Development of Radioactive Contaminated Waste Filter Disposal System in NPP

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1. Introduction

The HVAC (Heating, Ventilation, and Air conditioning) system of a nuclear power plant is equipped with a filter that passes air though a porous filter media to filter out foreign substance and dust. The types of filter used consist of HEPA(High efficiency particulate air)filter and medium filter.

More than 300 to 400 filters are exchanged per 1 unit in a nuclear power plant every year.

This working process is carried out when differential pressure is occurred and waste HEPA filters should be separated for disposal.

In the primary system, the separation work is performed by manual process to sort out the material, and it needs high intensity of labor and takes a long time.

Therefore, it is necessary to develop the automatic equipment that separates contaminated HEPA filter.

This paper presents the results of a separation condition test for developing a waste filter disposal system.

2. Methods and Results

2.1 Development background

Waste HEPA filter disposal contaminated with radiation from a nuclear power plants requires complete separation as shown in Figure 1. (Filter frame, Adhesive, Separator, Filter media)

Therefore, separation process of one waste filter required 0.8 M/D(Man/Day), and the serious problem is that unprocessed filters keep accumulating inside the primary system.

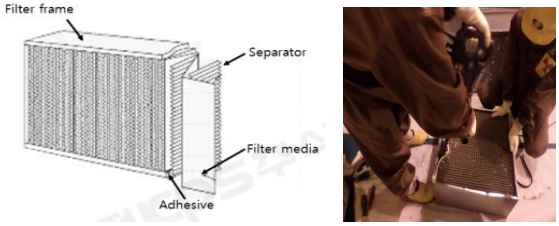


Fig. 1. waste filter composition and manual process.

Also, if we try to develop the equipment that can automatically remove a filter from a frame, there is no clear standard about the width and tolerance of the filter frame, which makes it difficult to develop standardized equipment.

2.2 principle of equipment

Figure 2 is a device for separating the filter from the frame by mechanical pressure method.

This device is fixed with left side of the frame as a reference and tighten the right side of the frame inward. Thereafter the cutter moves up and down in the vertical direction to separate the adhesives and Filter frame.

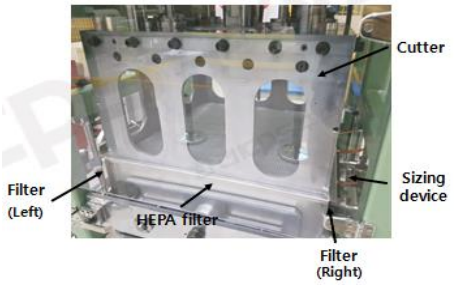


Fig. 2. Separating system.

In Table 1, this filter has no clear standard for outside and inside of “Before Sizing” with some tolerance at least 1~3mm, so this filter disposal system applied the standardized size for each Outside and Inside of “After Sizing” by Experimental Verification.

Table 1. HEPA Filer Size & Sizing dimension(mm)

Sample		Before sizing		After Sizing	
		Outside	Inside	Out side	Inside
HEPA Filer	Double-turned flange Type	577.8	573.8	576.6	572.6
		577.1	573.1	576.6	572.6
		577.3	573.3	576.6	572.6
		576.7	572.7	576.6	572.6

2.3 Mock-up Test

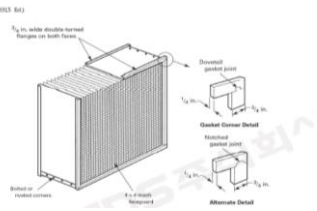


Fig. 2. HEPA Filter Double-turned flange Type.

In this Mock-up Test, the filter in Figure 2 is used. For the performance test, 4EA Filters of different sizes within HEPA Filter Nominal Size in Table 1 were arbitrarily selected, and the pressure and speed of the Hydraulic cylinder were set to the same condition in Table3 to confirm the effect of sizing.

Table 3. Main & Sub Cylinder Operation Speed & Pressure

Speed(mm/s)		Pressure	Gauge
Main(1^{st})	Sub(2^{nd})	(kgf/cm^2)	(kgf/cm^2)
7	20	100	60

2.4 Result of Mock-up Test

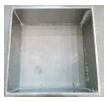
Outside		picture of test		Result
Before Sizing	After Sizing	Filter frame	Adhesive, Filter media	
577.8mm	576.6 mm			Very satisfied
577.1mm	576.6 mm			Very satisfied
577.3mm	576.6 mm			Very satisfied
576.7mm	576.6 mm			Very satisfied
577.8mm	577.8mm (unapplied)			Unsatisfied

Fig. 3. result of test.

As a result, we could confirm that all 4 tests were cleanly separated by applying “After sizing”. On the contrary, when sizing is not applied, the separation of the adhesives is not cleaned due to the widening of the Filter frame.

3. Conclusion

In the development of the waste HEPA filter disposal equipment the mock-up performance test using the unified sizing method showed that the work time was reduced by 90%. It is expected that by reducing the waiting time in the primary system where the work is done, the amount of radiation exposure can be significantly reduced. In the future, we intend to improve the completeness of this equipment by applying it to the field of waste HEPA filter disposal in a nuclear power plants.