§10. Performance of Simplified Active Sampler for Tritium Monitoring in a Fusion Test Facility

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As one of the tritium monitoring techniques, the tritium sampler to accumulate the extremely low level tritium within a given period is utilized as the tritium monitoring equipment. It is preferred to measure the tritium concentration with a different chemical form such as HTO, HT and CH_3T for tritium monitoring. This type of tritium sampler as shown in Fig. 1(a) has been operated in NIFS since 2012. The observed data show the good agreement with the level of environmental atmospheric tritium. To reduce the operational steps and number of measured samples, we proposed the simplified tritium sampler. In this report, we show the observed data by the proposal system compared with the data of existence system, "A type sampler".

The schematic diagram of the simplified tritium sampler, "B type sampler", is shown in Fig. 1(b). The sampler has two paths for continuously sampling, i.e., the operational path switches other path after a given period of time. Tritium in the chemical form of HT and CH_3T is converted into HTO by the particle type palladium catalyst heated to about 350°C. The HTO is collected in together with atmospheric water vapor in molecular sieves (3A type) packed column. After air sampling, the HTO collected in molecular sieves is desorbed at a heating temperature of 400°C and is recovered by the cold trap of about 2 °C under an N_2 gas purge for 3.5 h. The simplified tritium sampler system was installed in a machine room and connected the existence system (A type sampler) in parallel. The air sampling from the stack was made at maximum flow rate of few thousand cm^3/min for one or two weeks. The total amount of air collected was approximately 20 m^3. To measure the tritium activity, 65 ml of recovered water from the HTO collection column and 65 ml of liquid scintillator Ultima-Gold LLT were mixed in a 145 ml Teflon vial. Background samples in 145 mL were prepared using tritium free water. After leaving these samples for a few days in a low background liquid scintillation counter LSC-LB7, the tritium activity was counted in totally 1500 minutes per sample. The detection limits for the atmospheric tritium concentration are about 2-3 x 10^{-9} Bq/cm^3.

Figure 2 shows the preliminary monitoring results of the total tritium concentrations by B type sampler in compare with the results of A type sampler. The monitoring term extended from January 12th, 2015 to April 24th, 2015. The measured values by two different systems almost agree within the statistical error (3σ). Thus, it is found that simplified tritium sampling system is operated properly and measured correctly. However, few data of B type sampler deviate from one of A type sampler. Although the cause of different data between both systems is unknown, the air might leak inside of the sampling line via the connected portions. The air sampling by both systems in the stack of facility will be continued for the monitoring of background levels of tritium before the deuterium plasma experiments.

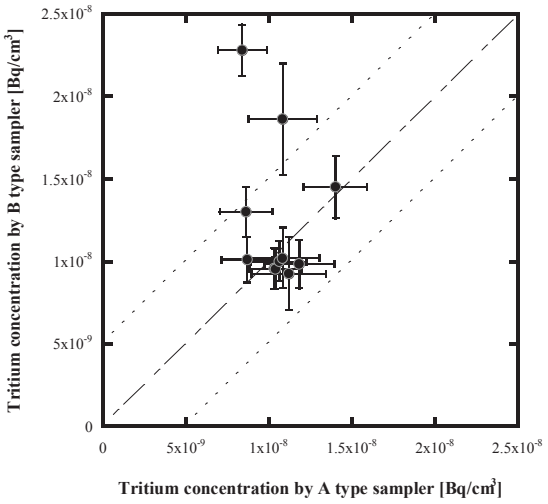

Fig. 2. The relationship of the total tritium concentrations between A type sampler and B type sampler from January 12th, 2015 to April 24th, 2015.

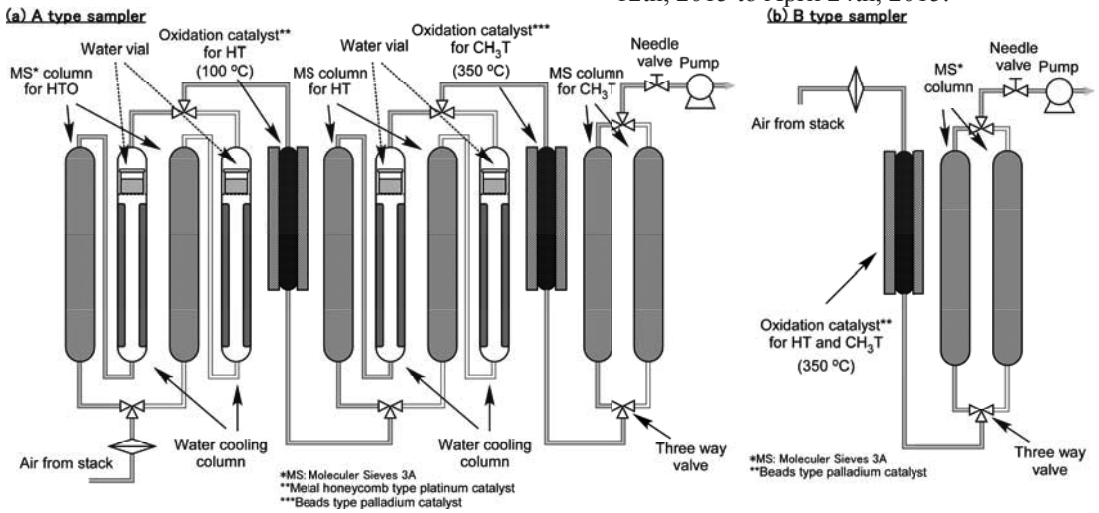

Fig. 1. The Schematic diagram of active tritium samplers; (a) tritium sampler with the discrimination of chemical forms, "A type sampler", (b) simplified tritium sampler without the discrimination of chemical forms, "B type sampler".