

## Plant upgrade

# New process line packages success in small and big bags

A phosphorus chemicals producer designs a new process line to mill, size, and package a food-grade powder product.

When confronting current economic realities, many companies are looking to gain a more competitive edge by streamlining their production processes to improve production efficiency, increase quality control, and reduce operating costs. One company that recently accomplished this is ICL Performance Products LP, St. Louis, a producer of phosphorus chemicals and various multifunctional derivative products that are used as raw materials or additives in the food, pharmaceutical, construction, and other industries.

To improve its operational efficiency, the company decided to shut down a food-grade sodium acid pyrophosphate (SAPP) production line in its Carteret, N.J., plant and move the operation to its Lawrence, Kans., plant. Before the company could do this, it needed to build an addition to the Lawrence plant and design and install a new process line to mill, size, and package the SAPP.

### Designing a new process line

In spring 2008, Bret Graham, ICL Performance Products (ICL PP) engineering manager, began planning the building addition and specifying the

necessary equipment to process and package the SAPP, a fine-particle, low-bulk-density powder primarily used as a leavening agent in baked goods. "Based on my experience with similar process lines, I sized the building addition to house the process equipment and a three-floor tower with three large-capacity surge bins," says Graham. "Since the equipment layout required a relatively small footprint, we only needed about five thousand square feet of floor space, but the building had to be forty feet tall to accommodate the tower and surge bins.

"To maintain food-grade standards, I specified a dilute-phase pressure pneumatic conveying system to move the SAPP from production to the milling and sizing equipment. From there, the pneumatic conveying system moves the product up to the surge bins, which are installed on the tower's third floor so that the product can flow by gravity to the packaging equipment."

After specifying the milling and sizing equipment, Graham began looking for the packaging and palletizing equipment to put the SAPP in bulk bags and 50-pound bags for shipment to customers. "We already had an air



***The company's 5,000-square-foot building addition, built according to food-grade standards, houses the new SAPP milling, sizing, and packaging process line.***

packing system with an automatic bag placer and really liked it, so we decided to install another one in the new line,” says Graham. “However, to minimize the system’s footprint and simplify maintenance, we decided to use a robotic bag placer and a robotic palletizer rather than a traditional style of bag placer and palletizer. Prior to this project, we’d never used robotics in the plant, so I contacted three air packer suppliers with robotics experience so I could evaluate their equipment and services. I sent each supplier the material characteristics, required packaging rates, equipment layout conditions, and product samples for testing.”

Graham analyzed the suppliers’ equipment, services, and test results, then decided to purchase packaging and palletizing equipment from Taylor Products, Div. of Magnum Systems, a supplier of automated bagging, weighing, and packaging equipment. “We selected this supplier’s packaging system and bulk bag filler based on their extensive experience with robotics, the level of service they can provide, and the price,” says Graham. “The tests proved that their equipment could handle the specified bagging rate of nine thousand pounds per hour without damaging the product or emitting fugitive dust. And they could custom-design the system to fit

the required layout and maximize its flexibility. In addition, since the supplier’s facility is in Parsons, Kansas, which is a little more than an hour from Lawrence, if we ever have any technical issues, they can be at our plant the same day, if needed.”

### **The new SAPP process line**

ICL PP’s Lawrence plant operates 24/7, producing phosphoric acid and other sodium phosphate chemicals. After producing the SAPP, the company pneumatically conveys it to the new process line, where it discharges into a feed bin that services an air classifying mill. A rotary airlock feeder at the bin’s discharge meters the product into the mill at a controlled rate for final size reduction and particle sizing. A rare earth magnet installed at the mill’s inlet removes any metal contaminants from the product stream, ensuring product quality while protecting the mill from damage.

The product discharges from the mill to a baghouse that collects the product. From the collector, the product is pneumatically conveyed to the tower’s top, and a three-way diverter valve directs it into one of the three surge bins, depending on its final packaging destination. One bin services a bulk bag filler, and each of the other two bins services a valve-bag air packer.

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***The automated palletizer’s four-axis robotic arm accurately stacks 50-pound bags on a pallet in a preset stacking pattern, ensuring safe transport to customers.***



“Air nozzles installed in each surge bin operate on a timer, blasting air into a bin’s bottom at regular intervals to promote material flow when the product is discharging from the bin,” says Graham. “And since the process line is located inside the plant, the mill’s feed bin has one modular bin vent and each surge bin has three modular bin vents to control fugitive dust emissions.”

The process line’s packaging and palletizing system, supplied by Taylor Products, consists of one IBC3000 bulk bag filler, two Model A valve-bag air packers, one TRV1000 robotic arm valve-bag placer, one TECW electronic checkweigher, one TRP3000 robotic

arm palletizer, one finished-product pallet dispenser, and one slip-sheet dispenser. Each air packer has a TRU Seal ultrasonic sealer, a T3000 weigh controller programmed to fill up to three 50-pound bags per minute, and a metal detector installed in the product line leading to the packer’s fill spout. The air packers are installed side by side, allowing the six-axis robotic bag placer access to each packer’s fill spout. A common conveying line moves the filled bags from both air packers to the robotic palletizer.

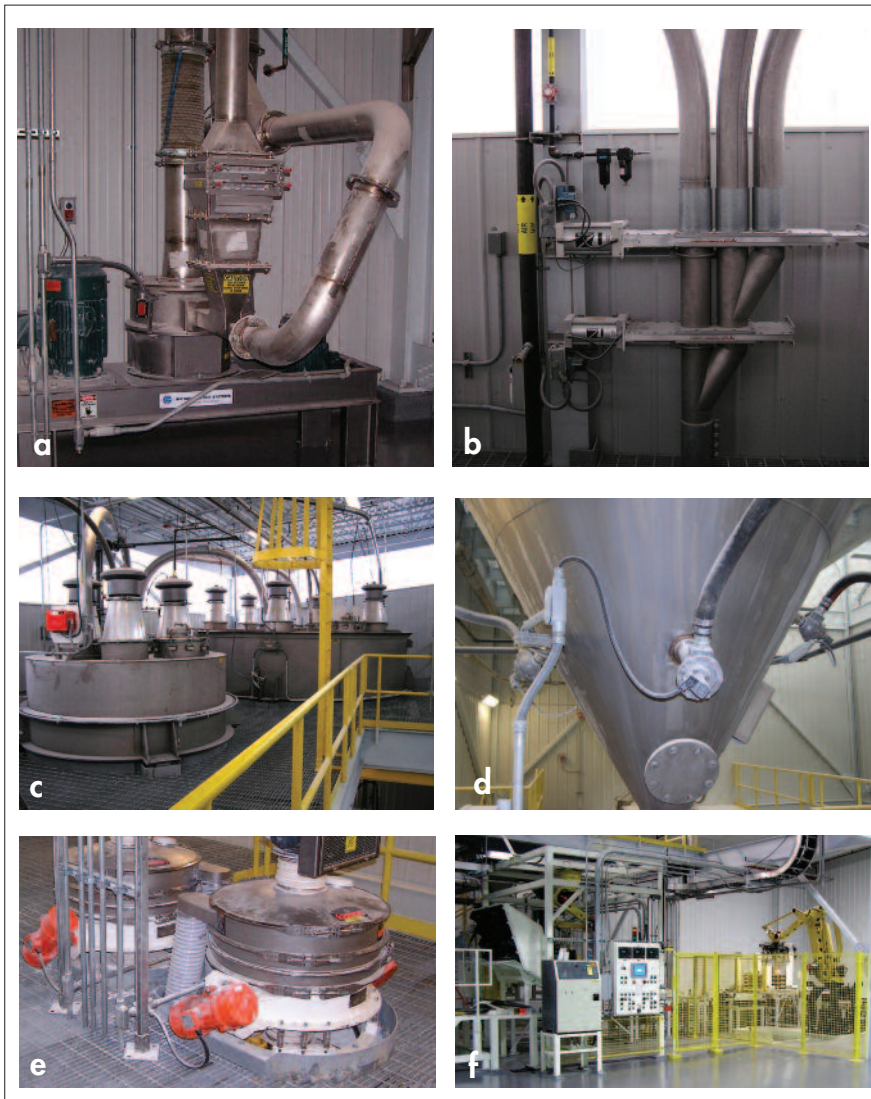
When filling bulk bags, the product discharges from a surge bin by gravity via a rotary airlock feeder to a dedi-

cated 30-inch-diameter vibratory screener to ensure proper particle sizing. The product discharges from the screener and passes through a rare earth magnet and a metal detector and then fills into a bulk bag.

When filling 50-pound bags, the company first specifies the air packer to receive the product. The product then discharges by gravity from the appropriate bin via a rotary airlock feeder to a dedicated 30-inch-diameter vibratory screener. From the screener, the product passes through a rare earth magnet into the packer’s surge hopper. As the product moves from the hopper to the fill spout, it first passes through the packer’s product chamber and then through the packer’s integral metal detector before filling into a bag. If any metal detector detects a metal contaminant when a bag is being filled, the packaging system shuts down and an alarm sounds, alerting an operator to the problem.

A filled bag is ultrasonically sealed, then conveyed across a custom-designed square-roller conditioning conveyor. “As the bag travels over the square rollers, it’s gently bounced up and down several times, which settles and distributes the product evenly inside the bag,” says Graham. “Rather than use a traditional bag flattener with dual-belt inclined conveyors, the packaging system supplier designed the square-roller conveyor because I wanted to keep all of the system’s equipment at the same elevation. This reduced the initial equipment costs and simplified maintenance requirements.”

From the conditioning conveyor, two pacing conveyors move the bag to a checkweigher, which weighs the bag and communicates the information to the four-axis robotic palletizer. If the bag is off-spec, the robotic palletizer picks it up and places it on a reject pallet located next to the checkweigher. If the bag is on-spec, the robotic palletizer picks it up and places it on the finished-product pallet in the appropriate stacking pattern. After a finished-product pallet is completed, it moves through a bag-squaring area



***These photos show some of the equipment in the SAPP process line: the air classifying mill (a), the three-way diverter valve (b), the tops of the surge bins (c), the material-flow-promoting air nozzles (d), two vibratory screeners (e), and the automated packaging system (f).***

and an indexing area to a pallet removal area. A forklift then takes the filled pallet to a stretch wrapper, which secures it for transport.

The packaging system's controllers and the process line's other equipment controllers are integrated with the plant's central control network, allowing for single-point control of the entire process line. During a product run, the central controller's database collects the process line's operating parameters, providing trending data the company uses to ensure product quality.

Because the SAPP is a food-grade product, the majority of the equipment and all product contact surfaces are made of Type 304 stainless steel, with some being Type 316 stainless steel. "We took great pains to keep this process closed to the outside to absolutely minimize any chance of contamination getting into the product," says Graham. "And if something should find its way into the process, the screeners and magnets will remove it from the product stream or the metal detectors will detect it and alert us to its presence.

"We also wanted to minimize the noise level inside the plant, so we built a separate enclosed mechanical room in the new addition. This houses the process line's fans, air compressor, pneumatic blower, and other equipment."

### **Process line maximizes production**

Graham designed flexibility into the packaging system by dedicating one surge bin to the bulk bag filler and one to each air packer. "For example, we can bag the same product with both air packers and get twice the throughput, or we can bag two different products running one packer at a time with a reduced throughput for each product," says Graham. "By doing this, we pretty much eliminated cross-contamination concerns and maximized our production efficiency because we don't always have to do a cleanout between a product changeover. We can also use the packaging system to bag products from other process lines in the plant, completely bypassing the

milling and sizing equipment. An inlet in the pneumatic conveying line between the product collector and three-way diverter valve allows us to connect the plant's other pneumatic conveying lines to the system."

The company has been using the process line a little more than a year. "We went through the normal debugging and optimization activities that typically occur with any new process line to refine the process and make it more efficient," says Graham. "Fortunately, those activities have been minimal because we worked with some great vendors on this project; many of whom were here for the installation or startup to help ensure that things went smoothly. And since completing the plant upgrade project, we've reduced operating costs by consolidating production and improved our food-grade operation and product quality by using a closed pneumatic conveying system that meets the most stringent requirements from a food-safety perspective."

**PBE**

**ICL Performance Products,  
Lawrence, KS  
800-244-6169  
[www.icl-perfproductslp.com](http://www.icl-perfproductslp.com)**

**Taylor Products, Parsons, KS  
888-882-9567  
[www.taylorproducts.com](http://www.taylorproducts.com)**

### **Equipment manufacturers**

Suppliers that provided some of the other equipment or systems for ICL PP's new SAPP milling, sizing, and packaging process line include:

Pneumatic conveying system, rotary airlock feeders, bin vents: **K-Tron Premier, Salina, Kans., 785-825-1611 ([www.ktronpremier.com](http://www.ktronpremier.com)).**

Rare earth magnets: **Eriez, Erie, Pa., 814-835-6000 ([www.eriez.com](http://www.eriez.com)).**

Air classifying mill, product collector: **Hosokawa Micron Powder Systems, Summit, N.J., 800-526-4491 ([www.hosokawamicron.com](http://www.hosokawamicron.com)).**

Diverter valves: **Vortex Valves North America, Salina, Kans., 888-829-7821 ([www.vortexvalves.com](http://www.vortexvalves.com)).**

Metal detectors (air packers): **Mettler-Toledo Safeline, Tampa, Fla., 813-889-9500 ([www.mettler-toledo.com](http://www.mettler-toledo.com)).**

Screeners: **Kason, Millburn, N.J., 973-467-8140 ([www.kason.com](http://www.kason.com)).**

Air nozzles: **Airsweep Systems by Myrlen, Coral Springs, Fla., 800-662-4762 ([www.airsweepsystems.com](http://www.airsweepsystems.com)).**

ControlLogix control system: **Allen-Bradley, Milwaukee, Wis., 414-359-970 ([www.rockwellautomation.com](http://www.rockwellautomation.com)).**

OSI Pi database: **OSIsoft Co., San Leandro, Calif., 510-297-5800 ([www.osisoft.com](http://www.osisoft.com)).**

**Note:** Find more information on this topic in articles listed under "Bagging and packaging" and "System or equipment design, fabrication" in *Powder and Bulk Engineering's* comprehensive Article Index in the December 2009 issue and at *PBE's* Web site, [www.powderbulk.com](http://www.powderbulk.com), and in books available through the Web site in the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at [www.powderbulk.com](http://www.powderbulk.com).