

Tritium Water Monitoring System Based on CaF₂ Flow-Cell Detector

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For measuring tritium concentration in water, a liquid scintillation counting system is usually used because it has a high sensitivity to tritium. However, with this system, continuous measurement is impossible and takes a somewhat long time to obtain measurement results. Moreover, careful attention must be paid to chemical luminescence, selection of a scintillation cocktail, and the ratio of the amount of water sample to that of the scintillation cocktail. These are disadvantages of measurement with a liquid scintillation counting system. For overcoming these disadvantages, our prototype tritium water monitoring system was developed using a CaF₂ flow-cell detector, and a performance test was carried out.

The monitoring system contains a pair of photomultiplier tubes, a high-voltage power supply, a signal processing circuit, and a water flow pump, along with the CaF₂ flow-cell detector. The CaF₂ flow-cell detector is a solid scintillation detector and fabricated by staffing granular CaF₂ into a narrow tube with a 3-mm inside diameter and a 44-mm length. The granular CaF₂ used was a 0.9 g and its size was 50 micrometer in diameter. A pair of photomultiplier tubes was installed for reducing background counting using the coincidence method. The water flow pump was used to send a tritium water sample into the CaF₂ flow-cell detector, and the water flow velocity was 1 ml/min. This monitor is free from problems, including chemical luminescence relating to liquid scintillation counting system.

The performance of the tritium water monitoring system based on the CaF₂ flow-cell detector was examined with five water samples containing different tritium concentrations of 10, 30, 50, 70, and 100 Bq/ml, and linearity between the count rate and tritium concentration was confirmed. These results suggest that our system reasonably works as a tritium water monitor as we had expected. In the near future, further investigations will be carried out for developing this flow cell-type tritium water monitoring system.