Midwest kiln baghouse rebuild

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In 2006, a cement company upgraded a plant in the Midwestern United States that had been in operation for nearly 30 years. Its kiln baghouse system was installed in 1978 by Fuller Company and originally as a 12-compartment reverse-air baghouse. A short time after start-up though, four additional compartments were added to increase the system gas volume to 144,000ACFM. Over time, it had experienced significant deterioration and the plant's modernisation would only increase its workload.

Figure 1: the tight access made the removal of individual compartments difficult

The deterioration stemmed from corrosion caused by ambient air leaks into the unit and general wear and tear. Deterioration had worsened enough for the system to become unreliable, causing production loss and higher operating costs due to the many housing leaks. The maintenance department did a sterling job of trying to keep up with the myriad of problems, but conditions continued to deteriorate.

According to estimates at the time, more than 35 per cent of the gas going through the system fan was a result of leaks in the housing. Low process gas flow resulted in plant production losses, and ambient gas leaks into the baghouse housing increased power costs resulting from higher gas volumes being required to satisfy process demands. The high in-leakage of ambient gas was a double-edged sword, as it drove the system to its gas flow limits while also driving up the pressure loss, resulting in the cleaning system struggling to keep up with the filter cleaning at high gas flow.

This leads to the question: "What do you do with a 30 year-old baghouse?"

Repairs without disrupting productivity

To gain a better understanding on how to improve the reliability of the collector, the cement company contracted GE Environmental Services in September 2007 to provide a detailed inspection and recommendations

The GE inspectors determined that the clean air plenum housing of 14 of the 16 compartments had deteriorated to the point that they required replacement. (Only 14 compartments needed to be replaced, since the company had previously contracted GE to re-clad the interior walls of two of the compartments with corrosion-resistant steel.) While the re-cladding work on two compartments helped the overall situation, it proved to be very time-consuming, and in the long run, re-cladding was not the best way to repair the compartments. Fortunately, the sheet metal on the hoppers had not experienced as much corrosion, since dust build-up on the hopper walls had provided a protective layer for the corrosive gases. This is not uncommon in baghouses.

The only options for the kiln system were to either completely replace the collector with a new unit, or replace the compartments from the hopper upwards. Installing a new unit was out of the question because of the downtime it would require and the substantially higher cost. It was determined that the collector would have to be repaired without disrupting the plant's production schedule. This meant replacing compartments one at a time while the collector remained in operation.

GE provided a proposal for new compartments and was awarded the contract to provide and install 14 new insulated reverse-air compartments. The project also included new inlet and outlet dampers and tie-in ductwork. Because of the previous deterioration of the collector housing, the company requested the housing be made of corrosion-resistant materials. The compartment sidewalls, top and tubesheets are made of Cor-Ten®, a trademark of United States Steel Corporation (USS). The access door and a portion of the sidewall around the access door is 304 stainless steel, since much of the corrosion of the original compartments started with in-leakage of ambient air into the compartments through the access doors.

The project was handled in two phases. Phase I was to provide and install new inlet and outlet dampers. The existing dampers had deteriorated and did not seal well enough to achieve the 100 per cent seal required to safely replace compartments on-line. The company had a short outage that allowed GE to remove the old inlet and outlet dampers and to install new guillotine-style dampers. The guillotine dampers create a 100 per cent seal and allowed a compartment to be completely isolated from the system. Once phase I was completed, the compartment replacement could begin.

Generally, shop assembly is preferred over field assembly, so GE decided to manufacture the compartments in all-welded assemblies in the shop. In the case of field-bolted-together assemblies it is not a matter of 'if' they will leak, but 'when', so all-welded shop assembly is the best way to design and fabricate baghouses, especially those on hot gas process systems. The old compartments were cut off at the top of the structural supports, leaving the structural 'C' channel and tubesheets in-place. Then the tubesheets were removed, and the new compartments were placed on the existing 'C' channel and seal welded from inside. The compartments were field insulated. Shipping considerations were the primary reason for field insulation, but in addition, this approach has often proven to be a better quality and more cost-effective way to insulate and ship large pieces of equipment.

Phase II was the installation of the compartments in a manner that allowed the plant to continue production. Safety was a key component of the planning. Making sure the work is performed in a 'safety first' manner requires careful consideration when dealing with the removal of old equipment and the installation of new replacement units – all while the kiln is still in operation.

One major concern when working on operating baghouses, particularly a kiln baghouse, is the temperature. A kiln baghouse like this one will see temperatures around 400˚F, creating safety concerns for staff. In addition to this, much of the work was carried out during the summer when ambient temperatures were also very high. To mitigate this problem, the onsite technical advisor made sure the installation team rotated tasks, staying properly hydrated and taking frequent breaks. Toolbox safety meetings were held daily before each shift to discuss the previous day's activities, the schedule for the day and what to watch for from a safety standpoint. With this process and a 'safety first' attitude, the job was completed with zero injuries.

Figure 2: difficult crane access required 'flying' half of the compartments over the on-line system. Careful planning and close co-ordination were required to assure the compartment change-outs went smoothly

Logistics proved to be the most difficult aspect of the overall project. Online equipment modifications require significant planning and coordination of the manufacture and shipment of the equipment, or else there would be breaks in the workflow. The lay down area was small and allowed only one new compartment at a time to be received and worked on. There was very little room to unload the equipment and leave available room for the insulation crews to do their work. At the same time, room was required for the demolition of the existing compartments. The kiln unit was in a relatively long narrow area that allowed crane access from only one side of the 16-compartment system. To remove and install seven of the 14 compartments, the crew had to lift the replacement modules over the operating equipment.

Difficult crane access required 'flying' half of the compartments over the on-line system. Careful planning and close co-ordination were required to assure the compartment change-outs went smoothly.

The schedule called for shipping one compartment per week to coincide with the removal of the old compartment, insulation of the new compartment and installation of the unit in place, including the ductwork tie-ins. Attaching the new equipment to the old hoppers required careful alignment to ensure proper fit up to the reverse air and outlet ducts on the top of the units. Welding the Cor-Ten® steel to the carbon steel of the hoppers, however, went easier than anticipated, speeding up the overall installation process. In addition to replacing the compartments, the end user selected GE Preveil® membrane filters. These filters offer excellent particulate capture, but they also have excellent release of collected product, which reduces the cleaning cycles and extends filter life.

As the project progressed, the fabrication time in the shop ended up being the critical path for completing the installation of an individual compartment. Often on repetitive work projects, the installation team becomes more proficient and the time required to install a compartment reduces. Some of this improvement was expected and was built in to the schedule, but the installation team reduced the time allowed per compartment to such a degree, it exceeded the ability of the fabrication shop to make the compartments.

Quickly seeing benefits

The company started seeing the benefits of the new compartments fairly quickly. With each new compartment installation, the ambient air in-leakage was reduced. By the time the project had progressed to the eighth unit, the plant was able to get all of the flow that was required to meet the production goals for the kiln. By the time the last compartment was installed, the plant was realising reduced power consumption, lower pressure loss across the collector and cleaning of the filters was much less frequent.

What do you do with a 30-year-old baghouse? Well in the case of this cement plant, you rebuild the unit and give it a new lease of life.