Beta emitters measurement with plastic scintillator without organic waste

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After the Fukushima Daiichi nuclear power plant accident, many kinds of pure beta-ray emitters were scattered in our environment. At an accident of nuclear power plants, of course, the radioactivity of fission fragments is the most serious problem. At the same time, safety management of our environment from low energy beta-ray emitters is important because they expose us from inside of our bodies when we inhale them. Especially, huge amounts of tritiated water and strontium-90, which are pure beta-ray emitters, have been measured several times a day, repeatedly, at Fukushima.

Generally, pure beta-ray emitters are measured using a liquid scintillation counter (LSC) because of its high sensitivity with \(4\pi\) measurement method. A liquid scintillator is considered an essential material for LSC because samples are dissolved in a liquid scintillator and the beta-ray energy is propagated through the solvent to fluorescence which is detectable with photomultiplier tubes. A LSC has a good mechanism; however, using a liquid scintillator is not good because it becomes organic radioactive liquid waste after measurement. Additionally, the wastes always increase the volume compared with that of the sample. The organic waste treatment is a load for the environment and no good for human health. So, I have developed a new measurement method using a plastic scintillator (PS) which is an alternative material of a liquid scintillator.

Plastic scintillators used are 2 types; a sheet (PS-sheet; BC-400, Saint Gobain) is 0.5 mm in thickness and cut for a suitable shape to use in a vial for LSC, and a pellets (PS-pellets; EJ-200 G-teck Japan) is 3 mm in both height and diameter. The PS-sheets are suitable for nonvolatile radioactive labeled compounds, and the PS-pellets are suitable for volatile one like tritiated water. The PSs are used for quantitative analysis with high sensitivity without organic liquid waste. Additionally, these PSs were able to use repeatedly. So, this PS-method generates no solid waste. The PS-method is superior for normal use and after an accident.

Keywords: plastic scintillator, pure beta emitter measurement, wasteless, high sensitivity, liquid scintillation counter