



TECHNOLOGY SOLUTION

Environment



Multi-Stage Filtration System

Particle impactor and scroll filter operate in high-temperature, extreme environments

Innovators at NASA's Glenn Research Center have developed a unique multi-stage filtration system to collect a wide range of particle sizes with minimal filter changes. This breakthrough capability keeps high-efficiency media and devices from becoming overloaded with larger particles. Glenn's system uses an impactor filter to capture larger particle matter through inertial separation and impaction methods on collection surfaces. After becoming heavily loaded, this filter can be cleaned automatically through a unique feed system, thereby reducing maintenance costs. In this way, the device provides a pre-filter stage that protects the more critical stages of the filter system, thereby extending the life of high-efficiency particulate arresting (HEPA) filter systems that are designed to capture fine and ultrafine particles. In an effort to reduce maintenance even further, the fine-particle filter media is provided in a scroll mechanism that is advanced to successive clean sections as needed. Highly sensitive filtration systems can be challenging to maintain and protect, so Glenn's system, which provides time and power savings offers great potential for commercial development.

BENEFITS

- Cost-saving: Provides operational longevity over state-of-the-art filter systems
- Low-maintenance: Offers regeneration capability, which saves on valuable resources such as crew time, waste disposal, and power usage
- Robust: Works in closed-system, extreme temperature, and high-pressure environments



THE TECHNOLOGY

While HEPA filter elements can last for years without intervention, pre-filtering systems that remove larger particles before they reach the HEPA filter need to be treated (most often by cleaning or replacement) as often as once a week. These treatments can be resource-intensive and expensive, especially in extreme environments. Glenn's innovative system combines a pre-filtration impactor and a scroll filter that reduces the need to replace the more sensitive or expensive filters, extending the system's working life. The system uses an endless belt system to provide the impaction surface. A thin layer of low-toxicity grease is applied to the impaction surface to increase particle adhesion. A high flow turning angle near the impaction surface causes relatively large particles to impact and stick to the surface while smaller particles stay within the air flow. When the surface is covered with particles - or if a layer of particles has grown to a thickness that impairs adhesion - the surface is regenerated. The band is rotated so that the loaded surface passes by a scrapper, removing the layer of particles and a clean segment of the band revolves to become the new impaction surface.

A further innovation is the scroll filter which allows the filtration media to be rotated out of the airflow when fully loaded, providing multiple changes of the filter through a motorized scrolling or indexing mechanism. When nearly fully loaded with dust particles, the exposed media is mechanically rolled up on one side of the filter to both contain and compactly store the dust. The spools that hold the clean and spent filter media are mounted on roller bearings to facilitate the scrolling operation and reduce motor power requirements. Nearly any grade of filter media can be used to meet the desired filtration specification. Additional media rolls can be added after the original roll is spent to further increase filter life.



Glenn's innovative filtering system combines impactor plates and a scroll filter (shown) for maximum efficiency and sturdiness



Glenn's filter system provides reliable performance and optimal operation to sustain proper air quality in air revitalization systems

APPLICATIONS

The technology has several potential applications:

- HEPA filters
- Fluid and gas dynamic research for flow imaging
- Air and gas systems
- Microgravity environments
- Fluid mechanics
- Commercial aircraft
- Submarines
- Remote instruments

PUBLICATIONS

Patent No: 9,121,792; 10,078,036; 10,663,376

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Glenn Research Center

21000 Brookpark Road

Cleveland, OH 44135

202-358-7432

Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2015-04-1513-HQ

technology.nasa.gov

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LEW-18837-1, LEW-18837-2, LEW-18837-3, LEW-TOPS-93