

The Economic Evaluation of Solid Radioactive Waste Treatment Units for Centralized Radioactive Waste Treatment Facility

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1. Introduction

Economical and safe processing of radioactive waste is one of the major element to enhance the safety and reliability of operation of nuclear power plant (NPP). Since radioactive waste treatment technologies are constantly developing, it is necessary to perform the economic evaluation considering various situation and technologies for the optimization of waste treatment.

This paper performed an economic evaluation for solid waste processing technologies in a centralized radioactive waste treatment facility assuming that several NPP operates in the same area such as Ulchin, Haiyang (China), and Barakah (U.A.E.).

In case of generating the large amounts of radioactive waste from multiple units, the results of this paper are expected to provide a technical basis for how to construct an optimal solid waste treatment system. The facility is assumed to handle solid radioactive waste generated from six 1,400 MWe PWR units.

2. Case Selection & Waste Drum Estimation

The spent resin generated from ion exchange bed, concentrate generated from filtering or evaporating process, and Dry Active Waste (DAW) are the major solid radioactive waste from NPP. These wastes are required to be packaged suitable for disposal by using appropriate treatment system. The solid radioactive waste treatment systems used in Korea are as follows:

Table 1. List for the Treatment Units

Waste Type	Treatment Unit
Spent Resin	- Spent Resin Drying System
	- Cementation System
	- Polymer Solidification System
	- Vitrification System
Concentrate	- Cementation System
	- Polymer Solidification System
	- Vitrification System
DAW	- Compactor
	- Vitrification System

Among the solid radioactive waste treatment unit in Table 1, three cases can be considered for solid radioactive waste treatment unit suitable for the centralized radioactive waste treatment facility.

- Case 1 : Cementation
- Case 2 : Polymer Solidification
- Case 3 : Vitrification

Since the radioactive waste generation data for 1,400 MWe PWR has not been available yet, the expected generation rate of 950 MWe unit in Korea (Kori 3&4) is used for estimating waste drum. The total scale-up value of 9 is applied. The estimated waste volume for six 1,400 MWe PWR is shown in Table 2.

Table 2. Estimated Waste Volume (Drums/yr-6unit)

Waste Type	Case 1	Case 2	Case 3
Spent Resin	477	239	9
Concentrate	1,314	132	438
DAW	2,601	2,601	220
By-product of Vitrification	-	-	40
Total	4,491	3,071	806

3. Economic Evaluation for each Case

Economic evaluation is performed to estimate the total cost for each case during 40 years operation. The parameters considered for the evaluation are as follows:

Table 3. The Input Parameters for each Case

Case 1 (By Cementation)				
Parameter	Unit	Conce- ntrate	Spent Resin	DAW
Purchasing Cost	\$		3,382,800	
Disposal Cost	\$		13,774 (Identical to Case 1~3)	
Personnel Expenses	\$/hr		25 (Identical to Case 1~3)	
Electric Cost	\$/kWh		0.07 (Identical to Case 1~3)	
Agent Cost	\$/m ³	152	152	0
Operating Time per Year	Hr	36	1,056	2,336
Manpower	Man	1	1	1
Electricity	kWh	8.4	8.4	10
Drum Cost	\$	120	120	120
Case 2 (By Polymer Solidification)				
Purchasing Cost	\$		3,482,800	
Agent Cost	\$/m ³	32,528	32,528	0
Operating Time per Year	Hr	72	1,056	2,336
Manpower	Man	2	1	1
Electricity	kWh	49.9	8.4	10
Drum Cost	\$	120	120	120
Case 3 (By Vitrification)				
Purchasing Cost	\$		39,732,800	
Agent Cost	\$/m ³	77,042	77,042	77,042
Operating Time per Year	Hr	240	2,080	1,756
Manpower	Man	3	3	4
Electricity	kWh	165	165	175
Drum Cost	\$	120	120	120

4. Conclusion

The result of economic evaluation for each case is shown in Fig. 1. The Figure shows the cost comparison for each case by the basis of waste type and the total cost for each case. As a result, the Case 3 by vitrification is evaluated as the most economical waste treatment unit for centralized radioactive waste treatment facility.

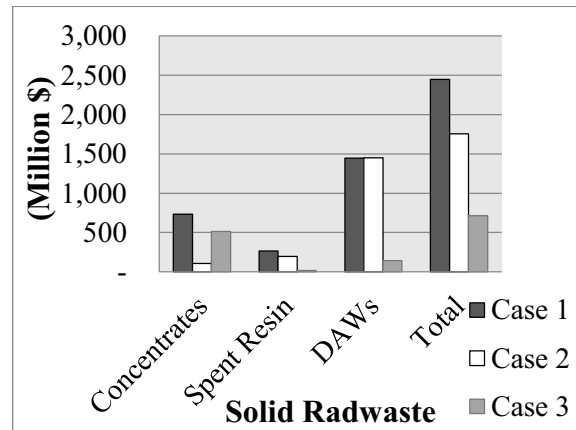


Fig. 1. The Result of Economic Evaluation.

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