GETTING THE GREEN LIGHT

Nathan Schindler, Evonik Corporation, shows how plant operators can clean up cement plant filter performance through the use of an instant baghouse check-up system.

Industrial demand for cement in the United States has increased steadily over the past decade as construction and infrastructure needs continue to grow. As reported by *The Boston Globe*, the United States may have insufficient cement capacity to meet the projected needs associated with the government's proposed US$2.2 trillion infrastructure plan.[1] Further, the National Association of Home Builders has called for lower tariffs on key building materials and higher levels of cement imports to meet higher demand.

These factors put pressure on US cement plants to operate at capacity, minimise unplanned outages, and reduce operating and maintenance costs. These pressures are further enhanced by the Cement MACT regulations, which have mandated a ten-fold reduction in dust emissions. The US EPA has recently announced that it may further reduce particulate emission limits.[2] Key to reducing dust emissions in modern cement plants is the application of multiple filter units, typically pulse-jet baghouse filters (Figure 1).

In addition to their role in efficient dust collection, these filters can also contribute to a reduced total cost of ownership.

Central to the plant is the kiln/raw mill filter (#7), where dust from the main kiln exit and raw mill are processed. Clinker cannot be produced if the filter is not operating, and if the filter is operating poorly, it can significantly impact the efficiency of the plant. Other critical filters in cement plants include the clinker cooler (#18), cement mill (#26), coal mill (#16), and alkali bypass (#11).

Table 1. Filt-O-Meter assessment and input fields.

Application: Cement Grinding Baghouse			
Assessment	**Choices**	**Assessment**	**Choices**
Maximum operating temperature	<300°F	Current pressure drop	>10 in. WC
Current baghouse filter media	Polyester	During normal operation, how does the baghouse affect production goals?	Reduced cement output
Number of bags in baghouse	<500	Impact of baghouse shutdown on plant production goals	Plant cement production goals are impacted
Baghouse type	Pulse Jet	Pulse frequency per bag	Constant
Current air-to-cloth ratio	>4:1	Frequency of shutdown for corrective action	Quarterly
Typical bag life	<1 year		

Online decision support tool

Analytical tools can be used to assess a plant's filtration performance and help identify efficiency improvement opportunities. Filt-O-Meter is a complimentary online instant baghouse check-up tool. Developed by Evonik, this tool assesses baghouse filters to help cement plants avoid various cost impacts:[3]

1) Production reliability: As production demand increases, the process filter can become a bottleneck, limiting production capacity largely due to unplanned outages.

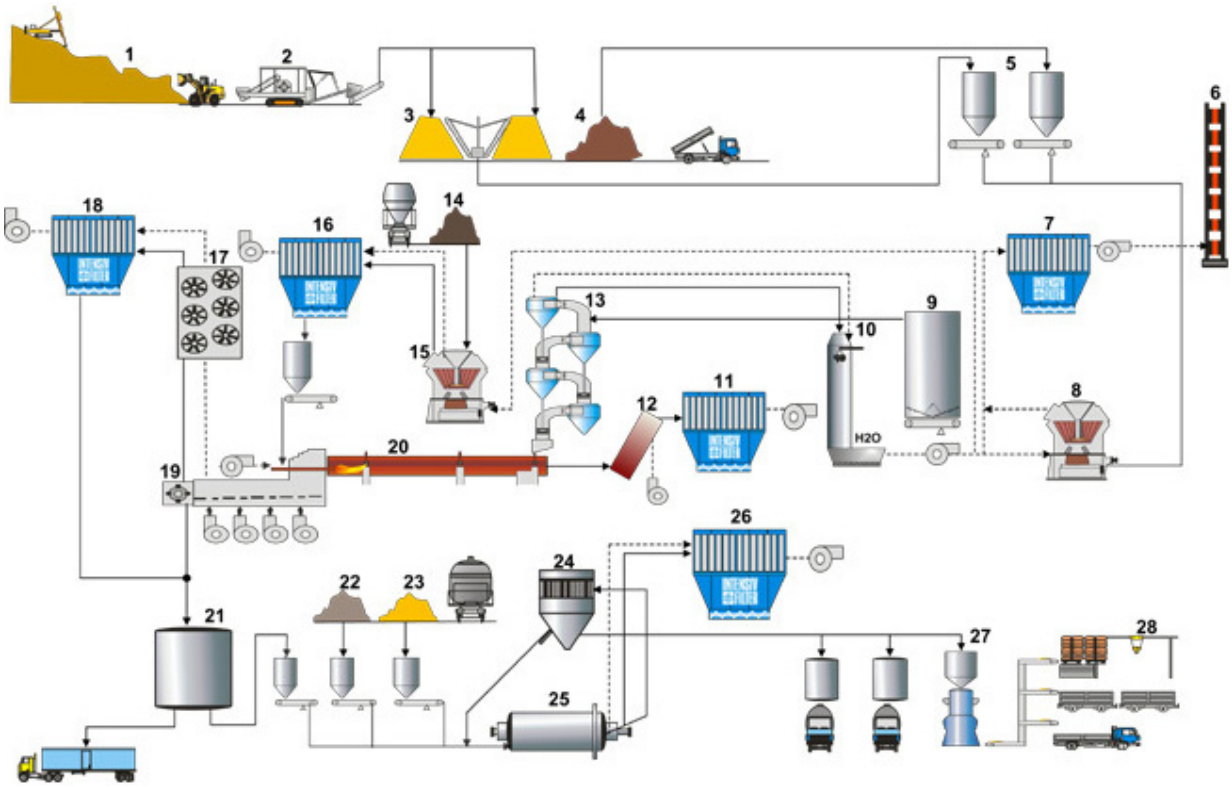


Figure 1. Common cement plant filters. ***Image courtesy of Intensiv-Filter Himenviro Technologies GmbH.***[4]

Shutdown of a 125 tph kiln over a four-day period, for example, would result in production losses of 12 000 t. At US$115/t of clinker, this represents a revenue loss of US$1.4 million.

2) Operating costs: Poor filter performance can result in increased electrical costs due to high pressure drop and frequent pulsing. This affects both fan hp and compressed air consumption. In many cases, the cost of increased pressure drop can be significantly more expensive than the cost of filter bags.

3) Maintenance costs: Shortened bag life results in increased bag replacement costs and higher labour costs for installation and corrective actions. Moreover, maintenance staff required for bag changes are taken away from other necessary projects around the plant.

4) Energy use: Filters not performing at highest efficiency can also result in excess energy use, which translates into higher plant operating costs. For example, for a 125 tph kiln, an increase in pressure drop of 4 in. W.C. over five years would increase energy use by about 5000 MWh.

Assessment tools such as Filt-O-Meter provide an overview assessment of reliability, operating costs, maintenance costs and energy use. Each of the five major filter applications noted above – kiln/raw mill, clinker cooler, cement mill, coal mill, and alkali bypass – can be assessed using this tool. The user provides input via responses to multiple-choice questions capturing readily available system information.

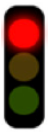
The input from the multiple-choice responses is used by the tool to identify areas that may or may not need attention:

- Areas warranting immediate attention are signalled in red.
- Areas needing consideration are signalled in yellow.
- Areas not in need of attention are signalled in green.

Clinker grinding case study

As a case assessment, Filt-O-Meter was applied to a cement finish mill filter on a ball mill clinker grinding line (Table 1). This particular filter, containing 480 polyester fibre filter bags and operating at 185°F, was evaluated after the plant decided to increase its production capacity, resulting in an increase in air-to-cloth ratio to 4.2 ft/sec. This capacity

Table 2. Filt-O-Meter output screens.

Status	Maintenance	Reliability	Operating	Energy use
	You should take immediate action to reduce your labour and filter bag costs.	You should take immediate action to meet your targets.	You should take immediate action to reduce fan and compressor electricity costs.	You should take immediate action to reduce your energy use.

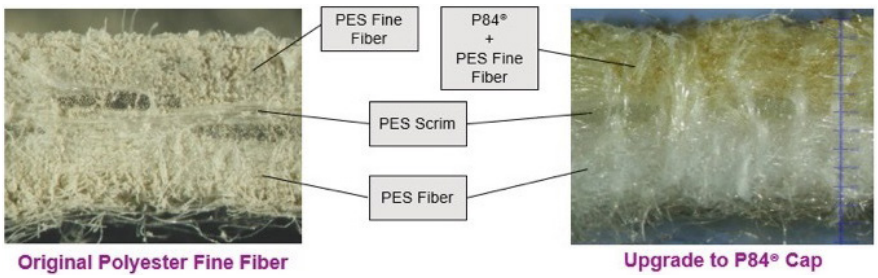


Figure 2. Original cement mill baghouse filter media (left image) and upgraded media with P84 Cap (right image).

Table 3. Cement mill filter performance for original and upgraded filter media.

	Performance of original PES filter media	PES filter media with P84 cap
Felt weight	18 oz.yd^2 (osy)	18 oz.yd^2
Clean air permeability	10 cfm	10 cfm
Operating time	7 months	48 months
Air permeability (as received)	1.5 cfm	2.1 cfm
Air permeability (cleaned)	2.1 cfm	3.8 cfm
Dust permeation	22 osy with corresponding increasing of pressure drop & pulse cycles	8 osy with low and consistent pressure drop and low pulsing frequency throughout life

increase came at the expense of higher pressure drop and increased dust emissions. Most notably, the filter bag life dropped from 18 to 7 months. Applying Filt-O-Meter to this case yielded red signals in all four output areas (Table 2).

The plant decided to upgrade the baghouse filter media to increase bag life and reduce operating costs. As shown in Figure 2 (left image), the original construction of the filter media was 100% polyester (PES). The filtration surface had already been upgraded by incorporating a fine fibre polyester. The felt media also incorporates a polyester scrim and standard polyester on the clean side.

Upgrading the filter bag construction to incorporate a P84® cap overlying the PES fine fibre, as shown in Figure 2 (right image), provides a highly retentive asymmetric construction with the same felt weight (18 osy) and air permeability (10 cfm).

At the end of bag life, however, distinct differences between the two felt media can be observed (Table 3). The original polyester bags are at the end of their life after only seven months, while the filter bags with the P84 cap upgrade are operating like new after 48 months, nearly seven times longer. With the original bags, dust has permeated throughout the felt, increasing pressure drop and pulse cycles.

On the other hand, the P84 capped bags still exhibit reasonable permeability, good recovery, and minimal dust incorporation.

Figure 3 shows the return on investment by incorporating the upgraded filter bags, with the total cost of ownership reduced by more than 50%, from US$270/bag to US$115/bag.

After upgrading the filter media with the P84 cap, re-running the Filt-O-Meter tool provides the results shown in Table 4.

Conclusion

In today's demanding market, cement manufacturers will benefit by continuing to identify and act on opportunities to increase production while reducing dust emissions and costs. Filt-O-Meter provides cement plant operators with a concise, easy-to-use tool to effectively identify and prioritise areas in the plant that can help reduce baghouse filter cost of ownership. ■

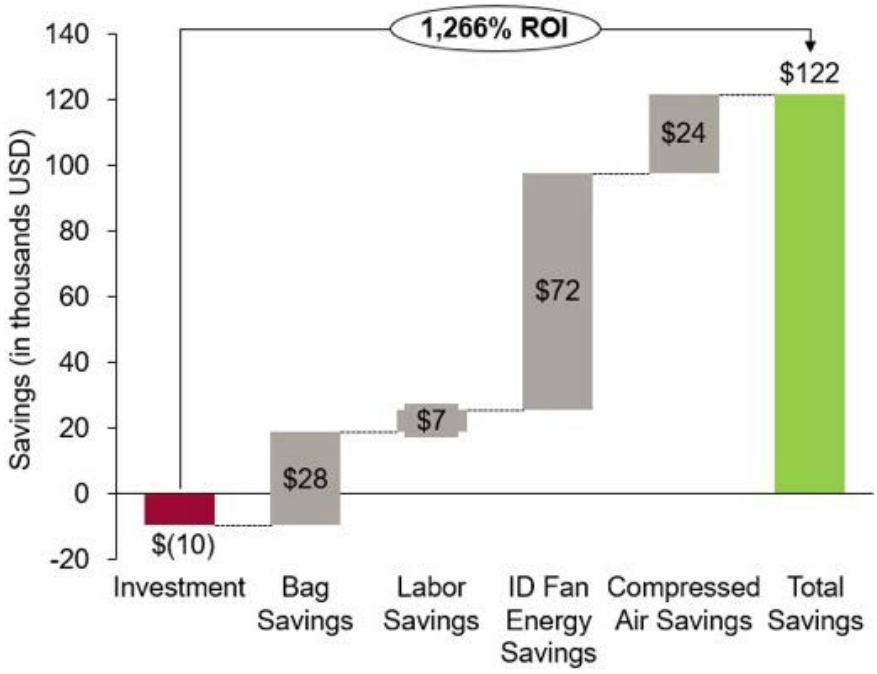


Figure 3. 4 Year ROI of P84®+Polyester filter bags.

Table 4. Filt-O-Meter output screen for upgraded cement mill filter.

Status	Maintenance	Reliability	Operating	Energy Use
	Good news! Your labour and filter bag costs meet industry expectations.	Good job. You are meeting your production targets.	Great job! Your fan and compressor electricity costs meet industry expectations.	Congratulations! Your energy use is low.

References

1. 'US May Lack Cement Capacity for Government's Proposed US$2.2 trillion Infrastructure Plan', *Global Cement*, June 2021.

2. 'EPA to Reexamine Health Standards for Harmful Soot that Previous Administration Left Unchanged,' June 10, 2021, https://www.epa.gov/newsreleases/epa-reexamine-health-standards-harmful-soot-previous-administration-left-unchanged, accessed 02/09/2021.

3. For additional details and considerations for baghouse cost of ownership, see 'Uncovering the True Cost,' *World Cement*, May 2020.

4. For more information and associated details, please visit: https://www.intensiv-filter.com/en/geschaeftsfelder/zement-kalk-gips/

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