Engineering solution

# Silo addition changes by-product from waste to profit

An engineering firm specifies a bolted steel tank to solve a power station's fly ash storage problem.

Every year, US power companies burn more than 1 billion tons of coal, resulting in more than 100 million tons of by-products, including some 70 million tons of fly ash, a glassy, powdery material. For decades, many power plants disposed of fly ash by sluicing it to closely regulated disposal ponds. But as land and water have become less plentiful and environmental regulations more stringent, it's become less practical for power plants to use this solution. Other power plants dispose of their fly ash by trucking it to landfills. Here, they have the advantage of being able to compact the material more thoroughly (thus disposing of more material per cubic foot) and of piling the fly ash upward, above the ground.

*The silo supplier designed this 65-foot-diameter, 10,000-ton-capacity tank to enable a power plant to store excess fly ash until it can be marketed.*

However, many power plants no longer want to dispose of their fly ash in either of these ways: Fly ash has become a valuable commodity. It's widely used as an ingredient in concrete, replacing a portion of the portland cement used as concrete's active ingredient.

During the past two decades or so, the number of power plants seeking to sell their fly ash rather than dispose of it has significantly increased. This is especially true of power plants that use western coal from the Powder River Basin in Wyoming. Nearly 50 percent of the coal used by power plants now comes from this area. The coal there is lower in sulfur than coals from other areas, and it produces relatively less fly ash. The fly ash itself is higher in calcium, which makes it more desirable in the concrete industry than other fly ash.

## Converting the fly ash handling system

The problem for most power plants has been converting their fly ash handling systems from sluicing to selling. That's where L.B. Industrial Systems LLC, a San Antonio-based turnkey engineering and contracting firm, comes in. The firm specializes in this type of conversion.

The firm is only a few years old; however, the core personnel have been in this business a long time. Bob Lister, the firm's president, got his start with a company that marketed fly ash from power stations. He later became that company's engineering department head. During the 25 or so years he worked there, the engineering department developed many of its own technologies. In July 2001, the engineering department demerged from the com-

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***The silo supplier designed this 500-ton-capacity silo to structurally support the vacuum collector and other equipment mounted on its top.***

pany and started its own firm, L.B. Industrial Systems. Today, the firm continues to do contract work for that company as well as many others.

## Undertaking a conversion project

About 3 years ago, a major southeastern US power company came to L.B. Industrial and contracted their services to convert a large power plant from ponding its fly ash to dry-storing and selling it. The project has been done in several stages. Most recently, the contractor helped the power plant take its final step — finding a way to make its year-round fly ash production a viable product.

The power plant had been successfully selling much of its fly ash during three seasons of the year, but during the winter, the construction industry didn't need as much of it, and the plant was having to dispose of most of its fly ash. This cost the plant both in terms of lost sales and the costs associated with disposal. The plant wanted to be able to store its excess winter fly ash production and sell it once construction season started again.

A big part of the problem was that the company produces some 600,000 tons of fly ash annually. This means that during the winter months, the company needed substantial storage space. It wanted a 10,000-ton storage facility; however, it didn't have much land space available. It challenged L.B. Industrial Systems to find a way to solve its problem.

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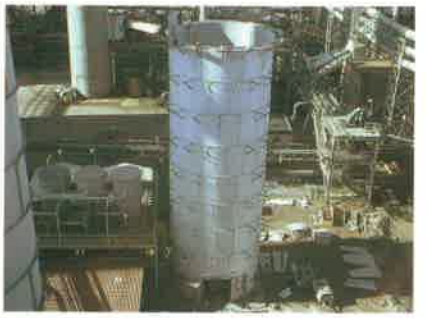
Lister says a company might take any of several approaches to such a problem, and his firm has used all of them with various customers. Some examples are converting an existing vessel — such as an oil tank — to fly ash storage; erecting a concrete building and using a front-end loader to load out the material to trucks; building a concrete dome with fully automatic load-in, load-out equipment; and erecting a concrete or metal silo with various load-in, load-out options. Each of these approaches is better suited to certain conditions.

When the firm takes on a job, it evaluates such things as the amount of space available, the kind of soil the structure will be sitting on, and the customer's specific goals. For example, some customers want to go the least expensive way possible for their plant conditions. Others want fully automated systems that only require an operator to push a button on a computer.

In the case of the southeastern power plant, it wanted affordable, reliable storage. The main constraint was the limited space available. After working with the plant to determine all parameters, the contractor proposed a plan that included a bolted steel silo from Columbian TecTank, a silo supplier based in Parsons, Kans. The contractor had worked with this supplier on numerous occasions before. Although the contractor's previous experience with the silo supplier had been with smaller tanks ranging from 500-ton to 2,000-ton capacities, the contractor was certain that the supplier could engineer a silo with the right ratio of height to diameter for the required 10,000-ton capacity and fit it into the space available.

After the customer accepted L.B. Industrial Systems's proposal, the contractor created detailed specifications, including those sent to the silo supplier. Lister says his firm essentially designs the "envelope" of the silo in terms of things that will go into and out of it (such as access doors and stairs, conveying equipment, level indicators, and so on) and tells the silo supplier where it wants holes and



***This bolted steel silo is being erected one ring at a time.***

flanges and access points for the various equipment. The silo supplier is represented in the contractor's area by The Tennant Co., Houston, which works closely with the contractor and silo supplier to integrate their efforts.

As on all typical projects, the silo supplier then must do the structural design and the detailed fabricating drawings showing the pieces that are going to be bolted together. Then, within about a week of getting the specs, the silo supplier quotes the contractor a price for engineering, fabricating, and erecting the silo. Once the contractor agrees to the price, it takes the silo supplier another 2 to 4 weeks to make the approval drawings, and 8 to 10 weeks for delivery.

The silo supplier supplies only the silo and its erection. L.B. Industrial Systems engineers and builds the silo's foundation. In this case, the contractor drove 60- to 100-foot-long piles into the ground and topped them with a concrete foundation. Once the silo supplier erected the silo on the foundation, the contractor mounted the other equipment it had designed or specified to make the silo function within the new fly ash handling system.

## The storage silo

The storage silo was designed by the supplier's staff of professional engineers (P.E.s), who have a combined total of more than 50 years of tank-design experience. The engineers use proprietary CAD software to design silos that exactly fit each customer's needs.

The 10,000-ton-capacity storage silo is a bolted steel tank 65 feet in diameter and a little more than 100 feet tall. It's made up of multiple factory-coated flanged panels with bolt holes around all four edges. Each plate has a slight curve, designed to precisely fit the specified silo's curvature. Automated production equipment ensures that bolt holes and flanges will line up perfectly and that the panels share a uniform curvature.

The baked-on interior and exterior coatings protect the panels from abrasion, corrosion, and environmental damage. Because the coatings are applied in the factory, the silo erection can take place in nearly any kind of weather, shortening the required erection time.

Once the silo parts were delivered to the site, the supplier erected the tank on the foundation the contractor had prepared. All that was needed was to add gaskets to the flanges, then bolt them together. The erection is done one ring at a time. "The supplier does scaffolding that's supported by the lower rings as they go up," says Lister.

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Allen Rogers, president of The Tennant Co., says that the supplier's silos can be delivered and erected relatively quickly on a predictable schedule." (Welded silos generally have to be coated in the field *after* they've been welded, and concrete structures usually can't be built during wet weather, making these structures' erection schedules somewhat less predictable.) Rogers says, "In the construction business, predictability is worth *a lot* of money. That's why many companies choose these silos. They're not cookie-cutter, but they're predictable."

## Operating the fly ash handling system

In operation, the power plant discharges its fly ash to three 1,000-ton-capacity loadout silos. When these fill, the fly ash is blown into the 10,000-ton-capacity storage silo. As a loadout silo's material level decreases, material is removed from the storage silo via a vacuum extraction system the contractor designed and sent to the available loadout silo.

"We did a comprehensive study on the best way to get ash out of big silos," says Lister. "We found the best way was a fluidized-zone floor system. We've divided the silo's concrete floor into several zones, each containing an aeration pod. When it's time to unload the silo, air enters a pod and fluidizes the material above it. A stationary nozzle similar to those used to unload big ships sucks the fluidized fly ash out of the fluidized zone. Piping attached to the nozzle drops the fly ash into a vacuum collector. Then another pod is fluidized and a nozzle sucks out the material from that zone. This process continues until the required amount has been removed. When the collector vessel is full, a valve opens to a pressure vessel below the vacuum collector and material flows by gravity into it. Then that valve closes and a compressor pressurizes the pressure vessel (also called a *transfer vessel*). The pressure blows the fly ash over to a loadout silo."

Lister says the unloading system is an economical design because it allows the silo to be placed on the ground instead of up in the air, making vessel support easier than if the silo were designed to stand on legs.

## Benefitting from the new system

The new fly ash storage system has been up and running since early 2005 and has had no problems. L.B. Industrial Systems is pleased with the silo it chose and its supplier. "What we like about this company's tanks," Lister says, "is the simplicity of their design and their ease of maintenance. We always want to make things as easy as possible for our customers and avoid interruption of their process. We've stayed with this silo supplier for many years because they make a good, well-engineered, economical tank, and they're willing to help us fix any problems that might arise."

Rogers agrees: "We've worked with the supplier for many years. They're a very creative company. They're willing to think outside the box and find out what the customer actually wants and then design the system that will accomplish that." **PBE**

**Note:** To find other articles on this topic, look under "Storage" in *Powder and Bulk Engineering*'s comprehensive article index at www.powderbulk.com and in the December 2004 issue.

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