Objectives - Gas Turbine Pulse Filter Design and Performance

Ultimate Design Objective – To provide a filter media and filter construction for a pulse style filter that provides for operational satisfaction in any environmentally challenging location where a GTI can be found, irrespective of temperature, humidity and/or dust loading.

Filter House Design - A self-cleaned pulse style air inlet system is recognized as the most flexible approach to varying operational challenges seen by GTI operators. Its design provides the capability to optimize media porosity through self-cleaning. As the restriction climbs due to dust loading, moisture or other contaminants, the pulse system can induce high pressure reverse pulses of air to relieve restriction on the filter surface.

Durable Media. Spun Bond polyester media is made with rigid continuous fibers that yield up to 3-4x the strength of traditional paper media. Engineered to withstand over 100,000 cleaning pulses ranging from 70 – 95 psi. The Polyester spun bond media is designed to perform resisting abrasion and wear throughout its lifetime caused by pulse cleaning.

Efficiency Layer –Thermally bonded bi-component nanofiber films bond the nanofiber to the filter media substrate and provides both the strength and flex performance needed to maximize the durability over the life of the filter.

Surface filtration technology. To maximize long term operating performance a filter must be designed with optimized surface filtration. The combination of a polyester substrate and nanofibers incorporates the high efficiency, two-dimensional surface that ensures the dust does not penetrate the nanofiber surface. This in turn provides maximum dust release during pulsing and lowest operating pressure drop over the life of the filter. It is critical the base media remains clean and free of dirt.

100% mechanical filtration technology. A pulse filter must maintain filtration performance mechanically. Which means the filter media and efficiency layers must perform before and after it is mechanically cleaned. Zero use of electro-statics and the stable two-dimensional nano layer ensures optimized filtration efficiency. In actuality the "as new" filter will be the lowest efficiency the filter will operate at during functional life.

Zero off gassing. From an environmental perspective, wet laid (paper) materials use binding agents such as acrylic which can be cross linked with formaldehyde to render them stiff and functional in use. Under certain types of environmental or storage conditions these cross-linking agents can "off gas" obnoxious and strong odors. A Spun bond polyester base media is a single component material and does not rely on any stiffening resins or chemicals to help provide rigidity or form pleat stability.

Lowest Initial DP at start up < 0.70" at 1500cfm. Most traditional cellulose or synthetic F7 – F9 materials start off at greater than 0.85" of pressure drop at start up based upon the specification of the media and construction of the filter. The spun bond with nano filter will start off 20% lower and offer immediate operational energy savings

Dust Holding Capacity (EN779-2012) > 6.0kgs. Most experts agree that comparisons of dust holding capacity is a significant baseline of data to consider when evaluating filter performance. A spun bond with nanofiber technology has been tested to hold more than 6.0kgs or 13lbs of dust up to 4.0" of operating pressure drop. This provides re-assurance the filter will operate in the most challenging of dust loading environments.

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ASHRAE 52.2-2012. A MERV rating must be taken in context for a pulsed filter where the efficiency must be aligned with the lowest pressure drop, for the rating to be meaningful. Higher MERV rated filters are available but the starting and operating pressure drop will also be considerably higher. Dependent upon application higher MERV rating filters should be available.

EN779-2012 compliant - > 70% at 0.4micron. The initial efficiency is defined after static charges are removed. This insures when the filter is installed it will be the lowest efficiency the filter will operate at during its working life. After only a few hours of use the filter begins to load with dust and will increase in efficiency. Testing shows that after just a few hours the filter is greater than E-10.

Hydrophobic performance and maximum wet strength. Using a spun bond substrate with the appropriate nanofiber polymer will provide a natural and inherent level of water resistance. When compared with the traditional hydrophilic wet laid media this feature will provide a level of moisture (humidity and/or water) to be repelled, versus dirty water being allowed to penetrate through the filter media to the turbine.

Pleat Support – For an air filter to perform at its maximum capacity, the pleated media must stay open and rigid through its entire pleat depth. Conventional pleated paper media will rely on corrugation/grooving imprinted into the media when made. Under certain environmental (wet) or very high dust loadings or high temperatures, these corrugations can collapse or flatten, leading to filter pressure drop rise. The filter must be designed with a permanent and fixed mechanical separation technique that won't collapse but stay functional allowing pressure drop to remain stable.

New Super hydrophobic performance. Generally speaking; water and dust don't mix. A revolutionary fluoropolymer treatment can now be applied via a plasma deposition process were every fiber and filament in the filter media is totally encapsulated. Further this treatment is permanent. It cannot be removed by pulsing or other means. The super hydrophobic media should withstand and operate in most challenging of moisture based, environments. Super Hydrophobic treated media causes the fog droplets to coalesce on the surface of the media and be repelled as water. This new advancement in media technology will now allow finer filtration to be used in the known areas of the world, prone to these difficult conditions.

- **Salt and saltwater.** Most traditional filters paper filters are hydrophilic. This property allows water or moisture to pass into and through the media. As salt crystals become soluble, the salt can pass through the media and precipitate out on the clean side. This then exposes those contaminants directly to the turbine itself causing a potential risk of corrosion. In any form, the salt present on the turbine blades can lead to a be catastrophic failure. With the new plasma treated media, the saltwater cannot penetrate the media and is mechanically filtered out at the surface, eliminating any salt bypass to the turbine.

- **Hydrocarbon fouling resistance.** The new revolutionary treatment also allows for the new filter to be resistant to oils or hydrocarbons. Known applications where hydrocarbon laden smoke or petroleum fumes have known issues for turbines can now be managed. The new treatment repels the hydrocarbons that can penetrate the filter media and block the pores of the filter causing high pressure drop.