

Case history

A kinder, gentler railcar unloading system

A low-pressure pneumatic railcar unloading system reduces fines and angel hair when unloading plastic pellets.

How raw materials are moved to a processing line can have more impact on production costs than you might expect. For a soda bottle producer, the pneumatic conveyor benefited the bottom line the minute the raw material left the railcar.

Headquartered in Broomfield, Colo., Ball Corp. is one of the largest manufacturers of beverage containers in the US. At its plant in Delran, N.J., Ball produces plastic soda bottles that are used for such products as Pepsi and Canada Dry.



As part of the railcar unloading system, the manufacturer installed the pipe bridge, with piping between the silos and into the plant.

To make the plastic bottles, the plant first receives bulk shipments of PET, a pellet form of polyethylene resin. Roughly 1/8-inch in diameter, the pellets are shipped to the plant by bulk truck or railcar and are pneumatically unloaded into four storage silos, each 63 feet high and 12 feet in diameter. Each holds 250,000 pounds of the PET pellets.

From the silos, the pellets are pneumatically conveyed to drying hoppers. From the hoppers, the pellets are fed into one of seven injection-molding machines. During the injection-molding process, the pellets are melted and shaped into what is called a *preform*, a plastic piece resembling a test tube with threads at the top for a cap.

Stored in large boxes or containers and carried by forklift to another area of the plant for blow molding, the preform containers are emptied into a hopper when needed for processing.

From the hopper, a belt conveyor carries the preforms to one of five blow-molding machines.

Tim Smith, injection-molding process engineer, oversees the molding process at the plant. The blow-molding machines make bottles of different sizes, he said. In the blow-molding process, the preform is stretched and blown into a 20-ounce, 1-liter, 2-liter, or 3-liter bottle.

Palletizers stack the finished bottles in layers on pallets, with a sheet of cardboard between each layer. The pallets are stretch-wrapped and stored in a warehouse until they are shipped to Ball's customers.

Unloading system creates too many fines

Across the country, Ball operates three plastic soda bottle plants identi-

"We would generally have two problems [with the previous railcar unloading systems]. One would be the pellets shattering, which would cause fines or dust. The other problem was the pellets would travel at a real high velocity. As a result, the railcar unloading process generated nearly 2,500 pounds of fines per week."



Plastic resin pellets are pneumatically conveyed from the railcar to the pots before they are blown into the large storage silos.

cal to the Delran facility. Before the company opened its newest plant at Delran, Ball wanted to change the way the PET pellets were unloaded from railcars.

At a previous plant, Smith produced plastic bottles using the same processing equipment and raw material. To pneumatically unload the pellets from the railcars, the plant used a blower package that included a cyclone separator and a small converging hopper that fed material directly through a rotary airlock.

The unloading system was a typical push-pull type. A vacuum was pulled from the cyclone top, pulling the pellets out of the railcar into the cyclone inlet. The material fell out of suspension and separated from the air. The airlock metered the pellets into a pressure conveying line, which directed them to a silo.

The air passed through a filter and was redirected to a line adapter from the blower's discharge side to the airlock, which metered the material into the conveying line. The process created problems both for the pellets and the process equipment.

"We would generally have two problems," Smith said. "One would be the pellets shattering, which would cause fines or dust. The other problem was the pellets would travel at a real high velocity. As a result, the railcar unloading process generated nearly 2,500 pounds of fines per week."

By traveling through the conveying line too quickly, the pellets created product buildup called *angel hair*. Friction during conveying caused the pellets to melt and laminate against the line's inside radius, forming a coating or skin. As other pellets passed during subsequent conveying cycles, the inside skin would peel away and create angel hair.

Smith said the angel hair would pass through the conveying lines but

would clog the conveyor's filters or the screens. The fines created during the unloading process would also clog the filters.

"Sometimes the fines would get carried into the injection cycle," Smith said. "More often than not the fines would get filtered through the filtration equipment, but what it ends up doing is increasing your maintenance costs to keep those filters clean. You need the labor to keep the filters clean, and then there's the expense associated with constantly changing filters."

If the system filters became clogged with too much material, the unloader wouldn't be able to move enough PET pellets to the injection-molding machines. Plant production would slow during downtime events. And as the processing line would start again, some scrap product was generated.

Looking for more than the status quo

As Ball planned for the Delran bottle production plant's 1997 opening, the company wanted to find a way to unload pellets from railcars and trucks without creating fines or angel hair. They approached five pneumatic unloader manufacturers.

"I don't think [the designs] addressed any of the traditional problems. When these manufacturers were challenged or when their quotes were challenged — especially when dealing with some of the problems that we had — they really didn't have any solutions. It was kind of the status quo."

"We defined our needs for the job, and then we went to a lot of traditional manufacturers of the equipment and



An operator attaches the manifold of the pneumatic railcar unloading system to a railcar.

left it very open," Smith said. "We said we wanted to move material from point A to point B and let [the equipment manufacturers] come up with their engineering designs as to how they wanted to do it."

Of the five manufacturers, four offered designs very similar to what Ball had been using. Smith characterized the designs as "the same push-pull systems," and he knew they would cause Ball to experience the same problems.

"I don't think [the designs] addressed any of the traditional problems," Smith said. "They were airlock systems. When these manufacturers were challenged or when their quotes were challenged — especially when dealing with some of the problems we had — they really didn't have any solutions. It was kind of the status quo. They would say it was the way they had done it for 20 years, so they really weren't open to any suggestions."

Smith said the system that stood ahead of the rest offered a unique approach to unloading railcars. While maintaining similar unloading rates, the system eliminated fines and the friction that causes angel hairs by moving the material through the conveying lines at a much slower rate.

"This manufacturer paid a lot more attention to product movement through the line," he said. "They had worked on designs that would reduce the product velocity but still keep up the throughput percentage of pounds per hour."

The system operates by using only one pump, whereas a traditional push-pull system uses up to two pumps, one to convey pellets from the railcar and another to move the material from the airlock to the silos. “Pumps generally run about \$10,000 each,” Smith said, “so there were definitely some savings related to that.”

The system was also easily compatible with metal detection equipment, an important criteria for Ball. Other systems would have required additional equipment and expense to interface with metal detection equipment.

The bottle producer didn’t conduct tests, but based on the manufacturers’ designs and the producer’s own experience with similar equipment, Ball chose to install two ALL-CON World Systems railcar unloading systems at the new Delran plant.

Low pressure unloading and loading

When the Delran plant began operating in June 1997, it was equipped with two railcar unloading systems. The manufacturer installed the equipment, integrating the systems into the plant’s design.

As the new plant was under construction, the manufacturer installed the pneumatic conveying line for the railcars. They also installed two small hoppers or *pots*, that receive the pellets and separate them from the air. These pressure-differential pots operate without any moving parts. The manufacturer also installed the filtration equipment for the railcars, and all of the stainless steel hose from the pots to the silos — including hose from the silos to the injection-molding machines.

Smith likened the installation to a custom project instead of an equipment upgrade. “They installed basically everything from the railcar to the injection machine,” Smith said. The unloaders differ in operation from those used at other Ball bottle plants.

In operation, an operator connects the flexible conveying hose to the railcar compartment. In vacuum cycle, the system’s pump works much like the airlock system, drawing the material through the line into a pot that can hold 40 cubic feet of material. Once the pot is full, the pressure cycle begins as a direct-air valve switches, fluidizing the PET pellets and allowing them to be pressurized and conveyed to the top of the 63-foot silos.

Once a batch of material has been blown to the silo, the cycle repeats — vacuuming a batch until a level indicator in each pot trips, then transferring the pellets to a pressure-conveying hose to fluidize them. The two unloading systems operating simultaneously at the Delran plant can unload nearly 23,000 lb/h.

When each system is in vacuum cycle, drawing air and material into the pot, the air goes through a filtration system that deposits any material lighter than the pellets (such as fines and angel hairs) into a filter, which in turn discharges it into a portable plastic drum.

“I have seen no angel hair at all. And with the other systems, we were generating about 2,500 pounds of fines per week. With this system, it’s about 1,100 pounds a month. So that’s a very substantial reduction.”

As the unloading systems were installed, they were also fitted with metal detection equipment. Smith said adding such equipment to the traditional systems at other plants required installing more expensive components, including a transfer station.

Even though the unloading system was a perfect fit for Ball, the installation wasn’t without its small bugs.



Before installing the railcar unloading systems, excess angel hair and fines would clog the pneumatic system’s filters.

“One time we were getting too much vibration in the piping,” Smith said, “but [the manufacturer] was real good about coming back, checking up, and then responding and making the repairs and engineering modifications.”

“At one point early in the job the specifications required a four-bolt coupling, and three-bolt couplings had come in,” he said. “They were about two-thirds finished with the installation when that was caught, but from their view it was no problem. They said the job calls for four, so they ripped them out and put in the four-bolt couplings. And they worked overtime and took that cost on themselves.”

Smith said the manufacturer paid attention to many little details that made an impact. For instance, all of the equipment for the unloading systems was installed inside Ball’s existing buildings — saving the company the expense of having to build separate shelters. For system continuity, the manufacturer installed four-bolt couplings with stainless steel gasket protectors and grounding strips. Also, the manufacturer used white gasket couplings instead of black. If a piece of a coupling were to find its way into the PET pellets, Smith said, white contamination looks better than black.

“Plus, a coupling is the only place in the system where we would use something like that,” Smith said. “It is very easy to identify where that source of contamination came from.”

Angel hair no more

The Delran plant has been operating for nearly 2 years. In that time, the railcar unloading systems haven't created any angel hair.

"With the other systems, we were generating about 2,500 pounds of fines per week," Smith said. "With this system, it's about 1,100 pounds a month. So that's a very substantial reduction."

With less angel hair and fines in the system, maintenance costs have been greatly reduced, both in labor and materials such as filters. "It also reduced downtime costs," Smith said. "I have a lot fewer loading problems."

Smith said the unloading systems have given the company extra advantages over the old systems, including less noise. "That's one of those subtle benefits," he said. "It's a pretty quiet system."

Other improvements have arrived because of the manufacturer's attention to detail, Smith said. "[The manufacturer] used stainless steel flexible hose where other manufacturers would use vinyl, so where on a traditional system I might have to change a worn-out hose every 4 or 5 months, I've now gone 2 years with the stainless and never had any issues with it."

Smith estimated the system's downtime, maintenance, and labor costs are nearly 35 percent lower than the previous systems. **PBE**