Process Laboratory (TPL), Tokai Research and Development Center, Japan Atomic Energy Agency (JAEA). CQ4 was supplied from American Radiolabeled Chemicals Inc. and was 3.7 GBq of tritium concentration in a break-seal ampoule.

A caisson of 12 m^3 in volume was used for preparing sample gas.

The Ion chamber (Aloka Co., DGM-1101) used in this experiment is designed to eliminate the contribution of radon / thoron liberated from the facility. Another specifications of the ion chamber is follows; the volume of the chamber is 3L and the identification limit is 1.3×10^{-3}Bqcm^{-1}.

The sample gas was circulated between the caisson and the separating and measuring assemblies containing the ion chamber. After this experiment, nitrogen gas was made to flow through the ion chamber, and then air was done.

3. Results and discussion

The memory effect of tritium in ion chamber used for the monitoring system of tritium concentration for each chemical form of tritium compounds was measured and the obtained results is shown in Fig. 1. A part of tritium was immediately removed from the ion chamber by flowing nitrogen gas through this ion chamber. From initial residual curve in Fig.1, it is assumed to be impossible to remove tritium from the ion chamber, because CQ_4 may contain HTO. So, wet air was made to flow through the ion chamber. Tritium concentration in wet air passing through the ion chamber decreased immediately and reached at back ground lever.

Tritium concentration in the caisson was measured after the final experiments and was estimated in initial tritium concentration in caisson. The initial tritium concentration was about 1,400 Bqcm^{-3}, and the composition of tritium compounds was 48% of CQ_4, 48% of HT and 4% of HTO, different from the specification of American Radiolabeled Chemicals Inc.

These facts suggest that the memory effect of tritium in ion chamber used for the monitoring system of tritium concentration for each chemical form is caused by high concentration (several handred MBq) of HTO containing in measuring gas. And then the memory effect due to HTO is removed by flowing wet air in ion chamber.

Therefore, ion chamber, especially one enabled to eliminate the contribution of radon / thoron liberated from the facility, is able to measure tritium compounds in coexistence of air and is prominent detector for tritium monitor in the exhaust gas in nuclear fusion facilities.

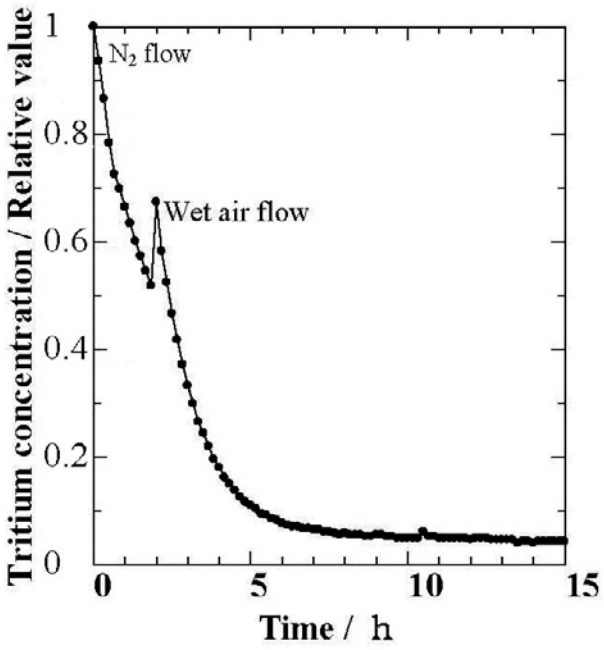

Fig. 1 Time dependence on tritium concentration in ion chamber.