REDUCING ELECTRIC POWER CONSUMPTION

CORINNE PRINCE-FIELDS, GE ENERGY'S FILTRATION TECHNOLOGIES, ROBERT KNISS, SOUTHERN CALIFORNIA EDISON, AND TIM RUEGG AND KEN CROSS, ONSITE ENERGY, USA, SHOW HOW ENVIRONMENTAL COMPLIANCE TECHNOLOGY AND ENERGY EFFICIENCY INCENTIVES WERE SUCCESSFULLY COMBINED AT A SOUTHERN CALIFORNIA CEMENT FACILITY.

To help spur several cement producers in Southern California to invest in technology that would reduce their electric power consumption by increasing operating efficiency, Southern California Edison has established an industrial energy efficiency incentive programme.

Potential technologies range from modernising controls to upgrading drives for large motors. The viability of a project is measured by the potential reduction in consumed kWh and peak kW demand, and the programme requires third-party validation of the specific assumptions used to project energy savings.

Incentives are paid on the energy savings above and beyond minimum federal and state-mandated energy efficiency performance. To calculate savings, the applicant uses Title 24 or current government minimum standards as the baseline, if applicable. If there are no current government standards for a particular measure, the current pre-project system specific energy consumption or current acceptable industry practices

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are used to establish baseline performance. The applicant calculates energy savings and peak demand reduction either by using the programme application software or by submitting engineering calculations.

Applicants can receive energy efficiency incentives of up to 50% of the total project costs for calculated measures, with a maximum incentive payment of US$2.4 million per site. Similar incentive programmes are available in a number of states. Detailed information is available from the Database for State Incentives for Renewables & Efficiency: www.dsireusa.org.

Southern California Edison actively solicited feedback from cement industry producers and suppliers regarding any technologies that may help reduce overall electric power consumption.

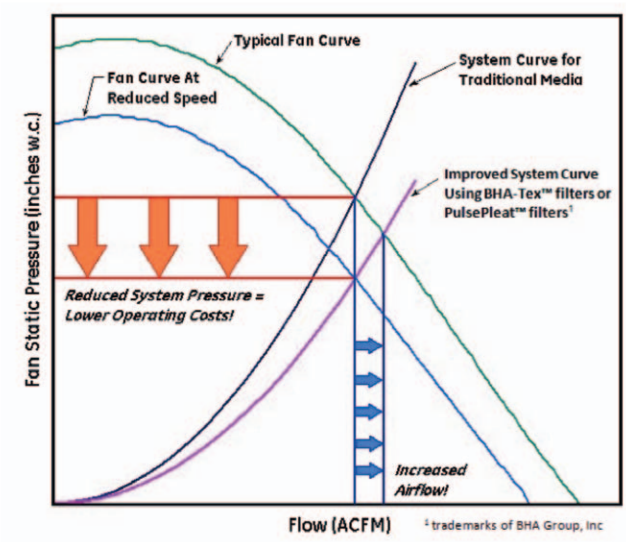

Figure 1. Fan performance curve showing reduction in D.P. related to fan energy consumption.

Figure 2. Main reverse air kiln baghouse.

Possible baghouse application

The opportunities for significant savings related to baghouse operation have previously focused on compressed air management for pulse jet baghouses. Looking at historic baghouse performance, those with the largest ID fans and motors appeared to be the best candidates for a significant energy reduction strategy.

Operating data shows that, compared to conventional filtration media, ePTFE membrane filter bags in large kiln dust collectors show a significant reduction in total system resistance (pressure drop) over the life of the filter bags. As differential pressure across the filter media is reduced in large baghouses, fan motors operated with a VFD (variable frequency drive) see a significant reduction in power usage.

How does it work?

The structure of conventional fabrics relies on a certain percentage of voids or interstices to allow for the passage of air. The capture of dust by these fabrics relies less on the filtration properties of the media and more on its ability to provide the infrastructure for a dust layer that performs the actual filtering. Building and maintaining this 'dust cake' is typically achieved by operating at a target differential pressure across the filter bags. Even in the most optimally controlled systems, over time, dust slowly accumulates in the depth of the standard fabrics. This blinding phenomenon causes a steady rise in system differential pressure until the pressure adversely affects the operation and the filters must be changed.

A thin layer of ePTFE membrane laminated to the collection surface of industrial filter media significantly improves filter life and performance. The ePTFE membrane provides a highly efficient collection surface that suspends dust particles, even very fine submicron dust, on its surface. This characteristic stops the eventual migration of dust into the depth of a filter media, preventing the gradual climb in resistance across the filters that results in increased differential pressure over time for non-membrane filters.

Example of possible impact

A 2 in. (wc) system pressure reduction in a system with the following operating parameters:

- Air volume: 500 000 ACFM.
- Motor: 900 hp.
- Average electric power cost: US$0.065/kWh.
- Estimated cost avoidance: US$80 000.

Calculation from Industrial Ventilation Guide: air volume (CFM) x system resistance (in. wc) x 0.746 (kW per hp) x unit cost of electric power (US$ per kWh) x (hours per day) x (days per year).

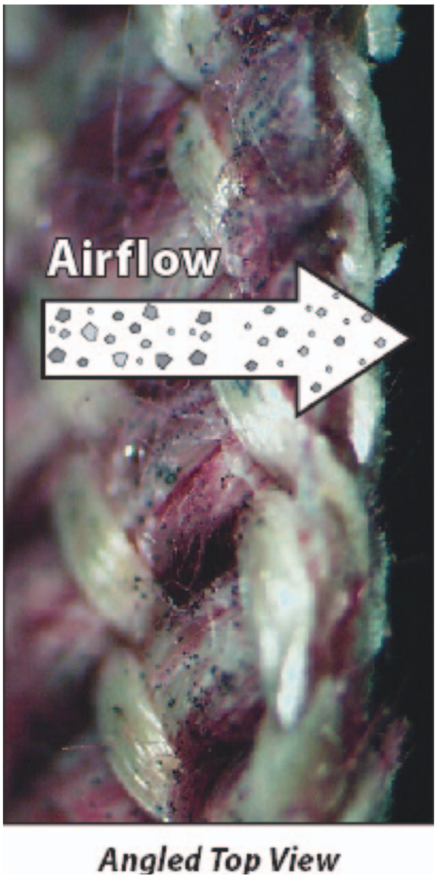

Figure 3. Conventional woven filtration fabric showing particulate migrating into and through the media.

Figure 4. Woven filtration fabric with ePTFE membrane showing that particulate is captured on the membrane surface.

Mechanical efficiencies include the following:

- Fan efficiency: 0.70 default value.
- Motor efficiency: 0.90 default value.
- Drive efficiency: 0.99 default value.

The success story

In the case of one cement producer in California, the unique baghouse design offered an opportunity to prove the impact of ePTFE membrane filters.

This particular baghouse design (Figure 1) consists of 36 compartments, each with its own exhaust fan. This configuration differs from the standard design, where a single baghouse ID fan provides the flow for multiple compartments.

In this particular system, if the filter technology reduced the average operating differential pressure across the filter bags, this would allow for a possible reduction in the number of compartments that had to be operating at any point in time. There were several possible benefits to this approach:

- For each compartment that was taken out of service, one 50 hp motor would be shut down.
- Increasing or decreasing the number of compartments in service as related to required airflow could match fluctuations in kiln production.
- For each compartment not in service, over time, additional operating/maintenance savings would be realised in reduced wear on both filter bags and equipment.
- Much lower particle emissions compared to conventional filtration media.

The cement plant and Southern California Edison worked with Onsite Energy Corp., a California-based energy services company, to support the savings analysis, baseline verification and application process. Approval for the project was based on the fact that the impact of shutting down any number of compartment fans would be immediately measurable. The application was approved based on a real time electric energy consumption reduction measured against an historical baseline.

Installation of the ePTFE filterbags was completed in March 2010 and real time data was gathered from April 2010 through December 2010. During that time frame, the operation was able to shut down between two and ten compartments, depending on production and airflow requirements.

Results

After a third-party verification, the final results showed a significant reduction in annual electrical energy consumption of over 1.25 million kWh. Post measurement data realised a reduction of 0.832 kWh/t of clinker produced with a total utility incentive payment of US$120 752.

Conclusion

Although the unique baghouse design in this case prevents exact project duplications, the filtration technology used can have a significant and measurable impact on overall electric power consumption, media life and operating/maintenance costs.