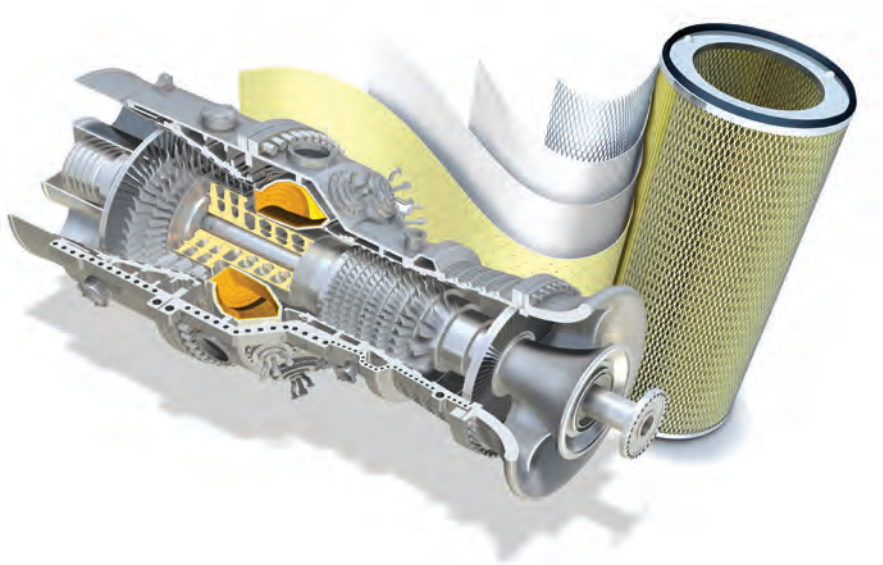

W.L. Gore's HEPA filtration technology, developed for gas turbine intake filters, offers H12 efficiency, low pressure drop, and protection from water and salt.

More Power, Less Wear

HEPA air filtration technology keeps compressor blades clean, allows gas turbines to maintain outputs

Combustion turbine operators generally experience turbine fouling from airborne particles passing through existing inlet air filters. Fouling can be caused by the particle capture limitations of conventional F-class (EN779:1998) or MERV-class (ASHRAE 52.2) filters. The consequence is reduced performance of the turbine operation.

Degradation can be measured rather quickly via power output reductions and heat rate increases caused by fouling of the compressor section. Additionally, costly corrosion caused by deliquescent salts passing through the filters is harder to measure and may take more time before its harmful effects are realized.

Typically, the operator either accepts these performance reductions or tries to minimize them via off-line and online washing programs. Online washing cannot completely clean the fouled blades or recover 100% of the power loss. Washing fluids are hazardous waste and must be disposed of at additional cost. During off-line washing, the turbine is stopped. The time to carry out the washing varies from several hours for small turbines to 24 hours for large turbines.

When off-line, the gas turbines are not generating profits and the operators may, in addition, have to buy power from the grid. Additionally, the starting and stopping cycles impose thermal fatigue on components and shorten the useful life of gas turbines and sub-systems. Online washing can entrain the contaminants into the airstream and carry them into other parts of the turbine, creating another potential cause for concern. An optimal resolution is to prevent the airborne particles from getting into the gas turbine in the first place.

W.L. Gore & Associates recently introduced a new technology for gas turbine inlet air filtration based on its Gore (formerly Gore-Tex) fluoropolymer membranes. This new technology was presented at the fall 2009 Combustion Turbine Operations Task Force (CTOTF) forum held in Scottsdale, Arizona, U.S.A.

Gore's HEPA filtration technology, developed for gas turbine intake filters, offers H12 efficiency, low pressure drop, and protection from water and salt. According to Dr. Marc Schroeter, Gore R&D engineer, this recently developed technology "changes the paradigm that turbine fouling must be accepted and managed via washings."

Dr. Wilson Poon, researcher at Gore, described the features of this new technology, "The Gore turbine filters do not require retrofitting of the inlet houses, and also eliminate the need for compressor washing. In all the field tests, compressor fouling and power losses were eliminated. The filters offer significant advantages to the operators by increasing profitability and reliability of the gas turbines. And, turbine operators can now benefit from high-efficiency particulate air (HEPA) filtration without the need to modify the filter house."

Poon further explained, "The Gore turbine filter is built on membrane developments similar to Gore-Tex waterproof fabrics. This filter virtually eliminates compressor fouling and the need for off-line washings. The filter also overcomes the low filter life, high pressure drop, and costly inlet filter house modifications associated with conventional HEPA filters," said Poon.

According to the company, the key to Gore's technology is a patented multilayer media that uses a proprietary bonding process to combine a microporous membrane with a pre-filtration layer. The hydrophobic expanded polytetrafluoroethylene (PTFE) membrane is air permeable but highly resistant to liquid water. The media is pleated to form a cartridge filter which can withstand extreme environmental conditions in the field and potential burst pressures from gas turbine upsets. An expanded view of the filter construction is shown in figure 1.

Dr. Schroeter said, "The collection efficiency of a Gore turbine filter is greater than 99.5% at 1000 m^3/hr at the most penetrating particle size (~0.1 µm diameter). This filter meets the H12 class definition according to EN 1822:1998."

"The H12 filter improves the capture of contaminants in the inlet air, especially submicron particles. Initial filtration efficiency of F-class filters for 0.1 to 0.3 µm particles are between 20 to 60%. It is estimated

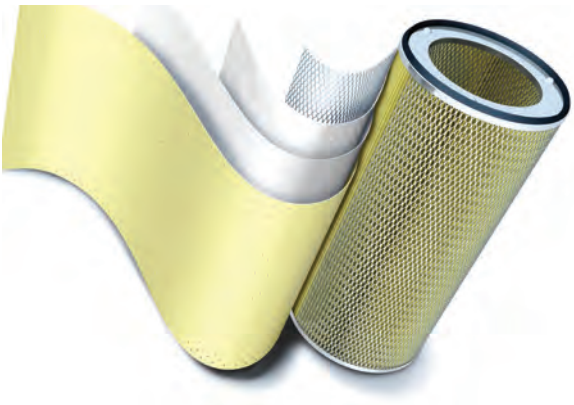

Figure 1. Expanded view of Gore H12 turbine filters with pleated composite media.

that for a 25 MW turbine with approximately 8200 hours runtime per year fitted with F9 filters, almost 13 kg of atmospheric contaminants pass through the filters. In contrast, the amount of uncaptured contaminants is only 0.04 kg per year for an H12 class filter," added Schroeter.

"Not only do the Gore turbine filters collect the airborne salt particles, they also resist water and soluble salt from migrating downstream. Filters can get wet due to high humidity, heavy fog or mist from nearby cooling towers. Typical F-class filters are made with cellulose or synthetic blend media that are nonhydrophobic. These filters allow water to easily pass through. The dissolved salt can migrate to the backside of the filter and recrystallize once the humidity is below the deliquescent point. Due to vibration and air turbulence, these particles can shed off from the filter and re-entrain into the airstream. Salt is a major concern for inducing hot corrosion in the hot section of gas turbines," said Schroeter.

"Polytetrafluoroethylene is very hydrophobic and repels liquid water. The microporous membrane in Gore turbine filters has the ability to block liquid water from entering, while allowing airflow to pass through. The membrane is fully sealed in between the pre-filter layer and the support substrate. Hence, Gore turbine filters offer gas turbines the protection from ingestion of water and salt contaminants," added Poon.

Installations of Gore turbine filters began in 2004 and, according to the company, optimize power output by eliminating fouling and online or offline washings.

Best known for products like Gore-Tex fabric and medical devices, Gore is a manufacturer of products for the electronics, industrial, fabric and medical markets. The company is headquartered in Newark, Delaware, U.S.A. and employs over 8000 associates at 45 facilities throughout the world, including Asia Pacific, Australia, Europe, North and South America.

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