GETTING THE MOST FROM AN *ePTFE FILTER BAG INVESTMENT*

ANDY WINSTON, GE ENERGY, USA, DEMONSTRATES HOW TO OPTIMISE INVESTMENT IN EPTFE MEMBRANE FILTER BAGS.

Investing in advanced technology ePTFE membrane filter bags will greatly improve cement and lime kiln dust collector performance. This article will demonstrate how to get even more from the investment by extending the life of the ePTFE membrane filter bags.

ePTFE – is it right for me?

It is important to understand that simply replacing filter bags will not repair dust collector problems. However, if the dust collector and its key components are structurally and mechanically sound, installing new, high efficiency ePTFE filter bags can greatly enhance dust collector performance.

Most importantly, the dust collector must be structurally sound. All welds must be structurally solid, as any holes or cracks between the dirty air and clean air plenums will result in unwanted emissions regardless of filter bag efficiency. Holes and cracks in the welds are generally caused by corrosion, or by dust collector expansion and contraction that occurs during normal operation. Adhering to proper start-up and shutdown procedures can help minimise weld corrosion. In addition, proper use of

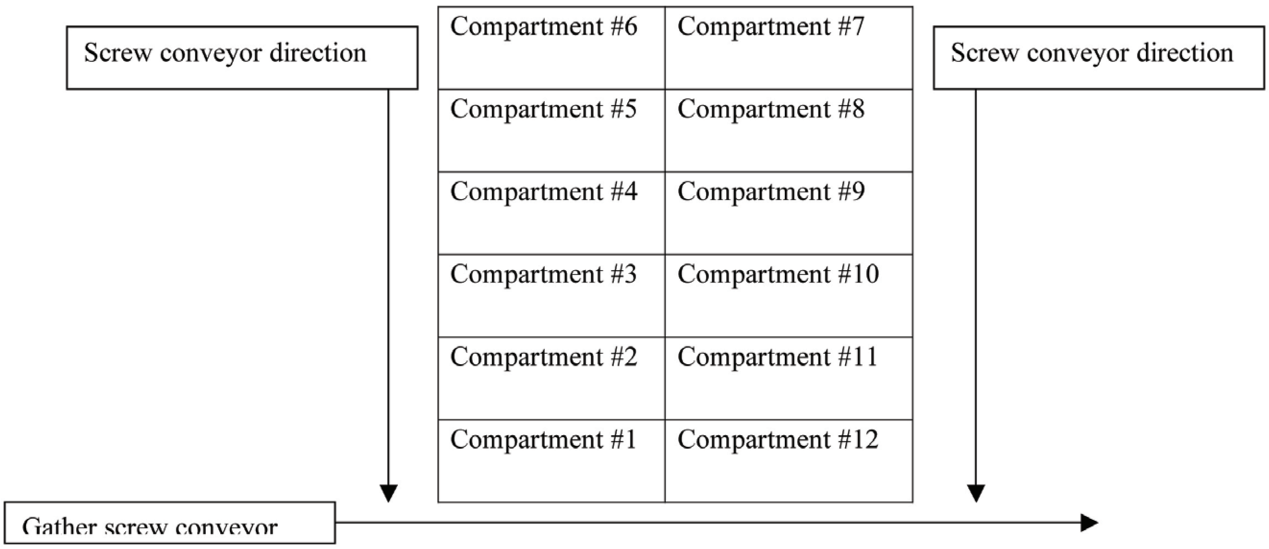

Figure 1. Reverse air cleaning sequence.

stiffening members in the structural design will minimise tubesheet over-flexing, and thus reduce the chances of cracks occurring in the welds. Without structurally sound welds, installing high efficiency ePTFE membrane filter bags in a dust collector will have little effect.

The dust collector must also be mechanically sound, and all mechanical parts must be in good working order at all times.

In a reverse air dust collector, all dampers must open, close, and seal properly as designed, otherwise the filter bags will not be properly cleaned. Incorrect damper operation in one compartment will affect the entire dust collector, as filter bags in the other compartments will have to compensate to maintain the required differential pressure. The filter bags that are compensating in this situation will tend to fail prematurely from flex fatigue. Also, if a compartment is not being efficiently cleaned, over time the amount of air handled by that compartment will be greatly reduced, forcing the remaining compartments to handle higher volumes of air, which is entering at higher velocities. This higher velocity airflow can result in abrasion damage to the filter bags. If all compartments are operating properly, airflow should be equally distributed and airflow velocities should remain below the damage water line.

The reverse air fan must also be in good operating condition and able to move the required amount of air. A damaged fan will produce reduced airflow, resulting in inadequate air volume to clean the filter bags, leading to more frequent compartment cleaning that in turn will result in premature failure due to flex fatigue. The required air volume that the fan must move (in cubic feet per minute) to clean the filter bags is 1.5 times the cubic feet of cloth area in a given compartment. The reverse air fan must be sized for 1 in. greater static pressure than the dust collector's main ID fan.

In a pulse jet dust collector, the main mechanical components of the cleaning system are the pulse (diaphragm) valves, and all pulse valves must be in proper working order at all times. A dust collector with only 80% of the pulse valves operational is not acceptable unless the dust collector was designed with 20% more filtering area than needed. And, as with the reverse air dust collector, filter bags that are not effectively cleaned will not allow sufficient air volume to pass through, rendering them essentially useless. The filter bags that are being cleaned will have to compensate by handling increased volumes of air and dust to maintain the required differential pressure, and again, because of the increased cleaning frequency, will be prone to premature failure due to flex fatigue. Pulse valve failure or malfunction can occur for many reasons, but is most often caused by the presence of water in the compressed air. Care should be taken to ensure that the compressed air is clean and moisture free, and the pulse valves should be checked daily for proper operation.

Although ePTFE membrane filter bags clean much more easily than non-membrane filter bags, poor cleaning operations due to mechanical malfunction will result in more frequent cleaning cycles and therefore reduced filter bag life. Maintenance should be performed immediately upon mechanical failure, and repeated mechanical failures warrant consideration of a redesign.

Sound cleaning control logic is important to good operation, and some basic principles of operation should be followed. It is very important to clean the filter bags only the minimum number of times necessary to maintain the required system differential pressure. Cleaning should be initiated and stopped by total system differential pressure, and the difference between the high and low set points should be no more than 1 in. (25 mm). When cleaning is initiated, clean only the number of compartments (in a reverse air collector) or the number of rows (in a pulse jet collector) necessary to drop system pressure by 1 in. (25 mm). Doing so will help ensure that the next time the high set point is reached, the cleaning sequence will begin where it previously stopped.

As a general rule for reverse air collectors, the cleaning logic starting point for each compartment would be:

- Isolate the compartment: 5 seconds.
- Open the reverse air damper: 20 – 30 seconds.

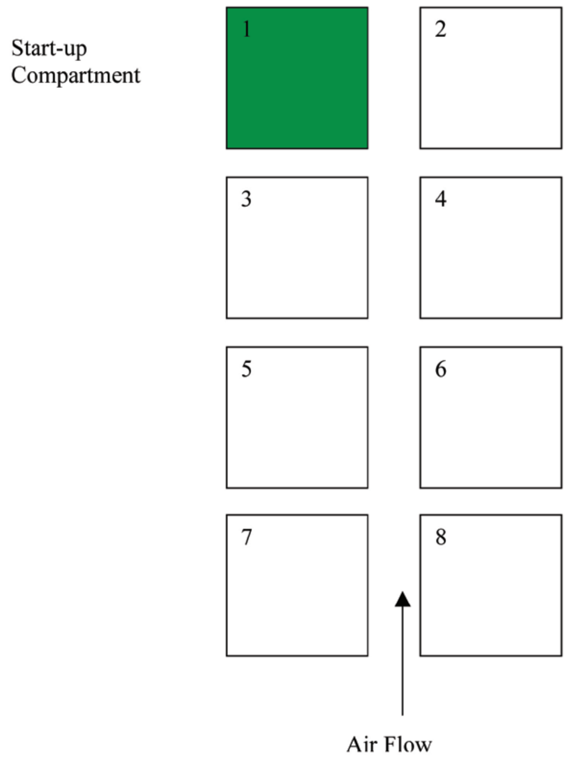

Figure 2. Start-up sequence.

- Close reverse air damper: 45 – 60 seconds.
- Open the isolation damper.

Each compartment should have a 10-0-10 magnehelic gauge, which enables fine-tuning of the cleaning sequence and allows operators to determine whether all components are working properly.

When closing the isolation damper, the reading on the gauge should be zero. If the gauge does not read zero, the compartment is not being isolated and the filter bags will not realise the full benefit of reverse air.

When opening the reverse air damper, the reading on the gauge should be 1 – 1.5 in. left of zero. If the gauge does not read at least 1 in. left of zero, adequate reverse air volume is not being achieved and the reverse air damper should be checked for proper operation.

When closing the reverse air damper, the reading on the gauge should again be zero. When putting the compartment back online, the compartment's differential pressure should not have changed more than 1.5 in. from where it was before cleaning was initiated. If the change in differential pressure is greater than 1.5 in., shorten the amount of time that the reverse air damper is open.

The order in which the compartments are cleaned depends upon the direction in which the take-away system (screw or drag conveyors) beneath each hopper is going. Compartments should always be cleaned in the same direction that the take-away system is going (Figure 1).

The correct cleaning sequence for Figure 1 is compartment 6, 7, 5, 8, 4, 9, 3, 10, 2, 11, 1, 12.

If the gather screw conveyor is in the middle of the dust collector between compartments #4 and #3 and #9 and #10, the correct cleaning sequence would be: 6, 12, 7, 1, 5, 11, 8, 2, 4, 10, 9, 3. Do not clean two back-to-back compartments on the same screw conveyor.

It is important to remember that this is an example starting point, and that each system should be individually adjusted to achieve the correct control settings.

Cleaning the filter bags in pulse jet dust collectors should be carried out online. For example, if the dust collector has eight compartments with 18 rows (valves) per compartment, the cleaning logic would be as follows:

When the high differential set point is reached and cleaning is initiated, clean one row in each compartment at the same time. In this example, eight rows would be cleaned simultaneously. The row sequencing through each compartment should be staggered so that no row is cleaned next to a row that has just been cleaned. In this example, the row sequence would be: row 1, 4, 7, 10, 13, 16, 2, 5, 8, 11, 14, 17, 3, 6, 9, 12, 15, 18.

Clean only the number of rows necessary to reduce system differential pressure 0.5 in. (12.7 mm). When the high set point is reached again, the row cleaning sequence should begin where it previously stopped. The header pressure should be 60 to 70 psi, with the goal being to clean each row 25 to 40 times within a 24-hour period.

Proper start-up procedures are important to maintain the dust collector's metal surfaces and the filter bags. When bringing the dust collector online, one should start by initially bringing only the back two compartments online. During start-up of a kiln, air volume and air velocity through the dust collector are reduced. Therefore, it takes much more time than normal for the collector to reach operating temperature with the entire dust collector online during start-up, as the compartments would be operating for a considerable amount of time in the dew point range. Bringing the dust collector online in a controlled manner allows the temperature in the compartments to pass through dew point and rise quickly. The author's recommendations are as follows.

Start with two compartments online and the cleaning system off. As the flange-to-flange differential pressure (total pressure) rises 6 in. (150 mm) and the temperature rises 300 ˚F (150 ˚C), add the next compartment(s) in the sequence. Alternate the sequence from side to side, injecting precoat into each compartment as it is brought online, and continue until all compartments are online. When all compartments are online and feed has been put into the kiln, start the cleaning system. Do not start the cleaning cycle until feed has been put into the kiln.

Early detection and correction of unwanted emissions are critical to successful operation. If an increase in particulate emissions is detected, the source must be quickly identified and corrected. This may require isolating a compartment until repairs can be made. Operating compartments that have leaks will compromise filter bag life, as a large amount of dust will accumulate on the tube sheets and on the clean side of the filter bags. Dust that accumulates on the clean side of the filter bag reduces the area for air to pass through, thus raising the differential pressure in the dust collector. This is more critical in pulse jet dust collectors, as the compressed air blast used to clean the bags will drive the dust at high velocities into the filter bag's surface. Over time, this mixture of dust and compressed air will abrade the filter bags, creating holes that allow emissions, more leakage, and cause clean-side

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contamination of the filter bags. In a reverse air dust collector, reduced airflow due to clean side contamination can cause filter openings to become plugged. This is also of great concern, as dust pulled into the fabric from the clean side will eventually abrade filter bag fibres, resulting in weak areas and holes.

For low-cost, high performance operation, dust collectors must be structurally sound, mechanically sound, and operated using proper controlled procedures. Key areas of focus are as follows.

Differential pressure

System and compartmental differential pressure are critical to proper operation and must be closely monitored. Any increase in pressure must be investigated and corrected immediately. All compartmental differential pressures should be within 1 in. (25 mm) of each other. A compartment operating at a differential pressure higher than other compartments indicates that the cleaning system in that compartment is not operating correctly. An increase in system or overall differential pressure indicates control problems, widespread cleaning problems, or that the dust collector has experienced an upset condition. Operating dust collectors at increased differential pressure will greatly reduce filter bag life.

Emissions

Any increase in emissions must be investigated and corrected immediately, as operating a leaking compartment can cause irreversible damage.

Number and frequency of cleaning cycles

An increase in the number or frequency of cleaning cycles can occur without the presence of emissions or high differential pressure, and will result in premature filter bag failure due to flex fatigue. Cleaning cycle operations outside of normal parameters should be investigated and repaired immediately.

ePTFE membrane filter bags will greatly enhance cement and lime kiln dust collector performance. These filter bags operate at lower differential pressures and higher airflows while producing lower emissions. Closely monitoring the areas addressed in this article will help to extend the life of high efficiency ePTFE filter bags, adding yet another to the long list of benefits that come as a result of installing ePTFE membrane filter bags in the plant.