Low Pressure Dust Impeller

Laboratory studies of fast moving, submillimeter dust particles at low atmospheric pressures such as those existing on Mars (5-9 mbars) require a mechanism for airlifting the particles into a rarified atmosphere while generating sufficient winds for moving the particles. Current studies rely on wind tunnels that move gases at the required speeds but are not suitable for small-scale experimentation with a small number of particles.

The Low Pressure Dust Impeller was designed at KSC's Electromagnetic Physics Laboratory to accelerate dust without direct contact. The instrument is designed to operate at pressures ranging from about 5 millibars to 1 bar. It uses either a vibrating membrane or a vibrating feeder to levitate dust particles, mechanically separating them and placing them under fluidized conditions. Once the particles are separated, conductive impeller blades move the atmospheric gas molecules to thrust the particles onto a target at velocities up to 22 m/s, simulating the Martian winds. The dust impeller is small and has been designed as a self-contained low-temperature vacuum system.

The impeller provides for a simple simulation of a dust storm at many different environmental conditions. More importantly, it allows for the simulation of a dust storm at the low atmospheric pressures existing in the Martian atmosphere.

The instrument has applications in the manufacture of spray-dried products, the production of pigments as well as in the application of pesticides. The application of aerosols administered in the treatment of respiratory diseases may be more readily studied with this impeller. An understanding of the properties of aerosols is of great practical importance. Since this instrument disperses dry powders without the physical contact of the particles, it avoids the build-up of electrostatic charge on the dust particles, a common problem to many commercially available dry-dispersion dust generators.

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Figure 1

Figure 1. Low Pressure Dust Impeller with vibrating membrane to propel dust at low pressures.

Figure 2

Figure 2. Low Pressure Dust Impeller with vibrating feeder to propel dust at low pressures.