The development, performance and evaluation of cyclone filter train for removal of hot particulate from contaminated hot cell

Gye-Nam Kim*, Mathuresh Narayan, Hui-Jun Won, Wang-Kyu Choi, Chong-Hun Jung, Won-zin Oh and Jin-Ho Park

Korea Atomic Energy Research Institute, 150 Duckjin-dong, Yuseong-gu, Daejeon

kimsum@kaeri.re.kr

The present study relates to design, fabrication and evaluation of a novel cyclone train for the removal of hot particulate from a hot cell. SEM (Scanning Electron Microscope) results revealed that the contaminated hot particulate of the size 0.2-20 μm had adhered to the inner surface of the hot cell at KAERI (Korea Atomic Energy Research Institute). Due to the higher radioactivity level in the hot cell, the as-developed cyclone train has a manipulator for safe operation. Collection efficiency of the cyclone was measured for different values of inlet flow rate and the vortex finder length. It was observed that the vortex finder length considerably affects the collection efficiency of the cyclone. A higher collection efficiency was measured with a vortex finder length of 49 mm, S/D_c=0.64. An inlet flow rate of 15 m/s wasthe best condition for this cyclone efficiency. Collection efficiencies were 70% for 1 μm and 97% for 10 μm, alumina mock particles at vortex finder length of 49 mm and inlet flow rate of 15 m/s. Measurements of the pressure drop indicated that increasing the vortex finder length or shortening the cylinder height helped in enhancing the pressure drops of the cyclone. It is concluded that the flow in the cyclone is a turbulent flow on the basis of the Reynolds number (Re), and this turbulent flow caused a pressure drop in the cyclone. Values of stokes number ($Stk_{50}^{1/2}$) decreased with increasing values of Re and gradually approached a constant value at higher values of Re. As the temperature of the inlet air increased, the collection efficiency was slightly decreased. However, the collection efficiency increased with an increase in the inlet air humidity in the cyclone.