Study on Optimization of Volume Reduction Treatment Process of Domestic Industrial Radioactive Waste

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1. Introduction

The domestic industrial radioactive waste in this study is powder type waste containing a large amount of moisture, and there is no suitable treatment method for satisfying the disposal condition. In this study, we constructed the treatment process based on the patented technology of Korea Atomic Energy Research Institute. The treatment process consisted of three steps: dissolution and solid - liquid separation, purification and solid - liquid separation, and precipitation for discharging.

In this study, the amount of radioactive waste is reduced by separating the support structure which occupies most of the volume. The radioactive concentration of the separated support structure is reduced to a level that complies with regulations for self-disposal and then discharged to the environment. Secondary wastes generated during this process are treated to be below the release criteria and discharged to the environment so that the volume of radioactive waste for disposal in a radioactive waste disposal facility is significantly reduced and the waste is to be treated to satisfy the waste acceptance criteria for radioactive waste [1].

Therefore, in order to minimize the amount of radioactive materials flowing into the support structure, this study aims to establish an efficient method of operating the solid-liquid separator by optimizing the operation method of the solid-liquid separator.

2. Operation method of solid-liquid separator

The solid – liquid separation is used in two separate processes. In a dissolution process, it is used to separate support structure and the waste. In purification and precipitation processes, it is used to treat the separated support structure for self-disposal. It is also used to treat the secondary waste to satisfy the release criteria. The operation method of solid – liquid separator varies depending on the purpose. The volume of single channel of the filter plate of solid - liquid separator is 8.5 ℓ, and a 3-channel filter plate was prepared to fill the solids according to the purpose of the study. In the dissolution process, the filter plate was precoated with bentonite, and the purification process was operated without pre-coating [2].

In the dissolving process, the particle size of the medium injected into the solid-liquid separator is very small. The filter plate needs to be protected and smooth flow of liquid should be ensured. In the refining process, the medium injected into the solid-liquid separator was excluded from the pre-coating since the particle size was larger than the medium injected into the solid-liquid separator after the dissolving process. First, the particulate radioactive waste dissolved by the operation method of the solid-liquid separator after the dissolution was injected by opening the lower pipe switch of the dissolution tank immediately after completion of the pre-coating of the filter plate of the solid-liquid separator. The operating pressure of the solid - liquid separator was set to 5 bars, and the dissolved particulate radioactive waste was fed and subjected to dehydration and solid - liquid separation. Secondly, after the purification process, the solid that was precipitated without pre-coating was injected into the solid-liquid separator. The operation pressure of the solid - liquid separator was set to 5 bars, and the solid - liquid separation was performed after washing and dehydration.

3. Optimization of operation method of solid-liquid separator

In order to optimize the operation method of the solid-liquid separator, the main purpose of the first dissolution process is to minimize the amount of the radioactive material flowing into the purification

process after the dissolution process by injecting the undissolved solids into the solid-liquid separator as much as possible. In the second purification process, the main purpose is to minimize the amount of radioactive materials in the solid by cleaning the radioactive material absorbed by the solid material flowing into the solid-liquid separator. The optimization of the operation method of solid - liquid separator has been studied in order to satisfy these objectives and to minimize the amount of secondary waste generated during operation of the apparatus. In the first dissolution process, dissolved particulate radioactive waste was injected by opening the bottom pipe switch of the dissolution tank immediately after completion of pre-coating of the filter plate of the solid - liquid separator to optimize the operation method of the solid - liquid separator. The operating pressure of the solid - liquid separator was set at 5 bars when the dissolved particulate radioactive waste was injected.

The solution discharged from the outlet pipe of the solid-liquid separator was re-fed into the solid-liquid separator again to minimize the particulate radioactive waste support material remaining in the solution.

Fig. 1 (a) is a liquid sample after one solid-liquid separation, and (b) is a liquid sample after two solid-liquid separations. When visually confirmed, turbidity was significantly lower when the liquid was separated twice.

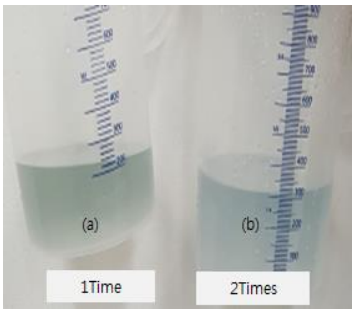

Fig. 1. Filter Press Operation Method.

In the second refining process, the sedimented solid was injected into the solid-liquid separator with the operation pressure set at 5 bars to optimize the operation method of the solid-liquid separator. In order to efficiently remove the radioactive particles remaining in the solid matter through the cleaning process after injecting the solid matter, the solid injected into the solid-liquid separator are repeatedly washed with water and acid. After that, squeezing and air blowing processes were performed to remove moisture that contains radioactive particles existing in the solid matter. The results are shown in Fig. 2.

Fig. 2. Silica cake after filter press.

4. Conclusion

In order to optimize the operation method of the solid - liquid separator, the turbidity of the solution according to the single operation and the double operation of the solid - liquid separator was visually confirmed. After dissolving in a dissolution tank, the solution produced in the process of separating the undissolved solids from the solid-liquid separator was fed into the solid-liquid separator again. As shown in Fig. 1, there was change of turbidity. The load of the filter installed upstream of the purification process is reduced. The possibility of containing the radioactive particles in the purification process was considerably reduced.

In addition, it was confirmed that the liquid containing the radioactive particles can be sufficiently removed from the inside of the solid material through dehydration and blowing after the solid material generated in the purification process is injected into the solid-liquid separator and then repeatedly washed with water and acid.

5. Acknowledgment

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REFERENCES

[1] KAERI. Patent Publication, 2013.
[2] Korea Filter Co., Ltd. (2017) Solid-liquid Separator Manual, pp.12-15.