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Advances in Fabric Selection for Dust Collection Equipment in WTE Plants

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Fabric selection is a critical component in the operation of a dust collection system venting a waste to energy boiler. This paper will discuss the factors to be evaluated when selecting the proper fabric to use in filtration systems venting waste and refuse derived fuel fired boilers. Consideration will be given to the type of scrubbing equipment, the type of cleaning system, the design parameters of the unit, and the gas stream chemistry. Operating experience from existing filtration systems will also be presented. Special emphasis will be made on equipment design, particulate capture and filter service life. A look at new developments in fabric filtration, including fabric blends, micro-denier filtration, and the use of pleated filter technology, will complete this overview.

Across the world, new waste to energy and power facilities are being built and/or retrofitted to more current air pollution control systems. At GE Energy, we see a lot of the newest technologies worldwide for the entire energy market.

Historically, when the primary dust collection vehicle on a boiler was a fabric filter, power generation facilities utilized woven fiberglass filter bags. The collectors were structural reverse air collectors with large filter bags (normally a 11.5" diameter by thirty feet in length) designed to operate at a 2:1 air-to-cloth ratio. These designs are dominant in the industry and offer an expected filter life of four to eight years. However, the trend in new installations of fabric filter collectors in the power generation industry is to install pulse jet collectors. This change is a direct result of cost considerations and the desire to use the baghouse to scrub gases with the addition of spray dryer atomizers (SDAs), selective catalytic reactors (SCRs), and selective noncatalytic reactors (SNCRs) before the dust collection system. Carbon, trona, and other injectables are utilized as well. While initial investment is lower for pulse jet collectors, long term operating costs may be higher due to costs of more frequent bag changes.

Pulse jet collectors offer several inherent advantages over the traditional reverse-air systems. First, the systems can operate at higher air-to-cloth ratios (3-4:1) that allow for a smaller housing footprint. In addition, pulse jet collectors employ filters with a felt construction which offer the potential for higher efficiencies than woven filter media used in reverse air collectors. Expected life of filters in these pulse jet collectors is typically three to six years.

Traditional pulse jet collectors in most industries utilize filters that work effectively at a maximum of 16 to 19 feet in length. The cleaning system pulses the filter bags with a shock of compressed air (between 60 and 100 PSI) for a fraction of a second that causes the dust to fall off of the filter and into a hopper. A 16- to 19-foot filter length is an effective design threshold because the airflow pulsed into this filter bag's five- or six inch diameter dissipates below the 16- to 19-foot filter length maximum and is no longer effective in snapping the bag against the cage in order to clean it.

Several new types of pulse jet systems are in the marketplace. These systems use compressed air at lower pressures (15-50 PSI) for longer periods to clean the filter bags. Many of these designs use filter bags well in excess of 16 feet in length (up to 27 feet). Since many of these installations are very new, the long-term effectiveness remains to be proven. However, these units have a much lower initial cost because the footprint needed to achieve the 3-4:1 air-to-cloth ratio is significantly smaller.

The driving force for the selection of fabric for the environmental market initially depended more on the availability of fabric, rather than the design of the fabric to fit the application. Filter media in the past consisted of very few options including cotton, wool, nylon, and fiberglass. Due to the temperature sensitivity of cotton and wool, their use in the design of ventilation for the boiler of any type was eliminated from consideration. Fiberglass was the original fabric of choice, with fiberglass being selected for the majority of the applications. The PPS product was introduced later and quickly became the workhorse

Specifically, well over half of the new pulse jet installations in the marketplace use a PPS (polyphenylene sulfide) media. PPS is most suited to applications where the continuous temperature is 375° F (191° C) or less, oxygen content is 15% or less, sulfur is present in the fuel, and/or oxides of sulfur are present in the flue gas, moisture is present in the flue gas, or dew-point excursions take place. PPS offers chemical resistance to acids that are typically a weak point for fiberglass.

Together, woven fiberglass and felted PPS constitute over 85% of the pulse jet installations in the boiler market. Other choices are acrylic and P84. Acrylic is an affordable alternative with chemical resistance similar to PPS. However, it is only good to 265° F (129° C). P84 gives continuous temperature resistance to 500° F (260° C) and its unique trilobal design produces a fabric with excellent filtration efficiencies. The main limitation of P84 in this marketplace is its relative expense compared to PPS or fiberglass.e of the waste to energy pulse jet market. P84 is also more susceptible to sulfur attack.

FUTURE GENERATION FABRICS AND DEVELOPMENTS

High Performance PPS and other new fiber developments

In cases where the baghouse restricts airflow , many facilitites have tried using the ePTFE membrane technology to lower differential pressures. The membrane has had mixed results for the Waste to Energy Industry, including success in Reverse Air collectors with acoustic horns augmenting the reverse air cleaning system.

In Europe and Asia, technology has been available for a number of years for microdenier or blended felted products to promote efficiency and chemical resistance. After extensive research and development, we feel that a next generation PPS is now available that offer lower differential pressures providing longer filter life and better production. This next generation PPS is a duo density PPS blend with a larger denier (diameter/weight) with a smaller denier cap to provide better surface capture of particulate.

The industry has developed ASTM standards for testing to determine number of pulse cylces and cleanability of fabrics. The testing device is known as VDI (Verin Deutches Ingineur) Testing . The ASTM designation for environmental testing with this equipment is the ASTM D6830-02 Protocol.

The testing consists of a fabric filter sample is challenged with a standard dust (particulate matter) under simulated baghouse conditions at specified rates for air and dust loading. The test consists of three test runs. Each run consists of three sequential phases or test periods during which dust and gas flow rates are constantly maintained to test specification. The test phases are:

-a conditioning period consisting of 10,000 rapid pulse filtration cycles (every 3 seconds) to simulate long term operation

-a 30 "normal" (i.e. pulse at dp = 1000 Pa) filtration cycle recovery period to allow the test specimen to recover from rapid pulsing

-a two hour performance test period, consisting of normal filtration cycles, during which measurements for particulate emissions are determined by gravimetric measurement of the particulate matter that passes through the specimen.

The VDI New Generation PPS test results against the most common sized denier (2.7) PPS used in waste to energy showed 25% less pressure drop with the testing above.

This would provide tremendous benefit to the filter life and plant operations.

Pleated Filter Elements (PFEs)

In cases where the size of the baghouse is restricts airflow, pleated filter elements have been used to increase the amount of cloth area available for filtration. Until recently, pleated filters were available only in fibers with the ability to withstand temperatures below 275° F (135° C). However, in the last several years, pleated filter elements have become available in aramid, PPS, and even fiberglass media. These developments expand the options for producers restricted in production by the size of the primary dust collection system.

Pleated filter elements provide a simple retrofit for upgrading existing dust collection systems and improving problem systems. These elements are one-piece units that are a direct replacement for traditional filter bags and cages in pulse jet units. The media resists surface penetration of particulate, dramatically increasing efficiencies while operating at significantly lower differential pressures than felted or woven medias. Though shorter in length, filter elements actually increase the available filtration area on a hole-for-hole basis.The media is pleated and molded into a filter element, increasing filtration surface area over filter bags by up to 300%, depending on existing filter bag sizes.

Several configurations using different combinations of basic filter components are available to accommodate a wide range of operating temperatures. As operating temperatures increase, the materials used for the inner core as well as the top and bottom components must change. In general, the temperature ranges for filter elements include the following general categories:

- Temperatures up to 180° F (83° C)
- Temperatures between 180° F and 225° F (107° C)
- Temperatures between 225° F and 265° F (130° C)
- High temperatures up to 375° F (191° C)

Each category requires the right combination of media, inner core, and top/bottom mold to ensure proper operation of the equipment.

Conclusion

The nature of fabric filter dust collectors is changing in the power generation industry. Pulse jet collectors are replacing reverse air units as the dust collection systems of choice in the industry due to cost considerations and the prevalence of systems with longer filter bags. The addition of scrubbing devices prior to the primary dust collection system changes the temperature level in the baghouse and the nature of the particulate collected. Fabric choice is an important decision that must be made on a case-by-case basis and cannot be generalized.