Engineering solution

Company finds cartridge dust collectors to be the gold standard

An international seed company works with an engineering firm to install a new dust collection system in one of its facilities.

Headquartered in Johnston, Iowa, Pioneer Hi-Bred International Inc., a DuPont company, develops, produces, and markets a full line of top-quality seeds, forage, and grain additives, providing services to customers in nearly 70 countries. The company operates a production facility in Laurinburg, N.C., that conditions, treats, and packages soybean and wheat seeds grown by local farmers. In fall 2005, the company decided to upgrade the facility by installing new equipment, including a more efficient dust collection system. To do so, the company worked with an engineering firm that has upgraded many of its other facilities in the past.

Conditioning soybean and wheat seeds

Each year, area farmers plant and grow soybeans, summer wheat, or winter wheat in the fields surrounding Laurinburg. After harvest, the farmers transport the seeds to Pioneer's production facility, where the seeds are conditioned for later use. During the conditioning process, the seeds are moved through various conditioning machines that clean them. The seeds are then conveyed to the facility's treatment area where they're coated with herbicides and insecticides before being packaged and distributed to various outlets for sale. The production facility typically operates two shifts a day, except during peak times between midsummer and late spring, when it operates 24 hours a day, 7 days a week, to handle the increased seed volume.

Underperforming cyclone separators

In the past, the facility used a dust collection system that consisted of several cyclone separators located outside the facility to remove the dust generated during the conditioning process. Some of the cyclones were connected directly to the conditioning machines to remove foreign materials and dust from the machines. To prevent fugitive dust from escaping into the facility, other cyclones were connected to dust collection hoods lo-

Six dust collectors, which are installed side by side on a custom-built support structure, generate a total airflow of around 90,000 cfm to effectively remove dust from the production facility.

cated at the various material-transfer points between the machines. And one stand-alone sock filter was connected to the treatment area to remove the dust containing the herbicides and insecticides, keeping it separated from the other dust because of special disposal requirements.

During operation, the heavier dust particles pulled from the conditioning machines and material-transfer points settled to the cyclone separators' bottoms. This dust discharged from the cyclones into a wagon for disposal. However, the smaller dust particles that weren't separated from the airstream were exhausted into the atmosphere since the cyclones lacked filters.

So in fall 2005 when Pioneer decided to upgrade the facility, it wanted to remove the old inefficient cyclones and install a new high-efficiency dust collection system that would exceed EPA dust emission standards and improve the working and safety conditions inside the facility, particularly in the treatment area.

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The engineering firm designed and built platforms around the dust collectors and stairways, allowing operators easy access for maintenance checks and filter changes.

Improving the dust collection system

Shortly after receiving approval for the facility upgrade project, Pioneer contacted Prairie Engineering Inc., Johnston, Iowa, an engineering firm specializing in engineering and design projects for the seed and agricultural industries. After talking with Pioneer, Don Francois, the engineering firm's vice president of engineering, worked with his team to put together some preliminary designs for the bidding process.

"Since we've worked for Pioneer in the past, they contacted us again to bid on this major plant upgrade," says Francois. "For this project, they wanted a new dust collection system for their production facility as well as some new conditioning equipment installed and some existing equipment rearranged — basically a complete facility renovation."

In January 2006, Prairie Engineering was awarded the contract and Francois began working on the final engineering drawings for the plant upgrade, completing them in March 2006. During this time, Pioneer's engineers provided Francois with the airflow requirements for each dust collector. After receiving this information, Francois called sales engineer Jerry Ruggle of W.D. Patterson Co., Perry, Iowa, a manufacturer's rep for Farr Air Pollution Control (APC), to specify the necessary equipment for the project. Farr APC, Jonesboro, Ark., supplies dust and fume collection equipment to a range of manufacturing industries.

Francois has been specifying the supplier's dust collection equipment since 1998. "When we started specifying the supplier's equipment," he says, "we were looking for something economical and effective, and we found that their equipment was priced right and worked great. For this project, I told Jerry the required airflow rates and other details, and he ordered the necessary dust collection equipment from the supplier. After completing the engineering drawings and ordering all of the equipment, we began renovating the production facility. As the general contractor, we supervised all aspects of the project, from removing the old equipment to installing the new, and we had the entire facility up and running four months later, in July."

The new dust collection system

The new dust collection system consists of seven Gold Series (GS) reverse-pulse cartridge-filter dust collectors. Six of the dust collectors are installed side by side on a custom-built support structure to remove dust from the production facility, and the seventh dust collector is installed on a custom-built support structure near the treatment area to remove the dust containing the herbicides and insecticides.

All seven dust collectors use round Gold Cone HemiPleat cartridge filters with PTS-PolyTech Standard filter media. Each filter has an injection-molded inner cone in its center, which increases the media area and provides uniform dispersion of reverse-pulsed air during cleaning. The filter media is a proprietary blend of cellulose and polyester fibers with a moisture-resistant silicone treatment for optimum dust release. The filter media's open-pleat design increases the media's filtration efficiency, extends the media's service life, and produces a lower pressure drop compared to other standard filter medias.

Of the six dust collectors that service the facility, one is used for general housekeeping and is connected to 52 pick-up points inside the facility (excluding the treatment area) to remove fugitive dust generated at the material-transfer points. This unit, called a GS24 dust collector, contains 24 cartridge filters.

The other five dust collectors are each connected directly to one of the conditioning machines located inside the facility. Three of the dust collectors are GS12 dust collectors, each with 12 round cartridge filters. The other two dust collectors are GS16 dust collectors, each with 16 round cartridge filters.

Like the other six dust collectors, the stand-alone treatment-area dust collector uses cartridge filters that remove 99.99 percent of dust particles down to 0.5 microns.

All six dust collectors function at the same time, generating a total airflow of around 90,000 cfm. To prevent the dust collection system from creating a negative air pressure zone inside the facility, the engineering firm installed wall louvers that allow fresh air into the facility.

During operation, air and dust particles are pulled in horizontally through a dust collector's side toward the vertically installed cartridge filters, which hang down from the unit's top. As the dirty air passes through the cartridge filters, the large dust particles fall to the unit's bottom hopper and the small dust particles become entrained in the filter media so that clean air discharges out of the unit's top through an exhaust fan. The cartridge filters remove 99.99 percent of particles down to 0.5 microns, ensuring that Pioneer meets the EPA's dust emission standards. And by having the fan on the unit's clean-air side pulling air through the unit (called a *negative pressure system*), rather than on the dirty-air side pushing air

through the unit (called a *positive pressure system*), an efficient, low-horsepower fan can be used and maintenance requirements are reduced because only clean air passes through the fan.

To keep the filters clean, each dust collector has a reverse-pulse air system that directs short air blasts at a filter's backside, knocking off dust particles from its front side and sending them to the unit's bottom hopper. Each dust collector's cartridge filters are installed in multiple-filter rows. For example, the GS24 has six rows four filters deep, totaling 24 cartridge filters. The reverse-pulse air system sequentially pulses one row at a time, repeatedly cycling through the rows. The pulse system's cycling sequence, pulse rate, and pulse duration are programmed based on an application's requirements.

After the dust falls to a dust collector's bottom hopper, a rotary valve continuously meters it into a 60-foot-long, 9-inch-diameter, enclosed discharge auger that runs the length of the support structure. The engineering firm installed a rotary airlock in each dust collector's bottom hopper to ensure that air is only pulled from inside the facility and to prevent the dust from being pulled back into the dust collectors from the discharge auger. The discharge auger moves the dust from all six dust collectors to a 42-foot-tall bucket elevator, which discharges it into a 30-foot-long, 9-inch-diameter, enclosed auger that moves it into an elevated 10-foot-diameter storage bin. The augers and bucket elevator operate continuously when the dust collection system is on.

When the storage bin nears capacity, an operator drives a truck underneath the bin and opens the bin's discharge gate, allowing the dust to gravity-discharge into the truck. The operator then drives away and disposes of the dust at a landfill.

The stand-alone treatment-area dust collector is a GS12 dust collector with 12 cartridge filters. This dust collector, which functions just as the other six do, only operates when the seeds are being treated with herbicides or insecticides. Since the dust this unit collects is considered hazardous and must be kept separate from the other dust, this unit discharges into a large box via a rotary airlock for disposal according to special requirements.

Increasing filtration efficiency, decreasing dust emissions

Whenever Pioneer's engineers design new plants or renovate or expand existing plants, they focus on ways to reduce hazard potentials. "For this project, our engineers wanted a highly effective dust collection system that would pull all of the dust out of the facility and make it a safe, dust-free environment for the employees, especially the ones working in the facility's treatment area," says Allison Larson, Pioneer supply management communications manager. "And for safety and easy access to the dust collectors for maintenance checks and replacing filters, we had the engineering firm design and build platforms around the dust collectors and stairways to access the platforms."

"Our engineers say that for future plant upgrades we're going to continue using these types of dust collectors and cartridge filters because of their effectiveness," says Larson. "They're just so much cleaner and better for the environment than the previous cyclone separators were, and they've dramatically reduced the facility's dust emissions."

If the dust collection system is run properly, kept clean, and not exposed to a lot of moisture, its cartridge filters can last several years. "For this application," says Francois, "I suspect that Pioneer can get two or three seasons of use, or more, out of the filters before they have to think about replacing them." **PBE**

Note: To find other articles on this topic, look under "Dust collection and dust control" in *Powder and Bulk Engineering*'s Article Index at www.powderbulk.com or in the December 2006 issue.

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