Improvement of Radioactive Waste Plasma Melting Reactor

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1. Introduction

Korea Hydro & Nuclear Power Co., Ltd. has developed plasma treatment technology for the stable disposal of radioactive waste generated from nuclear power plants Developed. Plasma processing technology is a technology that reduces the volume to about 1/5 or more by treating radioactive waste such as metal, concrete, and asbestos with high-temperature heat of about 1,600℃ or higher using electrical arc phenomena such as lightning. Plasma treatment technology is an innovative technology in the future nuclear power plant industry that leads the radioactive waste treatment field in the future because it can treat various types of radioactive waste in the same melting furnace without separate pretreatment and is easy to operate and maintain.

2. Plasma melting furnace demonstration

The third-generation plasma melting furnace is 1.8m(W)×2m(L)×2.2m(H) and can accommodate about 800L of melt, and it is designed to minimize heat loss and manage internal melt in the melting furnace by installing two outlets in a sliding gate method. The 200L drum input method is applied to the waste, and the outside of the melting furnace is cooled with water using a tube.

Fig. 1. 1.5 MW Plasma Facility (3rd Generation)

As a result of the plasma treatment demonstration test on simulated waste (STS304), it took a lot of time to raise the inside of the melting furnace to normal temperature, and melting was confirmed only in some areas of the melting furnace, confirming that it was necessary to redesign the melting furnace through the Heat/Mass Balance evaluation.

Fig. 2. MW PTM Melting View

As a result of the simulation waste (STS304) melting demonstration test using plasma, it was confirmed that the internal heat of the melting furnace (about 1,600℃) was not transferred around the outlet after the discharge operation, resulting in clogging of the outlet.

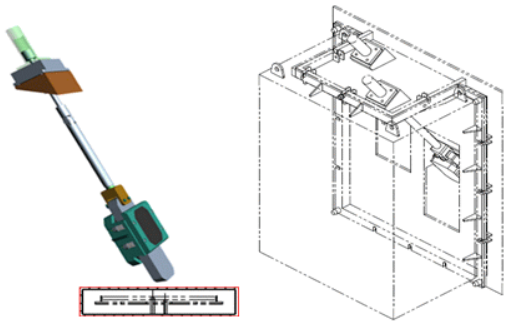

Fig. 3. Side gate valve and outlet box

3. Results of plasma melting furnace improvement

The internal volume of the melting furnace [1.0m(W)×1.4m(L)×0.9m(H)] was improved by reflecting the results of the heat/mass balance evaluation and heat flow analysis. The inside of the furnace is designed to be a temperature gradient suitable for minimizing heat loss through uniform fluid flow.

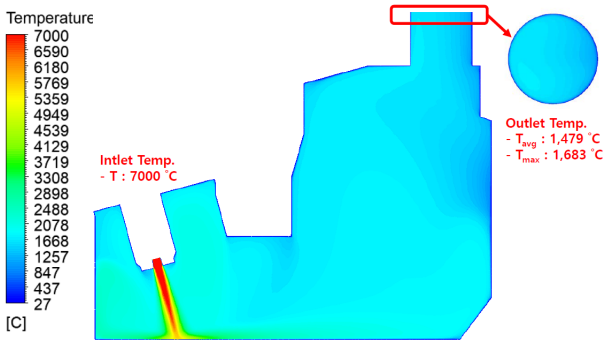

Fig. 4. MW PTM Temperature Distribution

Most of the waste melting facilities apply various types of discharge structures such as tilting, dam type, and discharge by centrifugal force. Considering the applicability of facilities and the reproducibility of melt discharge, it was judged that the dam discharge method would be suitable for plasma processing facilities. The dam type is a natural discharge method by overflow when the molten metal level increases during waste treatment, and the path through which the molten metal is discharged is maintained at a high temperature at all times due to the high temperature molten metal, thereby minimizing discharge delay.

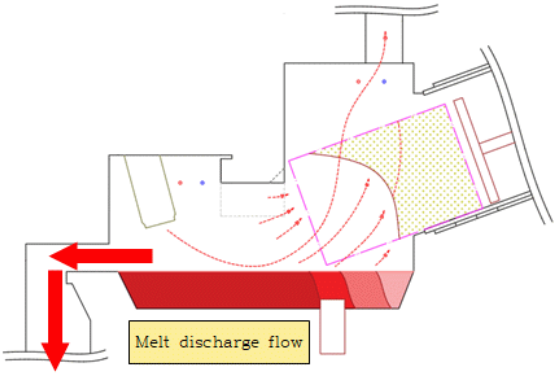

Fig. 5. Dam Type MW PTM Conceptual Plot

4. Future Plan

In order to secure the stability of waste treatment using plasma processing facilities, it will be applied to operational and dismantled nuclear power plants through long-term continuous operation demonstration using improved melting furnaces, waste process data verification, and optimization of operation variables.

REFERENCES

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