Finding the Right Filter

Andy Winston and Bryan Yetter, GE Energy Services, Filtration Technologies, USA, explain the benefits of employing the appropriate filter in a high-efficiency separator dust collector.

Introduction

High-efficiency separator dust collectors are critical to separator performance. The dust collector provides the air volume and dictates the air velocity through the separator. If the differential pressure across the dust collector is consistent then the air volume and velocity will also be consistent. If there are significant changes in the differential pressure, the air volume and velocity through the separator will also change, causing the separator to perform poorly. This results in less than desirable circulating loads and production rates.

To maintain consistent differential pressure across the dust collector, the filters used there must be capable of operating at the same differential pressure for years. If the filters are incapable of accomplishing this task, separator settings and feed rates would have to be altered based on the new operating point. These adjustments would be required each time the operating pressure of the baghouse increases.

For the best results, filters should not only operate at the same differential pressure over a 3 – 5 year period, but also maintain a low, consistent differential for the same period of time.

The ideal filters for a high-efficiency separator dust collector should:

- Maximise separator efficiency and production.
- Reduce dust collector fan energy cost.
- Reduce filter cost.
- Reduce labour cost.
- Reduce dust collector compressed air consumption and cost.

When properly applied and operated, pleated filter elements (PFEs) can help achieve all of those outcomes.

Advantages over conventional filters

In use for more than 20 years, PFEs are a direct replacement for traditional bag and cage filters in all types of nuisance dust-collector applications. Recently, PFEs have become an acceptable filter technology for upgrading process dust collection equipment in the cement industry. The potential benefits are numerous - from lower operating differential pressures, to an increase in airflow and throughput, as well as reduced emissions and operating costs.

The pleated configuration of the filters can increase the filtration area by up to 300% compared with conventional filters. In addition, the number of pleats, depth of the pleat valleys and filter length can be customised for nearly any application for trouble-free operation.

As with any filter, the ability to clean it properly is important. Proper air:media ratios (ratio between the actual ft.^{3}/min flowing through a filter and the amount of filter area available) must be monitored. If the ratio of incoming dust-laden air is too high for the available filtration area, the ability to properly clean the filter under normal pulse cleaning will be hampered. If the filters cannot be cleaned adequately, the operating differential pressure will increase, sacrificing production. Compressed air consumption will also increase, and the overall service life of the filter will be reduced. These factors contribute towards higher operational costs.

The benefits of upgrading existing dust collection equipment with PFEs are equivalent to that of increasing the size of the collector, but without any structural modifications. Increasing the filtration area with PFEs lowers the air:media ratio, resulting in a lower operating differential pressure and optimum separator performance. However, adding cloth area is just one part of the equation; the pleated filter makeup is also a key factor.

Figure 1. A pleated filter element.

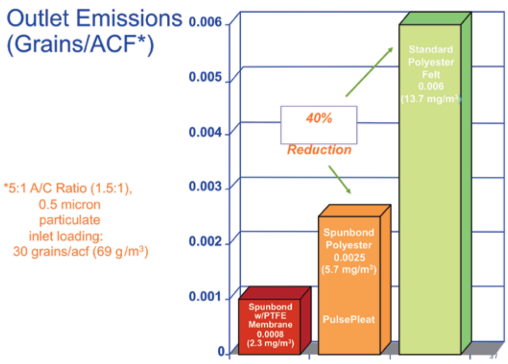

Figure 2. VESA test data.

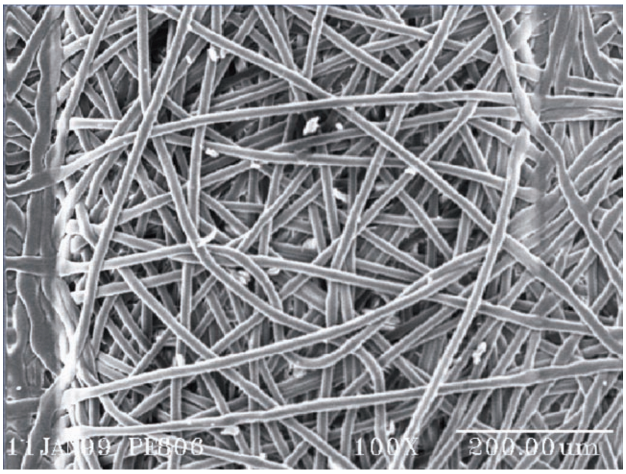

Figure 3. Spunbond polyester (face view magnified 100x).

Material matters

Pleated filter elements are made of spunbond polyester, the standard media used to manufacture PFEs. Unlike the traditional felt or woven media used in conventional filter bags, spunbond media have tight pore structures that resist penetration of particulates, resulting in lower emissions and naturally rigid physical properties that help to maintain the filters' pleated form during operation.

In a controlled variable environmental simulation analysis (VESA) test, the spunbond media were tested against conventional 16 oz (500 g) polyester felt media. Both media were subjected to particulate with a mean particle size of 0.5 μm and a dust loading of 30 grains (69 g/m^3) per ft.^{3}. Air:media ratio was 5:1 ft./min (1.5 m/min). Pulse cleaning was simulated at 80 psi (5.5 bar) on 15 minute intervals for 50 hours. The spunbond polyester medium reached a 99.99%+ filtering efficiency, allowing only 0.002 grains (4.5 mg/m^3) of emissions while maintaining a pressure drop of only 2.8 in. w.g. (70 mm). The conventional felt medium had more than twice the emissions and a higher-pressure drop of 4.9 in. w.g. (125 mm).

The cost and downtime associated with rebuilding or replacing existing dust collectors can be a burden, especially on reduced maintenance budgets and stressed capital expenditures. Upgrading to PFEs, however, offers the advantage of direct operational savings and a significant return on investment. Decreased operating differential pressures can lower the electrical costs required to run the dust collector. And, since it has been proven that PFEs can be pulsed with less pressure and frequency than conventional filters, customers can also achieve additional energy savings and a reduction in compressed air consumption.

Case study

Prior to contacting GE, a cement company employed a Fuller pulse jet dust collector connected to an OSEPA high efficiency separator. The configuration included 975 filters, each made of 16 oz (500 grams) polyester PTFE laminated felt with a dimension of 6.25 in. (158.75 mm) x 144 in. (3658 mm), totalling 19 134 ft.^{2} (1779 m^2) of filter area. The design airflow rate was 61 000 ft.^{3}/min (103 639 m^3/h); the air:media ratio was 3.1:1.

The company's main concern was the short life expectancy of its filters, which was just two years at the time due to a combination of issues. The velocity of the material was 'scrubbing' off the membrane on the filter bags, causing bleed through into the depth of the polyester felt bag. This eventually increased the operating differential pressure to over 8 in. (203 mm) and increased emissions. Due to the high operating differential pressure, the filter bags were being pulsed with 100 psi (6.9 bar) every 10 seconds and firing four valves simultaneously.

Solution and outcome

In 2005, the company contacted GE to find a reasonable solution. After evaluating several options, the customer chose to install PFEs to replace the existing conventional bags and cages, and 975 TA625 x 1.4 m (57 in.) long PFEs were installed. The PFEs were constructed with spunbond polyester media at only 57 in. (1400 mm) in length with a moulded urethane top and bottom end pan. No tube sheet or collector modifications were required to install the PFEs. One PFE replaced a bag and cage that was previously used. Even though the PFEs were more than 7 ft. (2133 mm) shorter, the total filtration area was increased by 75% to 33 590 ft.^{2} (3123 m^2), and the overall air:media ratio was reduced to 1.8:1.

After several months of operation with the newly installed PFEs, the customer realised numerous savings and benefits. The shorter elements created a dropout area in the dust collector, allowing for lower velocities and more even distribution of the grain loading to the PFEs. This success, combined with the lower air:media ratio, resolved the 'scrubbing' issue. Operating differential pressure was reduced by 55% to 3.5 in. (89 mm), allowing full flow of 61 000 ft.^{3}/min (103 639 m^3/h) and contributing to a 2 tph increase in production.

After the installation of the PFEs, the customer also realised significant energy savings. Pulse cycles were increased from a 10 second cycle to a 360 second cycle. Additionally, the number of simultaneous pulse valve firings was reduced from four to two, while the pulse pressure was reduced from 100 psi (6.9 bar) to 60 psi (4.1 bar). Based on a 24 hour per day operation, at 330 days per year, the customer has saved more than US$14 000 each year in compressed air.

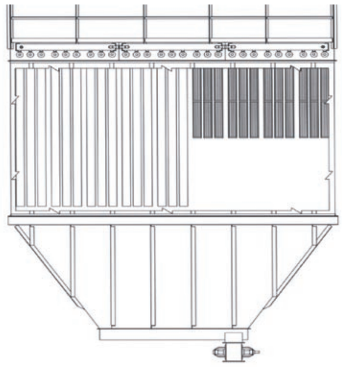

Figure 4. Shorter PFE elements for lower velocities and even distribution.

The dust collector still operates at a differential pressure of 3.25 in. (82.5 mm) w.g., pulsing one valve every 210 seconds at 60 psi (4.1 bar). The filter bag life has increased by 200%, equivalent to more than five years.

By installing the PFEs, the customer was able to avoid the costly options of either adding on to the existing collector or building a new one. It has now realised the full production capability of the separator with lower emissions, lower differential pressure, reduced energy cost and compressed air consumption, as well as longer filter life.