Transactions of the Korean Nuclear Society Autumn Meeting
Gwangju, Korea, May 29-31, 2013

A Study of the Reduction of Radioactive Waste by Reusing CVCS Demineralizer Twice

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1. Introduction

In this paper, in order to resolve the problem of early functional loss of the lithium removal demineralizer during the operation, which is generated by the use of a lithium-saturated resin in the purification demineralizer, and the problem of much generation of spent ion exchange resins, attempts were made to confirm if lithium-unsaturated resin can be filled for use in the purification demineralizer.

In addition, lithium was recovered and reused by finding the cause of continual increase in lithium ion concentration in the reactor coolant system (RCS) during the stop chemical treatment process of the overhaul and by improving the operating method of the demineralizer. Through these efforts, the problem of early functional loss of the lithium removal demineralizer was resolved and the generation of spent ion exchange resins was reduced to 1/3 of the previous level.

2. Methods and Results

2.1 Comparative Experiment between Lithium-Saturated Resin and Lithium-Unsaturated Resin

This experiment was conducted to confirm the problem of lithium-saturated resins used in the purification demineralizer of the power plants.

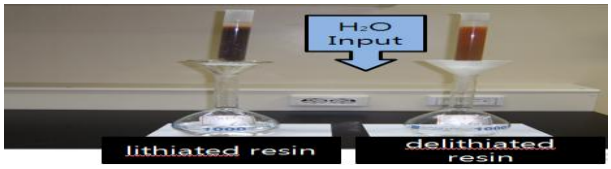

Fig.1 H2O Injection to lithium saturated resin and lithium-unsaturated resin

After injection of pure water, pH and Li concentration of the effluent were analyzed and the results confirm that an excessive amount of lithium was eluted from the lithium-saturated resin. The lithium excessively concentrated in the lithium-saturated resin used in the purification demineralizer was eluted into the rear end of the purification demineralizer during the normal operation, which caused the function of lithium removal demineralizer to be lost early.

2.2 Understanding of lithium elution phenomenon during the planned preventive maintenance period

Attempts were made to understand the phenomenon of continual increase of lithium in the reactor coolant system (RCS) during the stop chemical treatment of the 6th overhaul period of Yeonggwang Unit No. 6.

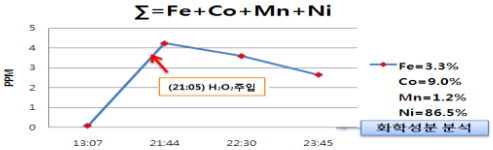

Fig.2 Change in radioactivity concentration during the 6th overhaul of Yeonggwang Unit No. 6

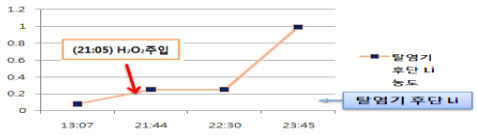

Fig.3 Change in lithium concentration at the rear end of the purification demineralizer during the 6th overhaul of Yeonggwang Unit No. 6

As shown in Figures 2 and 3, lithium was eluted at the rear end of the purification demineralizer after injecting hydrogen peroxide, a strong oxidizer, into RSC during the stop chemical treatment process. This means that the ion-selective reaction at the purification demineralizer eluted valence-1 lithium while removing valence-2 radioactive materials, which could be confirmed through the experiment for injection of ferrous iron (FeCl2) to the resin of the purification demineralizer.

2.3 Operation Plan of Improved CVCS Purification Demineralizer

The system of reusing one demineralizer twice, in other words, using it for lithium removal after using it for deborating (one-time reuse), and then finally using it for purification, was developed and applied to Yeonggwang Units 5 and 6.

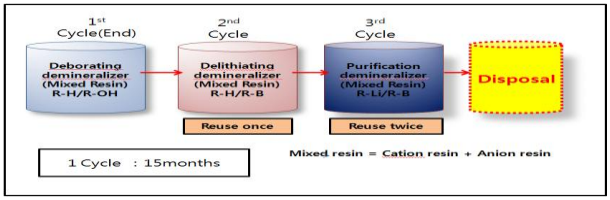

Fig.4 Application Method of Improved CVCS Purification Demineralizer

The largest characteristic in the application method of the improved purification demineralizer is that the problem of early functional loss for the lithium-removal demineralizer does not occur during the operation since lithium-saturation resin is not used in the purification demineralizer. And the lithium eluted from the purification demineralizer during the planned preventive maintenance was recovered from the lithium-removal demineralizer and then used for purification without additional injection of a certain amount of lithium required for use in the purification demineralizer. As a result, the amount of spent ion exchange resins generated for replacement during the planned preventive maintenance was reduced to 1000L, which is a tremendous waste reduction in comparison with the conventional operating method.

3. Conclusions

Through this paper, the amount of spent high-radioactivity ion exchange resins generated from the power plants could be reduced tremendously, the power plants could be operated stably by resolving the problem of functional loss for the lithium-removal demineralizer during the normal operation, and the cost reduction effect due to reuse of the lithium generated from the nuclear reactor could be observed.

REFERENCES

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