Treatment of Spent Air Filters by Repackaging and Decontamination of Frames

Il Sik Kang*, Tae Kuk Kim, Dae Seok Hong, Won Hyuk Jang, Kyung Kil Kwak, Bum Chul Lee, Woo Seog Ryu
Korea Atomic Energy Research Institute, 1045 Daedeok-daero Yuseong-gu,
**niskang@kaeri.re.kr*

1. Introduction

Radioactive spent air filters generated from radiation areas at KAERI are dismantled into glass fiber media, aluminum separators and filter frames. After that the media are compacted and packaged into a steel drum for storage and the separator and the filter frame are classified and decontaminated for further treatment. This treatment approach is appropriate for radioactive waste volume reduction and securing radioactive waste storage capacity.

Spent filters are mainly generated from the research reactor (HANARO), radio isotope (RI) production facility and various fuel cycle facilities. The filters are composed of HEPA filter, pre-filter and charcoal filter and among them, HEPA filter accounts for 88% of total spent filters. Before treatment, the spent filters are classified according to generation history and radiological characteristics.

Accompanied by the treatment, radioactivity and radionuclides required by acceptance criteria given by a disposal facility are analyzed for final disposal later.

For the treatment of spent filters, a booth and a tray were manufactured for limiting the distribution of contaminants during dismantling and for reducing exposure dose to workers. In addition, a punch was manufactured for taking 2 inch samples from the filter. Furthermore, equipment for removing adhesive from the filter frame using a knife was developed.

2. Dismantling and repackaging of spent air filters

2.1 Equipment development

2.1.1 Equipment for removing adhesive

In an air filter, filtering media are attached to the filter frame using an adhesive. During the treatment, the media are separated from the filter frame, compacted and repackaged into a steel drum for limiting radioactive dust spread and reducing internal dose to workers caused by inhalation of radioactive dust. The remaining filter frame can be recycled after some treatment for radioactive waste reduction, working environment enhancement and economic benefit.

Conventionally, the filter media was separated from the filter frame manually which took labor, time and was costly. Also, the dose on workers during filter treatment was a problem. Thus, equipment for removing filter media adhesive from filter frame was developed.

The equipment is a motor-driven system and composed of a base unit, separation unit, leveling unit, driving unit and collecting unit. Once a filter is fixed on the base unit, it is dismantled using an 'L' shaped steel knife attached in the separation unit. Other units are the leveling unit for adjusting the level of knife, the driving unit for controlling movement of the knife and the collecting unit for gathering media adhesives removed from the spent filter.

2.1.2. Working booth and classification tray

The spent filters were dismantled in a cutting room for Radioactive Waste Treatment Facility at KAERI. To limit radioactive dust dispersion in the cutting room, a working booth was used with a tray during filter treatment. The tray was made of stainless steel for easy decontamination. The working booth was connected to an exhausting duct for removing radioactive dust generated from the filters during treatment. In addition to that, for monitoring working condition, a transparent glass was installed on the working booth.

2.2 Working procedure

Before dismantlement, the spent filters were classified according to type, generating facility, surface dose rate and generation time.

2.2.1 Volume reduction of spent filter containing hazardous material and intermediate surface dose rate

If the spent filter was classified to have hazardous material and intermediate surface dose rate, it was compacted using a circular-shaping-compactor in order to fit in a drum with a circular cross section. Then, in the drum the filter was compacted again for volume reduction and managed as a radioactive waste.

2.2.2 Dismantlement and volume reduction of spent filter with low surface dose rate

In this case, the spent filter was classified depending on its type and dismantled on a working table. The filter frame (including face guard and separator), after removing sealant and gasket, was grouped by its material, decontaminated and re-classified according to its contamination level. Then, the contaminated frames were packaged into a 200 liter drum and managed as radioactive waste. Uncontaminated frames were separately packaged into 200 liter drums and managed as object wastes for regulatory clearance.

After that, the filter media were grouped depending on their material and packaged into 200 liter drums. At that time, based on surface contamination and dose rate, points showing the highest value were taken for analysis. During packaging, compressive media were compacted for volume reduction. Secondary wastes generated during dismantling were collected and packaged in drums. If adhesive removal using the equipment is not enough, the frames were heated up to 80 °C for 1 hour at a drying furnace. After that, the remaining adhesive was removed very easily.

2.2.3 Dismantlement and re-packaging of charcoal filter

Charcoal filters for removing radioactive iodine gas have a case filled with charcoal. For treatment, a fixing plate was removed from the case and charcoals were collected into 200 liter drums. And the cases were compacted for volume reduction.

3. Decontamination of filter frame

Filter frame decontamination was for regulatory clearance of extremely low level radioactive waste. When a filter frame was generated, it was monitored for surface contamination. If the surface contamination level was below 100 cpm the filter frame was classified for clearance. Otherwise, it was classified as radioactive waste.

3.1 Decontamination

Once the filter frame was classified for regulatory clearance, the remaining sticker and rubber on the frame were totally removed using appropriate tools. After then, the frame was soaked in sticker removal agent for 24 hours. Finally, the remaining neoprene gasket and adhesives were completely removed.

If the surface contamination level of the decontaminated filter frame was below MDA of the contamination monitor, it was packaged and stored at a designated area for regulatory clearance by grouping depending on its material.

3.2 Sampling

For the filter frames of the same generation facility and time, sampling was performed. Because 12 filter frame plates were generated by dismantling of each 3 spent filters, a representative sample was taken based on comparison of contamination of the 12 plates having same generation history i.e., generation facility and generation time. As a result, a sample would represent a filter frame with the highest contamination level among 3 spent filters having the same generation history.

Before sampling, a serial number was given and marked on each spent filter. After that, a filter frame was chosen for sampling which used a perforator to get a 2 inch circular sample. Once generated, a sample was packed in a sample container having an identification number and analyzed for gamma radionuclides. When analysis is completed, sample containers are stored separately in order to limit contamination.

Filter frames confirmed for regulatory clearance based on the analysis result were packaged to have 12 frames in one package having a mark for clearance. To protect filter frames from radioactive contamination, the frame packages will be separately stored in a designated area until getting permission for regulatory clearance.

4. Conclusion

By developing and applying adhesive removal equipment for filter frames generated from spent filters at KAERI, the remaining adhesive was removed from the filter frame which easily and safely reduced radioactive dust inhalation of workers. After dismantlement, filter media were collected in steel drums and compacted for volume reduction and filter frames were analyzed for contamination and classified for recycling by regulatory clearance.

While conventional filter treatment methods made 2 filters collected in a 200 liter steel drum, the circular-shaping-compactor made 4 filters collected in a 200 liter steel drum. As a more efficient method, the filter dismantlement considered in this study makes 10 ~ 12 filters packaged in a 200 liter steel drum.

By dismantlement of spent filters, storage capacity was secured and safety of radioactive waste storage was enhanced by limiting contamination and protecting from fire. Also, cost for final disposal of radioactive wastes will be reduced by a more efficient volume reduction of filter media and regulatory clearance of filter frame.