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PFC Spray Decontamination on the Metal Specimens

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1. Introduction

Korea Atomic Energy Research Institute is developing the dry decontamination technologies applicable to the decontamination of the highly radioactive surfaces loosely contaminated with radioactive particles. One of the technologies is the PFC decontamination technology. Two kinds of the PFC decontamination technologies were developed. The one is the PFC ultrasonic decontamination technology which was performed in 2004[1]. The other is the PFC spray decontamination technology which has been performed since 2005. In this study, the decontamination performance of the recently developed PFC spray decontamination equipment on the several shapes of metal specimens was presented. In addition, the results of the PFC distillation unit which uses the dry ice as a coolant were also presented.

2. Methods and Results

In this section experimental procedures and the test results of decontamination and distillation tests are described

2.1 Methods

The PFC used in this study was perfluoroheptane (PFC-5070), 3M. Anionic fluorinated surfactant containing the carboxylic group was mixed with perfluoroheptane and the solution was used as a decontamination agent.

After weighing of the test specimen, the specimen was contaminated with the ethyl alcohol containing Eu_2O_3 powders. Dried in a shadow place and photographed. It was weighed again. After the application of the PFC spray decontamination method, the test specimen was dried and its weight was measured. The spray pressure was 41 kgf/cm^2, the orifice diameter was 0.2 mm and the spray velocity was 0.2 L/min. It was sprayed for 5 minutes for each specimen. To investigate the decontamination surface, it was photographed again.

To investigate the recovery and purification efficiency on the contaminated PFC solution, the solution containing Al_2O_3 powders was distilled at 80 ℃ and condensed near -80 ℃. The volume of the PFC solution was 2 L. The variation of the temperature of the heating mantle against time was measured. Before and after distillation, turbidity of the solution was also measured (Model, DRT 15-CE HF Scientific, Inc.).

The change of the decontamination performance on the distillation times was also monitored.

2.2 Decontamination equipment

Figure 1 is the photograph which shows the vacuum cup of the PFC spray decontamination process. The one side of the vacuum cup is connected with the high pressure pump. PFC is sprayed from the orifice in the vacuum cup. And, the other side is connected with the filtration system. The vacuum cup is designed to be hold by the manipulator.

Figure 1. Vacuum cup of the PFC spray decontamination equipment.

2.3 Distillation

As there is no water supply in the IMEF (Irradiated Material Examination Facility), we can not use water. Therefore, the use of the dry ice as a coolant of the vaporized PFC. Figure 2 shows the diagram of the PFC condensation tower. As the temperature at which condensation of vaporized PFC occurs is near -80 ^{0}C, the collected quantity of PFC by distillation is larger than that of the water.

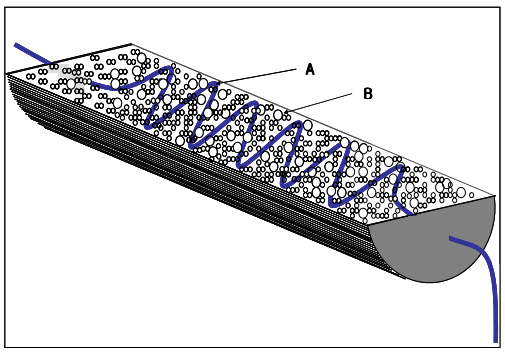
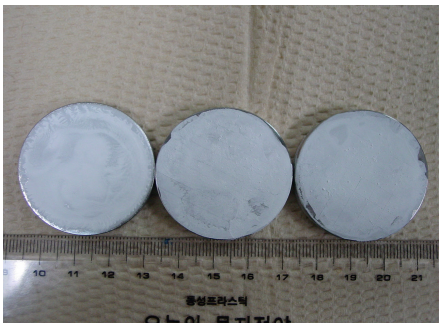


Figure 2. Diagram of the PFC condensation tower (A: cooling tube, B: dry ice).

Figure 3 is the photographs showing the decontamination performance of the PFC spray method on the 3 kinds of the disk type specimen. For all the tested specimens, contaminants were satisfactorily removed by the PFC spray method. Decontamination factors were higher than 30 for all the specimens. The decontamination performance of the PFC spray decontamination is comparable to the decontamination performance of the Sonatol process [2].



(a)

(b)

Figure 3. Three kinds of disk type specimens, (a) : before and, (b) : after decontamination.

3. Conclusion

The decontamination performance of the PFC spray methods on the simulated metal specimens was investigated. For all the shapes of specimens, we found that the PFC spray decontamination was satisfactorily applicable. The characteristic of PFC spray method was comparable to the PFC ultrasonic decontamination method. From the feasibility test of using the dry ice as a coolant, we found that the recycle of the PFC solution by distillation in the no water supply area was possible. Decontamination work will be performed with a little loss of a main decontamination agent.

Acknowledgment

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REFERENCES

[1] H. J. Won, G. N. Kim, C. H. Jung, J. H. Park and W. Z. Oh, W. Z., J. of the Korean Radioactive Waste Society, Vol. 3, No. 4, pp.293-300, 2005.

[2] A. Desrosiers, “Separation and extraction of plutonium in mixed waste”, DOE award number: DE-AC26-01NT41308, DOE, Plymouth, MA 2002.