

§4. On Quasi-peak of Spectrum Measured by Tritium Water Monitoring System

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A tritium water monitoring system was developed using a flow-cell detector for measuring tritium concentrations in effluent water. The flow-cell detector was a 44 mm long Teflon PFA (Perfluoroalkoxy) tube (inside and outside diameters: 3 and 4 mm) and granular CaF₂ (Eu) solid scintillator with a 50 μm in diameter was stuffed into the tube. A weight of CaF₂ stuffed in the tube was roughly 0.9 g. This monitoring system needs no scintillation cocktail and the problem of radioactive organic liquid waste containing tritium never arises. Our own developed system was the first such real-time monitoring system able to measure tritium concentrations in water continuously flowing through the solid scintillation detector.

In the previous study, the performance tests were carried out and definite linearity between the count rate and tritium concentration was certified, meaning that the system worked correctly. The detection limit of tritium in water may be as low as 10 Bq/ml. However, there was the serious problem that an unknown peak appeared on the energy spectrum measured by this system. Figure.1 shows the typical beta-ray spectrum of tritium and background spectrum. In Fig.1, open argyles and small filled circles show tritium and background spectra, respectively.

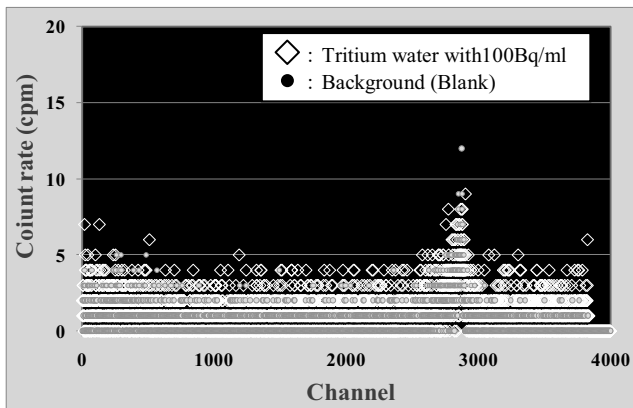


Fig.1 Typical beta-ray spectra of tritium and Background.

As peaks can be observed at the same channels on both spectra, the peaks must not be from tritium but from some other cause. To find out the cause, background measurements were carried out with and without a cooper shielding with 5 mm in thickness to examine if external radiation like cosmic rays outside the system could be the cause of the unknown peaks. Furthermore, background measurements were also carried out with and without a flow-cell detector to examine if circuits other than the CaF₂ (Eu) solid scintillator can be the cause. Obtained spectra are shown in Fig.2. The unknown peaks appeared at the same channel in the four spectra, (A), (B), (C), and (D), unrelated to the shielding and flow cell. This result means that the

unknown peaks were not caused by external radiation and/or light-emitting from the flow cell. It was determined some circuits to be a cause of the unknown peaks.

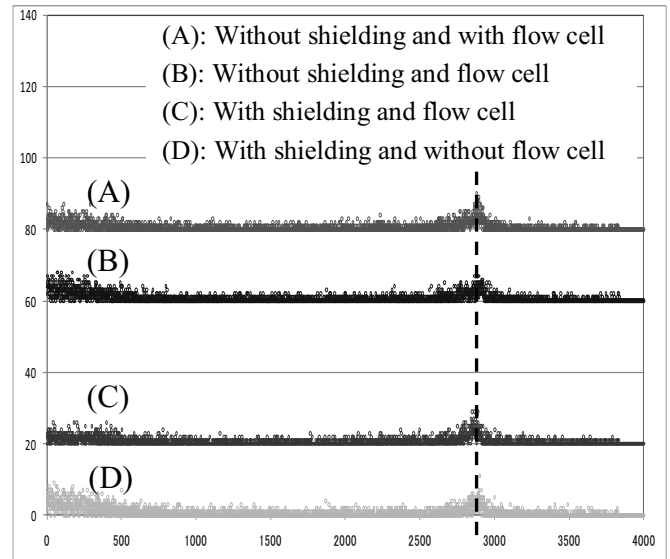


Fig.2 Background spectrum measured with/without shielding and flow cell.

Next, background spectra were measured with various applied voltages from 1420 V to 1700V. Thus obtained spectra are shown in Fig.3. In Fig.3, the unknown peaks appear for the applied voltage higher than 1480V, but not for the applied voltage lower than 1460V. On the basis of these results, it was determined that the unknown peaks must be quasi-ones caused by a high-voltage circuit and the applied voltage should be adjusted lower than 1480 V to prevent the quasi-peak from appearing.

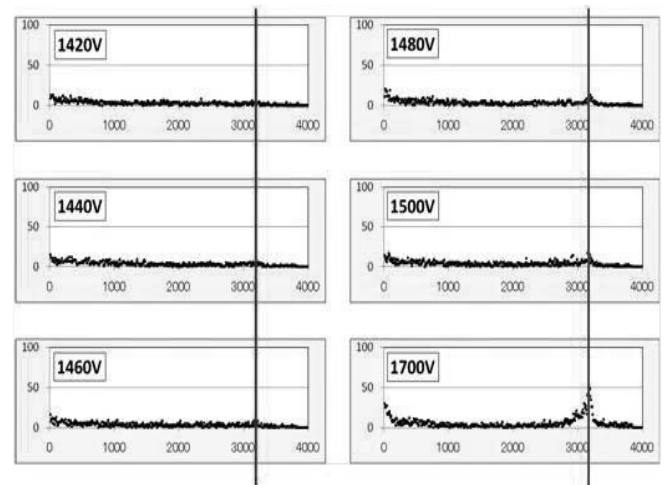


Fig.3 Effect of applied voltage on background spectra measured by the system.