

Low Emission Plans for Clinker Cooler Dust Collectors



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With new particulate limits issued by the Environmental Protection Agency (EPA), many cement plants in the United States face the difficult decision of whether to upgrade or replace their existing clinker cooler dust collectors.

Many existing clinker cooler dust collectors will not meet the EPA's new particulate limits, which were issued under the National Emissions Standards for Hazardous Air Pollutants (NESHAP). Undersized units are one of the biggest problems. Undersized units make it difficult to meet the new limits because of the high air-to-cloth ratio and because they yield high velocities throughout the dust collector system. High velocity leads to duct work abrasion and, in most cases, filter bag abrasion. This filter bag abrasion leads to more emissions and repeated clean-side dust contamination, making it difficult to operate under the new particulate emissions limit.

While it would be ideal for plants operating with undersized or old equipment to get new dust collectors with air-to-air heat exchangers in the front of the dust collector, this may not be realistic for a couple years due to capital expense. So, what is the alternative? For many, it will be to put the dust collectors in the best working condition possible.

The following information outlines a less costly plan than replacing the existing dust collector and some of the other steps necessary for a successful project.

Air-to-air heat exchanger

If the clinker cooler system does not currently have one, it is a must to add one. This will give double benefits: The heat exchanger will reduce the dust collector inlet temperature and reduce dust loading to the dust collector. The heat exchanger greatly reduces the chance of the filter bag experiencing fatal temperatures. The dust loading reduction is always a plus, especially when dealing with clinker dust. Reduced dust loading helps extend filter life.

Duct Work and Velocities

In many cases inlet duct work to the dust collector will need to be modified to help ensure correct velocity. Most projects can benefit greatly from a precise design approach using Computation Fluid Dynamics (CFD). CFD allows modeling and analysis of pressure and velocity patterns within a 3D domain, which due to the complex geometry of a dust collector would be difficult to achieve using traditional scale models. Enlarging duct work and installing

turning vanes or baffle systems can be done with extreme confidence using CFD.

Dust Collector controls

Cleaning of the filters must be done based on differential pressure. The control system should have monitoring capability. The areas that should be monitored are:

- Differential pressure
- Broken filters
- Compressed air pressure
- Cleaning system mechanical operation
- Hopper levels
- Temperature

Dust Collector

If the existing dust collector is anything other than a pulse jet, give serious consideration to converting it to a pulse jet. This applies to plenum pulse collectors as well. A well maintained pulse jet dust collector will be more reliable than a reverse air or plenum pulse dust collector.

Filters

There are two primary filter options: traditional aramid felt filter bags and cages, and high temperature pleated filter elements.

Aramid filter bags laminated with expanded polytetrafluoroethylene (ePTFE) membrane will perform well as long as the air-to-cloth ratio is below 4.5:1 and inlet velocities have been slowed below 2,500 fpm. If these conditions exist, the aramid felt laminated with ePTFE membrane should meet the new EPA standards.

High temperature pleated filters work well in situations where the air-to-cloth ratio and inlet velocities are high, causing filter bag abrasion. These filters, usually made of aramid felt, when laminated with ePTFE can improve existing dust collector operation in several ways as an alternative to collector replacement. First, pleated filters can help reduce housing velocity and prevent bottom bag abrasion in cases where (1) inlet velocities cannot be brought below 2,500 fpm because of equipment design or production requirements and (2) bottom bag abrasion or failure is a continuing problem (both environmentally and production-related). Pleated filters are shorter by design, replacing a typical 10 to 12-foot filter bag with a 2-meter filter element. Shorter filters, in combination with an open lower housing area, allow the incoming dirty gas flow to expand and slow prior to reaching the filters, thus reducing or eliminating bottom bag abrasion while also reducing grain loading

to the filters (see Figure 1).

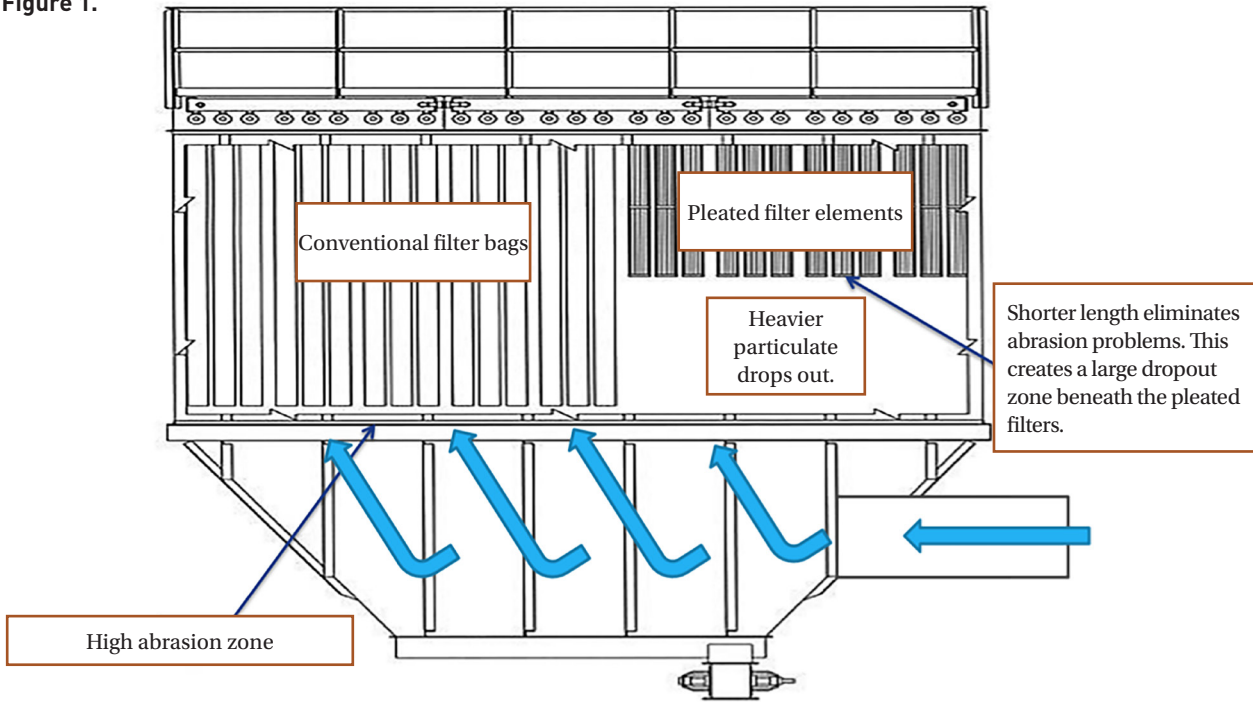
This reduction in housing velocity can also reduce turbulence in the dirty air plenum enough to prevent bag-to-bag or bag-to-housing related abrasion failures. Other issues such as improper bag-to-cage fit and failure are also resolved by the pleated filters' one-piece design.

In addition, pleated filters allow for the reduction of high air-to-cloth ratios in existing clinker cooler dust collectors without collector modification. Because of the pleated design of the filters, they can easily achieve about three to four times more cloth area than a traditional bag-and-cage. An increase in total filtration area allows for a reduction in operating differential pressure across the filters in the dust collector. Ideal air-to-cloth target ranges with pleated filters in clinker cooler dust collectors would be less than 3:1 for a pulse-jet system, and less than 2:1 in a plenum-pulse system. Most existing clinker cooler dust collectors can achieve these ranges with pleated filters installed. If desired, an increase in airflow capacity can also be achieved without collector modification by installing pleated filters, which increases total filtration area. Many plants don't currently require a volume increase, but as forecasted demand increases, the reserve in existing systems can and would be available.

High temperature pleated filters are an excellent and proven alternative to filter bags. Parker Hannifin (previously GE Environmental Services) recently submitted high-temperature pleated filters laminated with ePTFE membrane for third-party ASHRAE 52.2 testing. The results of this testing showed an efficiency rating of 99+ percent for particles 1 micron and above, and 100 percent efficient above 3 micron, which correlates directly to a MERV 16 efficiency value for this filter style and filter media.

Numerous cement plants have taken advantage of pleated technology in recent years with very good results, which have netted these producers many benefits. First, current users of pleated filters in clinker cooler dust collectors are typically averaging more than five years' filter life, whereas bags tend to last one to three years. Second, pleated filters can also lead to significant energy savings; plants have saved thousands of dollars per year in fan and compressed air energy costs, and some have received substantial credit from local utilities for their energy saving measures. Also, increased kiln production is being realized from operating

Figure 1.



at a lower and more consistent differential pressure across the filters. Lastly, the reduction of cleaning pressure and frequency typically required for pleated filters can make a deficient plant's compressed air supply and/or a marginal dust collector pulsing system effective again with the additional cloth area and ease of cleaning.

In addition to the proven benefits of energy savings, longer filter life, quicker installation and lower maintenance costs, the use of these next generation filtration products - filter bags laminated with ePTFE membrane or high-temperature pleated filter elements - can help producers meet pending NESHAP requirements and improve collector performance and reliability, all at a lower total operating cost.

Imperial		Units of Measure
SAMPLE ROI using Fine Filtration		
Compressed Air Savings		
1.50	Valve Size (inches)	
4.500	Compressed Air per pulse at 100 psi (CF)	
\$ 0.080	Unit Cost of Electrical Energy (\$ per kwh - \$0.07-\$0.10 typical range)	
24	HR per Day of Operation	
340	Days per Year of Operation	
0.25	HP per SCF Compressed Air	
0.746	kW per HP	
0.9	Motor Efficiency	
BEFORE		
100	Current pressure in air header (psi)	
4.500	Actual SCF per pulse Before	
3	Number of Valves Firing Simultaneously	
5	Pulse Frequency (seconds)	
\$ 21,914	Compressed Air Cost Before	
AFTER		
70.05	Current psi in air header	
3.150	Actual SCF per pulse Before	
3	Number of Valves Firing Simultaneously	
15	Pulse Frequency (seconds)	
\$ 5,113	Compressed Air Cost After	
\$ 16,801	Total Compressed Air Savings	
Energy Savings		
Fan Parameters		
100000	Air Volume (ACFM)	
16	Original System Resistance (in. w.c.)	
0.70	Fan Efficiency (0.70 default value)	
0.90	Motor Efficiency (0.90 default value)	
0.99	Drive Efficiency (0.99 default value)	
\$ 0.080	Unit Cost of Electrical Energy (\$ per kwh - \$0.07-\$0.10 typical range)	
24	Hours per Day	
340	Days Per Year	
\$ 196,653	Energy Cost Before	
13	Modified System Resistance (in. w.c.)	
\$ 169,699	Energy Cost After	
\$ 36,854	Total Energy Savings **	
** VFD or Re Sheaving of the fan required to realize full energy savings.		
\$ 53,655	Total Savings PER YEAR	
**The above results are an example of potential savings that can be realized. Individual results may vary depending on the application and operating procedures.		

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Parker Hannifin is committed to providing clean air solutions that protect your employees, improve plant performance and enable you to realize your operating goals.

State-of-the-Art Labs and Advanced Filtration Research for Optimized Performance. Purpose-built labs and test facilities with the latest equipment allow our engineers and technicians to quickly and accurately assess filter capabilities and develop innovative new medias.

High Performance Filters & Specialized Equipment Solutions. With decades of experience manufacturing high performance original equipment and aftermarket filters to meet a variety of system types and configurations, we can satisfy whatever requirement is needed including customized solutions.

Industrial Applications

- Abrasive Blasting
- Carbon Black
- Cement
- Chemicals
- CNC Machining
- Coal-Fired Boilers
- Cold Heading
- Die Casting
- Food Processing
- Lime
- Metals
- Metalworking
- Pharmaceutical
- Plasma & Laser Cutting
- Plastics Processing
- Powder Paint
- Thermal Metal Spraying
- Utility
- Waste-to-Energy
- Welding
- Woodworking
- Other Applications
- Custom or OEM Applications

World-class Manufacturing Processes with a Global Footprint. We produce top quality filtration solutions through stringent manufacturing processes.

Application Expertise for Any Filtration Challenge. Our ability to design a solution to fit your application begins with engineering expertise proven by hundreds of global installations.

