

DEVELOPMENT OF A MULTI-STAGE AXIAL CYCLONES FOR DUST SEPARATION

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ABSTRACT

In this study a six-stage cyclone has been developed to separate the Lunar and Martian dust simulants according to the particle size. The cutoff particle sizes of cyclone stages are 10 μm , 1 μm , 500 nm, 200 nm, 100 nm, and 20 nm. Different from other stages the impactor design was used for the first stage (with the 10 μm cutoff particle size) of the developed cyclone. The configuration of other five cyclone stages is in axial flow design. The axial flow cyclone design utilizes a spindle vane to create flow vortex in the cyclone body and hence separate particles based on the particle inertia effect. The axial flow configuration allows the cyclone to be easily connected with other devices. The first four stages of developed cyclone were designed to operate at 50 lpm at ambient pressure. The last two stages of the cyclone were operated at 11.0 lpm and 1.0 lpm at low pressure conditions for the separation of nano-particles. The reduced flowrate operation at the last two cyclone stages is mainly due to the vacuum pump capacity. A series of experiments had been done to evaluate the performance of cyclone stages (i.e., particle penetration vs. particle size as a function of aerosol flowrate). The dimensional analysis on the collected data shows that at the same Reynolds number all the penetration curves can be merged into one by using the square root of the Stokes number as the abscissa of the curves and the cut-off Stokes number (i.e., at 50% particle penetration) is a function of flow Reynolds number.

Keywords: Multi-stage axial cyclone; Dust separation; Particle inertial separation; Lunar/Mars dust simulants