Decontamination Technology for Low Activity Spent Resin From PWR's

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1. Introduction

The low activity spent resin from a pressurized water reactor(PWR) is stored in the radwaste building. The storage space of the radwaste building has been saturated due to the prolonged operation time of the nuclear power reactor[1].

Therefore, it is necessary to develop a proper method to handle and transfer the spent resin. However, because the spent resin contaminates a trace amount of ^{60}Co and ^{137}Cs, the spent resin is currently under long-term storage.

Particularly, ^{60}Co and ^{137}Cs, which are mainly generated in the nuclear reactor, are adsorbed physicochemically with ferrite as a form of the radioactive crud. This crud moves in the ion exchange resin tower and accumulate at the top layer. These nuclides are also physicochemically bonded to the ion exchange resin. This spent resin contaminates low concentration of radioactive, but it is necessary for decontamination because it is more concentrations than the IAEA Safety standards[2]. If the spent resin is sent to the radioactive waste disposal facility without decontamination, it will be a lot of expense, so the decontamination technique is necessary to treat the spent resin.

This study focuses on introducing of the method of the radioactive crud separation without the secondary waste.

2. Experiment method

2.1 Preparation of spent resin

Before of the separation and decontamination experiment, in order to evaluate the radioactivity of the spent resin from PWR, we transferred the spent resin from Hanbit Nuclear Power Plant to the isotope laboratory in Huviswater. The major nuclides of spent resin were ^{60}Co and ^{137}Cs. Table 1 shows the specific activity of the spent resin.

Fig. 1. The spent resin from Hanbit nuclear power plant.

Table 1. The specific activity of the spent resin

Sample	A		B		C	
Nuclide	^{60}Co	^{137}Cs	^{60}Co	^{137}Cs	^{60}Co	^{137}Cs
Specific activity (Bq/g)	0.413	MDA	0.462	MDA	0.075	0.049

MDA: Minimum Detectable Activity

The activity of all sample are more than IAEA safety standards, it is necessary to reduce below 0.1 Bq/g of ^{60}Co and ^{137}Cs.

2.2 Decontamination experiment method of spent resin

In order to separate the radioactive crud, that has been physicochemically bonded to the spent resin, the ultrasonic wave was applied. The radioactive crud is separated by the cavitation of the shock wave. The spent resin is separated radioactive crud and spent resin by the mesh filter, and the radioactive crud moves to the next step with process water. Because this process water gets mixed with the radioactive crud, it must treat water to remove the radioactive crud. As mentioned above, the nuclides are combined with ferrite as the form of radioactive crud. Therefore, the magnets are very useful to collect and remove the radioactive crud. We tested 2 kind of experiment(Lab. scale and Semi-pilot scale). Semi-Pilot devices are shown in Fig. 2.

Fig. 2. Semi-Pilot decontamination system(4L/hr).

3. Results and discussion

3.1 Results of Lab. scale experiment

Table 2 show that the total activity of the spent resin decontaminated from 0.413Bq/g, 0.462Bq/g, 0.075Bq/g of ^{60}Co to MDA. As a result, it means that almost ^{60}Co and ^{137}Cs were removed completely.

Table 2. The specific activity of the spent resin before and after decontamination

Sample		A		B		C	
Nuclide		^{60}Co	^{137}Cs	^{60}Co	^{137}Cs	^{60}Co	^{137}Cs
Specific activity (Bq/g)	Before	0.413	MDA	0.462	MDA	0.075	0.049
	After	MDA	MDA	MDA	MDA	MDA	MDA

3.2 Results of Semi-pilot scale experiment

Table 3 show that the total activity of spent resin decontaminated from 0.11Bq/g, 0.01Bq/g, to 0.002Bq/g, 0.006Bq/g. As a result, it means that almost ^{60}Co and ^{137}Cs were removed as well. And also, it is much lower than the IAEA safety standards.

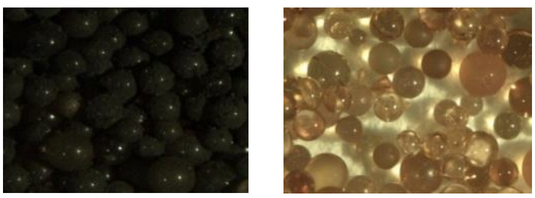
The total activity of treated process water was MDA value, it means ^{60}Co and ^{137}Cs were removed by magnet.

Table 3. The specific activity of the spent resin and process water before and after the decontamination

Sample		Spent resin		Process water	
Nuclide		^{60}Co	^{137}Cs	^{60}Co	^{137}Cs
Specific activity (Bq/g)	Before	0.11	0.01	MDA	MDA
	After	0.002	0.006	MDA	MDA

3.3 Optical microscope image of spent resin

Fig. 3 shows the optical microscope image of spent resin before and after decontamination. Fig. 3(a) is the image of the spent resin before the decontamination test, and Fig. 3(b) is the image of the spent resin after decontamination test. The optical microscope scales 75 times. Fig. 3(b) means that almost the radioactive crud have been removed.



(a)Before (b)After

Fig. 3. The optical microscope image of spent resin before and after decontamination(x 75).

4. Conclusion

Through the decontamination experiment, it was assured that almost ^{60}Co and ^{137}Cs were removed. And, process water can be also reused because the nuclides were not detected in the process water.

Through the magnet separation of the spent resin, it was affirmed that the radioactive crud can be collected by magnet, and it can be expected that there will be considerably less amount of the secondary waste than radioactive crud collection by using the bag filter and the cartridge filter.

Therefore, if the spent resin is decontaminated by applying these technology in PWR, It must be an effective technology for dispose of spent resin with minimum amount of secondary waste.

REFERENCES

[1] Hyun-ki Kim, besides 4, “The test of Co-60 decontamination from the spent waste resin using ultrasonic wave technology”, Abstracts of Proceedings of the Korean Radioactive Waste Society Spring 2014, 12(1), 313-314 (2014).

[2] Application of the Concepts of Exclusion, Exemption and Clearance (RS-G-1.7).