High-efficiency cartridge dust collectors slash emissions, save water and energy for major mine

Controlling the high levels of dust generated in crushing operations to meet stringent permitting requirements is a difficult challenge for mining engineers. At one U.S. copper mine, the use of a cartridge-style dry dust collection system from Farr Air Pollution Control (APC) has reduced emissions to a level of only 0.00037 grains/dry standard cubic foot (dscf) average. This is just a fraction of the required limit of 0.02 grains/dscf – while delivering added benefits of energy savings, water savings and ease of maintenance.

Emissions history

When the facility began operating, emissions were not yet subject to environmental monitoring and control. Using emission estimates extrapolated from recent data, mine officials estimate that the facility potentially emitted more than 13.6 kt/a (15,000 stpy) of particulate emissions less than 10 microns in size (PM10) in its early years.

To meet more stringent controls following passage of the Clean Air Act and New Source Performance Standards (NSPS), the facility was later retrofitted with wet scrubber dust collectors that allowed it to achieve compliance. The scrubbers reduced potential PM10 by more than 90 percent, to less than an estimated 453 t/a (500 stpy).

After the turn of the century, the facility experienced an extended shutdown due to market conditions. However, when the mining company made plans to restart the unit and expand the facility, tighter new emission regulations called for a 13.6-t (15-st) ceiling on annual PM10 emissions for the total project, and it was clear that the 20-year-old scrubbers would no longer be adequate.

In their search for a more efficient way to control dust, management learned of a dry collection system, the Gold Series dust collector, manufactured by Farr APC and incorporating high efficiency cartridge filters rated at 99.99 percent efficiency on 0.3 micron particles. "The planned retrofit using this system would deliver an estimated emission rate of 0.001 grains/dscf, facilitating air quality permitting under strict project guidelines and allowing the facility to restart with emissions well within the required limit of 0.02 grains/dscf average. Standard baghouse technology could not make that claim and would have exceeded the allowable limit," said Dave Stock, mining market manager at Farr APC.

In 2006, upon restart of the facility, potential PM10 emissions from sources controlled by the new cartridge collectors were estimated at 3.6 t/a (4 stpy) – a reduction by a factor of 10 compared to when the same sources were controlled by wet scrubbers. Stack performance tests conducted in 2007 yielded positive results: Actual PM10 emissions measured only 0.00037 grains/dscf average, yielding about 1.8 t/a (2 stpy) of particulate or half the expected level.

"Officials at the mine assured us that the emissions comparisons from its original startup to 2007 are valid because the facility has remained essentially unchanged since then," Stock said.

Farr Air Pollution Control system.

Equipment used

To control emissions from the primary crusher and fine ore crusher, Farr APC provided a custom system designed to withstand the rigors of the mining environment. According to Stock, "the Gold Series collector is well suited to the mining industry because of its extremely rugged heavy-gauge construction. It features a compact modular design that optimizes field flexibility. Service benefits include easy access and fast, trouble-free filter changeout."

High efficiency filtration is supplied by the moisture-resistant Farr HemiPleat filter, that offers greatly extended service life and lower pressure drop than standard pleated filters. Filter service life at the mine had exceeded three years on the majority of units or three times the projected service life.

The key to superior performance is an innovative media pack design that holds the pleats open, making virtually all the media surface available for filtration — unlike conventional filters, which are packed too tightly to maximize media use. The wide, uniform spacing results in lower pressure drop for more energy-efficient performance. The open-pleat design also causes dust to release more readily from the filter during pulse cleaning and

avoid problems of filter plugging due to moisture in the ore. The pleated filters are mounted vertically inside the collector, eliminating the dust blinding and premature failure that sometimes occur with horizontally installed filters.

As dust-laden air enters the unit, an inlet baffle directs the heaviest dust particles down into the hopper, which conveys the particulates away. The finer dust continues through the unit and is filtered through the HemiPleat filter cartridges.

To cope with the high levels of abrasive dust, the system is equipped with a customized, wear-resistant inlet baffle and uses a special anti-wear coating on the walls to minimize damage from dust abrasion.

Energy, water savings

"While the mine's first dust collection priority is to ensure compliance with permitting conditions, an important secondary goal is conservation of resources," said Stock. "Here, again, Gold Series technology has proved beneficial."

In the fine ore crushing application, the previous 22 wet scrubbers, which used a total of 1,297 kW (1,740 hp), have been replaced with 52 cartridge filter units that use 768 kW (1,030 hp), for a savings of 529 kW (710 hp). The resulting electrical energy savings are estimated at approximately $400,000 per year.

In addition, the wet scrubbers required pumping and re-pumping of water with the periodic addition of make-up water, previously costing about $700,000 annually. By retrofitting the facility with the Farr dry collection system, the mine has eliminated this substantial cost while also conserving a precious resource.

"The HemiPleat cartridge filters in this application carry a normal-use replacement cost of about $200,000 per year based on annual changeout. Subtracting this amount for filter replacement, we calculate that the mine is saving about $900,000 a year through reduced water and energy use," said Stock. "In reality, since most of the filters have gone for three years without needing replacement, the true operational savings may be upwards of a million dollars a year." ■