Ash and Material Handling Solutions
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Introduction

L.B. Industrial Systems is a turnkey supplier of ash handling and other bulk material conveying, processing, and storage systems. With over twenty-five years of experience in projects for coal combustion by-products, cement, petroleum coke and other bulk powder materials, we deliver cost-effective services from feasibility studies through engineering, procurement, construction, start-up, performance certification, and operator training.

Optimized Systems Design

Every LB installation is designed and made to provide long, trouble-free operation for our customers under the most demanding operating conditions. We assess our customers’ unique needs and then apply the best available solution, utilizing both our proprietary equipment and specific 3rd party manufactured components which have proven reliable in our installations over the years. The results we deliver to our customers include better performance, less wear resulting in lower overall maintenance costs, and lower operating energy cost.

LB optimized systems begin with the fundamentals of material handling science. Material properties, plant layout and Owner operating requirements allow us to determine basic system equipment sizing and piping routes. Our proprietary conveying software, including empirical data from our installed base of systems, allows us to size key components so that material flows freely within a controlled range of velocities. By controlling the conveying velocity in this manner, LB systems reduce wear at elbows and tees, while assuring material remains properly aerated and fluid. Typical LB systems require less horsepower for conveying, while providing for an appropriate reserve margin of conveying air supply.

Our Equipment and Systems Experience includes:

- Dilute Phase Vacuum and Pressure Conveying Systems
- Dense Phase Pressure Conveying Systems
- Mechanical Conveying Systems
- Concrete and Steel Silos
- Mass Storage Facilities
- Bins and Bunkers
- Dust Control Systems
- Truck and Rail Unloading Systems
- Stand-alone and Networked Control Systems
- Blending Systems
- Weighing Systems
- Ash Conditioning Systems
- Classification Systems
- Aeration Systems
- Compressed Air and Air Drying Systems
- Grinding and Screening Systems
- Carbon and Ammonia Remediation Systems
- Drying Systems
- Sitework and Foundations
- Railways and Roadways
- Workshops, Control Rooms and other plant buildings
- Electrical Power Distribution and Control
LB utilizes both our in-house engineering expertise and a network of established specialty consultants and subcontractors to enhance our project execution capabilities. Each subcontractor and supplier is familiar with the implementation of LBIS concepts, methods and systems. We take great care to balance project commitments among our subcontractors. This provides LBIS the flexibility to quickly respond to market requirements.

Safety and risk management are essential elements of our business. Our primary focus is on our front-line supervision in the field. We take a hands-on approach to managing our projects and pay close attention to the details. We insist on the strict adherence to all safety, environmental, and health laws and regulations, and to good engineering practices. Construction projects are professionally managed. We implement a program which meets our client's plant policies concerning safety, permitting, clearances, security, substance abuse and other such provisions. Our personnel are highly experienced in working in and around operating plant environments and we work cooperatively with the client's operating and maintenance personnel.

Today, our customer base includes well-known companies, which are recognized leaders in the utility power, basic metals, and cement industries. Our capability extends throughout the U.S. Our previous experience also includes several projects in international locations.

Belews Creek - 100% dry fly ash with truck and rail loadout and 40,000 ton mass storage. 500,000 tons per year production.
Choose vacuum fly ash conveying to transfer moderate amounts of material to adjacent storage / loadout facilities.

View the system diagram above to see the components comprising the vacuum conveying system. A positive displacement vacuum blower pulls air through the intake on the conveying pipe. Automatic hopper valves open in sequence allowing fly ash to fall into the air stream moving to the vacuum collector on top of the silo.

A deflector plate and filters in the collector separate material from the airflow to the blower. Material accumulates in the collector hopper and falls into the airlock vessel. The valve on top of the airlock isolates the silo from the collector. When the airlock vessel fills the top valve closes and the bottom valve opens to empty the airlock vessel into the silo.

**VACUUM CONVEYING BENEFITS**

- Convey material from hopper to storage with vacuum all the way
- Reduce height requirement under hoppers with low profile piping
- Seal pipe joints with flanged, bolted connections — expansion joints accommodate hopper movement
- Run carbon steel pipe on straight routes
- Apply wear resistant hardened fittings with heat-treated spool pieces at high wear bend locations only
Pressure fly ash conveying is the system often specified for new installations to transfer moderate to large amounts of material to storage/loadout facilities at remote locations of the plant.

View the system diagram at right to see the components comprising the pressure conveying system. A rotary screw compressor produces transfer air to supply pressure feeder vessels and the conveying line. Automatic hopper valves open in sequence allowing fly ash to fall into a pressure feeder vessel under each hopper.

The pressure conveying pipeline extends to the vertical riser pipe on the silo which delivers fly ash to the roof mounted inlet box. Transfer air is run through a coalescing filter. Each row of pressure vessels can be transferred into the branch line simultaneously permitting efficient transfer with fewer valves.

DENSE PHASE HIGH CAPACITY CONVEYING
Top discharge feeders force material into the line ahead of the transport air making for a high solids-to-air ratio. Dense phase conveying means higher transfer rates and lower velocities. This helps reduce wear to fittings in the system.

PRESSURE CONVEYING BENEFITS
- Convey material from hopper to storage with pressure all the way
- Unload one row of feeders at once – unique system requires fewer valves
- Reduce height requirement under hoppers with low profile feeders
- Suspend feeders from hoppers – flexible discharge hose isolates movement
- Run carbon steel pipe on straight routes
- Apply wear resistant hardened fittings with heat-treated spool pieces at high wear bend locations only
- Hold conveying velocities to the optimum range for material suspension and low wear characteristics
Vacuum/pressure fly ash conveying is best suited for the transfer of moderate to large amounts of material to storage or loadout facilities located at remote locations of the plant.

View the system diagram at right to see the components comprising the vacuum / pressure conveying system. A positive displacement vacuum blower pulls air through the intake on the conveying pipe. Automatic hopper valves open in sequence allowing fly ash to fall into the air stream moving to the vacuum collector.

A deflector plate and filters in the collector separate material from the air flow to the blower. Material accumulates in the collector hopper and feeds into a pressure transfer vessel below. When the pressure vessel fills, the vessel fill valve closes, it pressurizes and the discharge valve opens. Ash is fed into the pressurized transfer line which conveys it to the silo or tank.

**VACUUM/ PRESSURE CONVEYING BENEFITS**

- Convert wet system to dry utilizing existing hopper piping
- Convey material long distances at high rates
- Reduce height requirement under hoppers with low profile piping
- Run carbon steel pipe on straight routes

- Apply wear resistant hardened fittings with heat-treated spool pieces at high wear bend locations only
- Hold conveying velocities to the optimum range for material suspension and low wear characteristics
Hybrid fly ash conveying is ideal for transfer of very large amounts of material to storage / loadout facilities located at remote locations of the plant.

View the system diagram at right to see the components comprising the hybrid conveying system. An aeration blower furnishes fluidizing air to the air gravity conveyors. Automatic hopper valves open in sequence allowing fly ash to fall into the air gravity conveyor moving to a large pressure feeder.

When the pressure feeder fills to the appropriate level, the fill valve closes. The feeder pressurizes, the discharge valve opens and the ash is fed into the pressurized conveying line. The ash is conveyed to the silo and conveying air is vented through the silo baghouse.

**GRAVITY FEEDS FLUIDIZED FLY ASH TO CONVEYING VESSEL**

With the hybrid fly ash conveying system a transfer vessel can serve a row or rows of hoppers. Material flows downhill from the hopper outlets into the transfer vessel. The vessel fills quickly and discharges into the conveying line at a high solids to air ratio. Dense phase conveying results in a high transfer rate to storage facilities long distances from the hoppers.

**HYBRID CONVEYING BENEFITS**

- Convey material from hopper to storage with fewer pressure vessels
- Unload multiple hoppers at once
- Feed air conveyors from hoppers - flexible inlets isolate movement
- Run carbon steel pipe on straight routes
- Apply wear resistant hardened fittings with heat-treated spool pieces at high wear bend locations only
- Hold conveying velocities to the optimum range for material suspension and low wear characteristics

Figure 1 - Hybrid system installation
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-

The plant wanted to be able to store its excess winter fly ash production and sell it once construction season started again.

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.

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 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.

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.”

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.

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.”

“... predicts that predictability is worth a lot of money. That’s why many companies choose these silos. They’re not cookie-cutter, but they’re predictable.”

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Two 818 MW units (units 3&4) were converted from wet sluicing to dry handling of class C fly ash. Four collectors and two 1000-ton silos Rail & Truck loadout. Fly ash conditioning and road base production.

LB Industrial Systems, LLC, has since provided detailed design for the conversion of units 1&2, supply of selected equipment for the project, and Engineering, Procurement and Construction of a 10,000 ton fly ash storage tank and pneumatic ash recovery system.
Georgia Power Company
Plant Scherer
10,000 Ton Tank Fly Ash Tank
Juliette, Georgia

LB Industrial Systems designed, supplied and installed this 10,000 ton capacity bolted and gasketed tank for the storage of class C fly ash. The tank receives ash from the power plant by pneumatic (pressure) transfer system. Transfer air is vented through a roof mounted bin vent filter. Ash is recovered by a floor mounted LB vacuum retrieval system which uses an array of aeration elements and vacuum nozzles to aerate and pull the ash to the associated vacuum filter/collector (foreground). The ash is transferred by pressure to another silo in the plant for truck and rail loading.
Flat floor of fly ash mass storage tank is aerated in zones. A vacuum pick up nozzle extracts fly ash from the center of each aerated zone.
A 1200 ton capacity fly ash silo and two vacuum/pressure dense phase transfer systems (4000 foot transfer distance) were installed in 1994 in response to a Sargent and Lundy Bid Specification.

The Precipitator has recently been replaced by a baghouse. LB was contracted to extend the vacuum side of the system to the new baghouse hoppers.
LB designed and installed a second fly ash storage silo for Coleto Creek in 2006. The silo was built for the ash marketer as supplemental storage.

The silo is a 1000 ton capacity bolted and gasketed tank with a 60° cone bottom. Fly ash from the plant conveying pipeline can be diverted to either silo. Fly ash can then be re-conveyed from the new silo to the old silo for loadout into trucks.
Duke Energy Company
Belews Creek
Walnut Cove, North Carolina

This plant was converted from wet sluicing to dry handling of fly ash. Three 1000 ton and two 130 ton silos were installed. The existing dilute phase pressure transfer systems were extended to the silos. Ash conditioning, rail car loading and blending capabilities were installed as well as computerized selective collection into the silos.

A 40,000 ton capacity fly ash storage dome was constructed which incorporates a 2300 ft. long two way dense phase transfer system between the dome and the loadout silos.
LB provided design, supply and installation for a wet-to-dry fly ash conversion of unit 5 (550 mw) and unit 4 (200 mw). The project included collectors, transfer vessels, 1,250 feet of low pressure ash transfer piping, a new 1,500 ton silo and all associated equipment. The system is designed to move 66 TPH of fly ash and it exceeded design criteria in performance tests. Commercial operation – November, 2003.
Georgia Power Company
Plant Bowen
Cartersville, Georgia

Dry fly ash vacuum collection / pressure transfer (dense phase) equipment was installed on all four units as a result of a competitive bid process. The networked processor control system provides maximum operating flexibility.

Fly ash for disposal is conveyed up to a mile to the Portable Ash Conditioning (PAC) Machine in the landfill at conveying rates up to 250 tons per hour in a dense phase mode. The PAC machine is a fully equipped skid mounted plant which includes a silo, baghouse, diesel generator, ash conditioner, radial stacker, aeration system, compressed air system, fuel tank, water tank, and networked control system.
LB industrial Systems provided engineering, procurement and construction for the wet-to-dry fly ash conversion of Plant Gadsden. The project included a 500-ton dry ash silo, vacuum collector and airlock, new vacuum pump, fly ash conditioner, truck scale, foundations, piping, electrical and instrumentation. The system is designed for 20 tph of dry ash collection from two precipitators, one on the powerhouse roof and one at ground level. The ash conditioner is designed to process 50 tph of ash.
Alcoa/TXU
Plant Sandow
Rockdale, Texas

Dry fly ash collection systems installed to collect 100% of fly ash from four units. Reliability has been sufficient to allow complete disconnection of wet sluice system.

Sales silo located in the plant. Waste fly ash is dense phase conveyed 2000 feet to the disposal silo located in the mine.

1600-ton capacity disposal silo is set up to load off road dump trucks with conditioned ash at 600 tons per hour without an operator.
Sandow is a mine-mouth Lignite plant. All of the fly ash hoppers on the four units are served by vacuum collection systems. However, the eight primary hoppers on the unit 4 precipitator collect half of the fly ash produced at the plant. Due to a problem with reduced unit 4 power output while burning coal with a higher than normal ash content; it was decided to install a supplemental fly ash conveying system to serve the unit 4 primary hoppers only. Fly ash flows as-produced from a manually valved outlet near the bottom of each hopper through an airslide into a transfer vessel. When the transfer vessel is full, the vessel fill valve automatically closes and the vessel discharges to the silo. Each airslide serves two hoppers and each transfer vessel serves two airslides. The system conveys fly ash at 300tph.
An Existing Oil tank was converted to an 18,000 ton capacity fly ash silo. It has been used for both class C and class F fly ash. When loading trucks, the fly ash is recovered continuously by the SILECTOR vacuum system. A full truckload of fly ash is pre-weighed; eliminating the need for a truck scale.

Georgia Power Company
Plant McDonough
Atlanta, Georgia
Florida Power Company
Crystal River
Crystal River, Florida

A 200 foot diameter oil tank was converted to an active bulk storage silo with a capacity to store and reclaim 40,000 tons of fly ash. This storage system was integrated into the plant’s fly ash handling systems.

Replaced the plant’s existing ash collectors, piping and dilute phase pressure system with new larger collectors and vacuum pumps. Project included dense phase pressure transfer system to silos. Pressure conveying capacity increased from 25 tons per hour to 160 tons per hour.
During a period of high local demand for cement, this facility needed to increase its terminal throughput by 50%. A study was undertaken to evaluate the addition of a third mass storage dome and loadout system, or alternate configurations to meet this need. Analysis of marine deliveries, weather trends, maintenance history, truck waiting time, and other factors revealed that the plant needed 24 hours worth of cement storage “in the air” on a continuous basis to avoid interruptions or delays in the loading process. The solution was the turnkey design and installation of two 1500-ton steel silos with truck loading directly beneath them.
We have installed several economizer ash systems based on screw conveyors which have performed very well over the last 20 years. Systems are in operation at the Deely, Gibbons Creek, Northeastern and, most recently, the Nixon Power stations. Slow moving screws, bucket elevators and other mechanical conveying equipment are well suited to this granular material.
The Little Barford (U.K.) fly ash processing facility was constructed in record time to British standards. Fly ash was delivered from three power stations in the Midlands by unit train. The conveying systems were capable of unloading 48 rail cars in 1½ hours.

Projects have also been carried out in Australia, Mexico, Israel, India and Indonesia.
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