Development of Filtration Equipment to Reuse PFC Decontamination Wastewater

Gye-Nam Kim, Sung-Yeol Lee, Hui-Jun Won, Chong-Hun Jung, Won-Zin Oh, Jin-Ho Park
Researcher, Korea Atomic Energy Research Institute, kimsum@kaeri.re.kr

1. Introduction

When PFC(Perfluorocarbonate) decontamination technology is applied to removal of radioactive contaminated particulate adhered at surface during the operation of nuclear research facilities, it is necessary to develop a filtration equipment to reuse of PFC solution due to high price, also to minimize the volume of second wastewater. Contaminated characteristics of hot particulate was investigated and a filtration process was presented to remove suspended radioactive particulate from PFC decontamination wastewater generated on PFC decontamination.

2. Methods and Results

2.1 Experimental method

The size of hot particulate in hot cell was measured by SEM(Scanning Electron Microscopy) and OM(Optical Microscope) and results of measurement showed that range of size of hot particulate adhered at the surface of research facilities was 0.1~10 ㎛. Therefore, 0.1~10 ㎛ of mock particulate was used for filtration experiment. Filtration system consists of pre-filtration and final-filtration. Filtration experiment was executed with stirred cell model 8050 to investigate removal efficiency and flux by 0.2 ㎛ and 2.0 ㎛ filters.

2.2 Removal efficiency of mock particulate

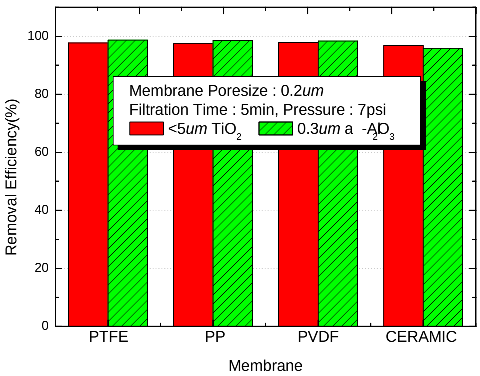

Figure 1. Removal efficiency of mock particle on selected filters

Removal efficiency of mock particulate was executed under pH 4 and 7 psi with 0.2 ㎛ of PTFE, PP, PVDF, and ceramic filters. Results of experiment showed that removal efficiency by PTFE, PP and PVDF filters were more than 97% and that by ceramic filter were more than 95%. Thus, it was founded that filtering performance of all filters has no problem under 7 psi.

2.3 Flux by ceramic filter

Permeate volume(mL) of PFC solution including mock particulate by 0.2 ㎛ ceramic filter along pressure and time was measured as Fig. 2. 0.3 ㎛ of Al_2O_3 was used as mock particulate within PFC solution. Permeate volume(mL) of more than 35 mL showed under more than 10 psi. But ceramic filter was highly stable at radioactivity in comparison of PVDF and PP of a macromolecule which generate H_2 gas in alpha radioactivity environment.

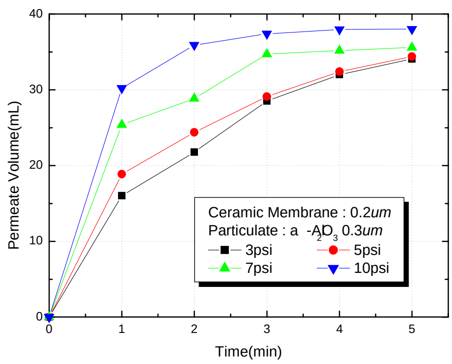

Figure 2. Permeate volume of PFC solution including mock particulate by final ceramic filter

2.4 Flux by Polypropylene filter

Permeate volume(mL) of PFC solution including mock particulate by 0.2 ㎛ ceramic filter along pressure and time was measured as Fig. 3. 0.3 ㎛ of Al_2O_3 was used as mock particulate within PFC solution. Permeate volume(mL) of more than 35 mL showed under more than 7 psi..

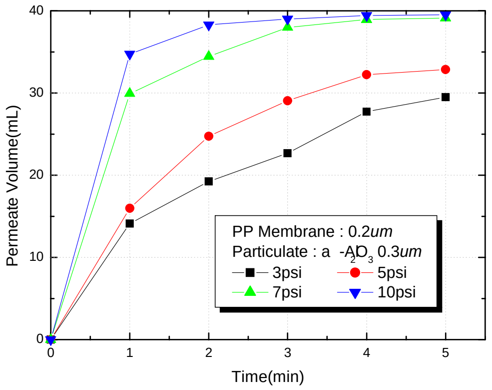

Figure 3. Permeate volume of PFC solution including mock particulate by final PP filter

2.5 Flux by Poly vinylidene fluoride filter

Permeate volume(mL) of PFC solution including mock particulate by 0.2 ㎛ ceramic filter along pressure and time was measured as Fig. 4. 0.3 ㎛ of Al_2O_3 was used as mock particulate within PFC solution. Permeate volume(mL) of more than 35 mL showed under more than 3 psi.

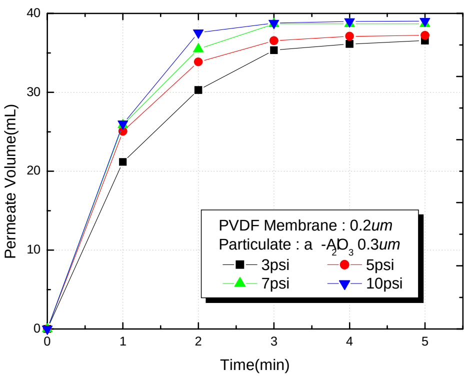

Figure 4. Permeate volume of PFC solution including mock particulate by final PVDF filter

3. Conclusion

The range of size of hot particulate adhered at the surface of research facilities measured by SEM was 0.1~10 ㎛. Hot particulate of more than 2 ㎛ in PFC contamination wastewater was removed by first filter and then hot particulate of more than 0.2 ㎛ was removed by second filter. Results of filter experiments showed that filtration efficiency of PVDF(Poly vinylidene fluoride), PP(Polypropylene), Ceramic filter was 95~97%. PVDF filter showed a little higher permeate volume than ceramic and PP filters But ceramic filter was highly in alpha radioactivity environment.

REFERENCES

[1] Archibald, K.E. : CO_2 Pellet Blasting Literature Search and Decontamination Scoping Tests Report, WINCO-1180 (1993)
[2] Tatenuma, K., Hishinuma, Y. and Tomatsuri, S. : Newly Developed Decontamination Technology Based on Gaseous Reactions Coverting to Carbonyl and Fluoric Compounds, Nucl. Tech., Vol.124, pp.147-164 (1998)
[3] Kaiser. R. and Harling. O. K. : Enhanced Removal of Radioactive Particles by Fluorocarbon Surfactant Solutions, NUREG/CR-6081 (1993)
[4] Kaiser. R. and Benson. C. E. : Decontamination by Cleaning with by Fluorocarbon Surfactant Solutions, ORNL/TM-12444 (1994)
[5] Desrosiers, A. E. and Kaiser, R. : Separation and Extraction of Plutonium in Mixed Waste, Bartlett Services, Inc., Plymouth, MA, USA, DE-AC26- 01NT41308 (2002)