The Radioactivity of ^{3}H and ^{14}C in the Resin Samples of a Nuclear Power Plant

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1. Introduction

Stable radioisotopes of hydrogen (H) and carbon (C) are contained in a resin which is used for nuclear power plants. Tritium (^{3}H) and carbon fourteen (^{14}C) are produced by a nuclear reaction from these stable isotopes. Therefore, ^{3}H and ^{14}C can be found in radioactive wastes of an intermediate/low level. In fact, a radioactivity analysis of ^{3}H and ^{14}C is required to monitor the environment of a disposal site for radioactive wastes of an intermediate/low level or to self-dispose of the radioactive waste from nuclear power plants. In the present study, the radioactivity of ^{3}H and ^{14}C in the resin samples used in nuclear power plants (NPP) is analyzed by using a commercialized high temperature furnace and a LSC. Also, it is determined whether the resin can be self-disposed of or not.

2. The Experiment

Fig.1 shows the experimental system for measuring the radioactivity.

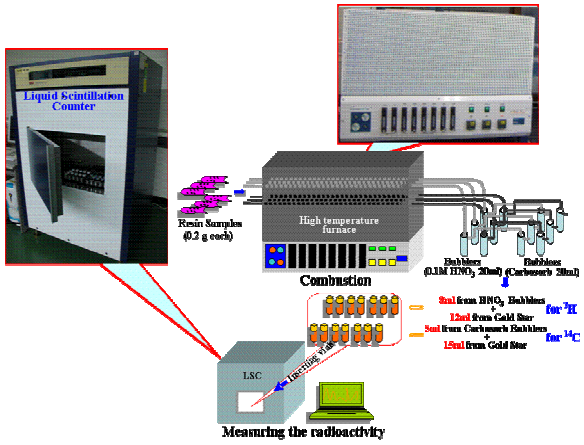

Fig.1. The experimental system with a commercialized furnace and a LSC for measuring the radioactivity

A pre-treatment by using a chemical procedure and a combustion of a sample is carried out to analyze these radioisotopes [1]. First of all, a nitric acid solution with a concentration of 0.1M and a carbosorb are pipeted at 20 ml each and they are placed into the corresponding bubblers. And then, the bubblers are connected to the quartz pipe of the combustion furnace by using rubber tubes as seen in the Fig. 2 .

Fig. 2. The combustion furnace with auxiliaries for measuring the radioactivity

A resin sample with a constant quantity is burned at a maximum temperature of 500 ^{o}C in the combustion furnace of a quartz tube with a catalyst. Then the heating cycle for the resin is given in the Fig. 3 and the resin samples on the boats after the combustion are shown in the Fig. 4. Actually, the resin particles are seen to be rarely left after they were combusted more than 200 minutes under the high temperature of 500 ^{o}C.

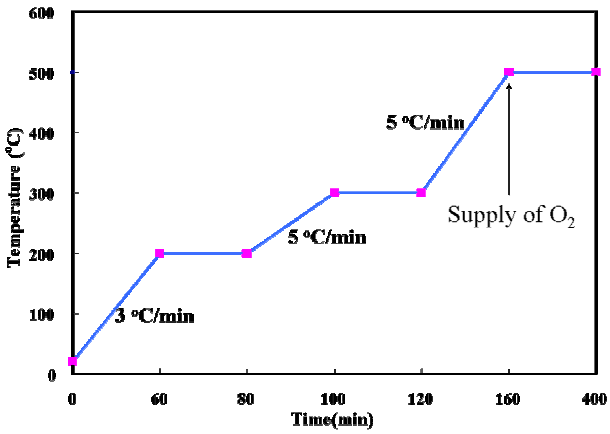

Fig. 3. Furnace heating cycle for resin

Fig. 4. The resin samples after the high temperature combustion

On the other hand, the ^{3}H and ^{14}C which are generated from this process are trapped in a nitric acid solution and a carbosorb respectively. The ^{3}H trapped in the nitric acid solution is mixed with a scintillation solution (Gold star) in a vial and the ^{14}C trapped in the carbosorb is also mixed with a scintillation solution (Gold star) in another vial. Finally, their radioactivity is measured by a low level liquid scintillation counter (LSC, Quantlus 1220, Walac) as seen in Fig. 5.

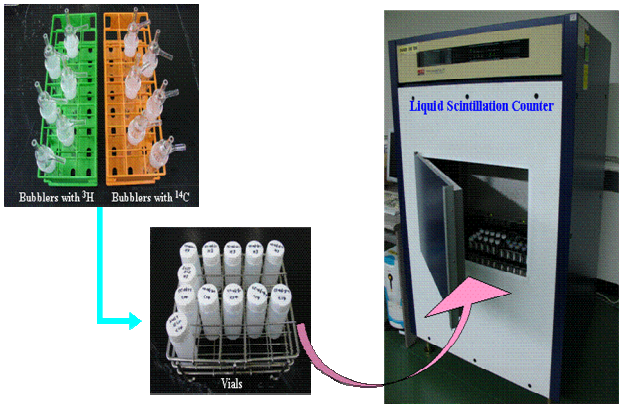

Fig. 5. The sample vials placed into LSC for measuring

3. Analysis Results

The specific activity of ^{14}C was 3.3 Bq/g at a maximum. It is much less than the limit of a concentration available for a self-disposal of ^{14}C [3] while the specific activity of ^{3}H was more than the limit of a concentration available for a self-disposal of ^{3}H. On the other hand, effective dose rate by an inhalation of ^{3}H is conservatively calculated to be less than 1 mS/y when 365 day-work in a 10 m * 10 m * 10 m radioactive waste building is considered [4-5].

4. Conclusion

The radioactivity of ^{3}H and ^{14}C of the resin used in a nuclear power plant was simultaneously analyzed by using a high temperature combustion furnace and the LSC method. It is suggested that the resin has a difficulty in being self-disposed of from the analysis result but it is thought to give little effect on publics in terms of the effective dose rate by inhalation.

The procedure of the present study will be continuously applied to an analysis of the ^{3}H and ^{14}C for an environmental monitoring and for determining a self-disposal.

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