Development of Treatment Technology of Non-Disposal Radwastes for the Increase of Their Volume at Disposal Site

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1. Introduction

In general, the radioactive wastes (liquid, dried powder, and sludge) were solidified by mixing with a proper binding matrix (cement, polymer, asphalt, etc.), but their solidified volume inevitably increases due to the limitation of incorporation of radwastes to a binding matrix. To solve this problem, some of Korean NPPs operate both the CTS (Concentrate Treatment System, evaporation, and granulation) and the polymer solidification system. The size distribution of granulated wastes produced by CTS is so broad (diameter; several μm ~ several cm) that a polymer cannot impregnate into the void between granulates due to their fine particulate.

On the contrary, if the powdered radwastes can be compacted as the high-density pellets, and the pellets can be loaded in a waste drum as much as possible, and then the adhesive matrix can be seized while filling the void between pellets.

Through this study, we will contribute to the reduction of disposal cost of radioactive waste and the improvement of disposal technology.

2. Roll Compaction of Powdered Radioactive Wastes

2.1 Necessity of Technology Development

Non-Disposal radwaste is a term referring to particulate radioactive waste generated during the operation of a nuclear power plant or dismantling a nuclear power plant. Because it is not currently securing processing technology, it is targeted for concentrated waste liquid powder, slurry and sludge which are not processed. In addition, any powder waste (concrete crushed material, decontaminated sludge, etc.) generated in the process of dismantling nuclear power plants in the future, and contaminated soil of fine size not used for decontamination are also target waste.

These radioactive wastes are concentrated and managed in specially designed and constructed areas in the country for comprehensive and safe management. This is referred to as "disposal of radioactive waste at disposal sites." These radioactive wastes must satisfy the acquisition criteria of the repository and the regulations of the country of India and safety must be secured [1][2].

Table 1. Acceptance criteria test method for disposal safety

classification	Test Items	Related standards
Structural stability	Compressive strength test	Hard case : KS F 2405 Soft case : KS F 2351
	Immersion test	NRC/Technical Position on Waste Form, Rev.1
	Heat cycle test	ASTM B553
	Free water measuring	Apply method similar to ANS 55.1
	Irradiation test	NRC/Technical Position on Waste Form, Rev.1
Leachability	Leaching Test	ANS 16.1

Table 2. Waste solidification criteria for disposal safety

Number	Test Items	Criteria	
		Hard solidification	Soft solidification
1	Compressive strength test	3.44 MPa (500 psig) or higher	0.41 MPa (60 psig) or more when the specimen's vertical strain is 3%
2	Compressive strength test after immersion test		
3	Compressive strength test after heat cycling test		
4	Compressive strength test after irradiation test		
5	Leaching Test	The leaching index of the sample is 6 or more for Cs, Sr, Co nuclides	
6	Free water measuring	1% of high-integrity containers, and others shall not exceed 0.5%.	

2.2 Differentiation of technology development

The feature of this technology is that the dried powder is pelletized and compressed to a high degree, and the pellets are packed in the drum to the maximum to solidify the pores between them into a high-adhesive and high-strength polymer.

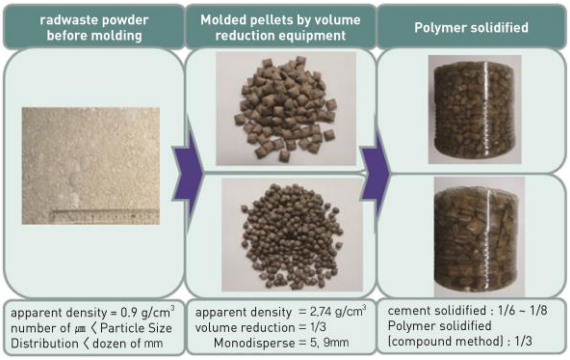

Fig. 1. Roll Compaction of Powdered Radioactive Wastes.

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If the bulk density of Non-Disposal waste is maximized and pellets are manufactured in a form that maximizes the filling rate in the waste drum and the pellet filling space is consolidated into a highly adhesive special polymer then it is more than 3 times as much as that of powder (0.7 ~ 0.9 → 3.0g / 〖 cm〗 ^ 5), 1.2 times higher on pellet and drum basis and 6 times higher than cement solid dependent, and the polymer solid is 3 times or more.

Conventional solidification technology adopts a simple mixing method between waste and solidification medium, so the amount of waste is increased rather than being scraped. However, the present technology is differentiated to attain high sensitivity by multiplying the filling rate in the drum first.

3. Conclusion

If the radioactive waste is delivered to the disposal site without being highly reduced, the amount of waste disposed at the disposal site will increase significantly, necessitating another disposal site. For this reason, it is considered that the development of waste reduction technology is essential and important, and it can contribute to the reduction of related burdens such as excessive waste disposal cost and solving the problem of saturation of temporary waste storage in NPP through technology development.

REFERENCES

[1] Radwaste Acceptance Criteria, LILW-Operation-Radiation-028, Korea Radioactive Waste Agency.

[2] Solidification Radwaste structural soundness verification of examination, LILW-Operate-Radiation-048, Korea Radioactive Waste Agency.