Case History

Custom-designed mixer shaft seal eliminates waste and hazards

A soy ingredient manufacturer experienced significant product loss and an explosion hazard before replacing ineffective gland seals with custom-designed split shaft seals.

In 2011, worldwide soybean production reached 251.5 million metric tons and soy ingredient demand is holding steady. To help meet the demand for soy ingredients, Solae, a division of DuPont Nutrition & Health, produces 1,000 soy-based food ingredients that are used in baked goods, beverages, meats, vegetarian meals, and many other products.

To produce its soy ingredients, this manufacturer relies heavily on a 7-metric-ton ribbon blender. But problems arose when the ribbon blender could no longer maintain a tight seal and significant product loss became a factor at the manufacturer's Ieper, Belgium, plant. Not only was the sealing issue creating a financial loss, but it also exposed the plant to danger because of the explosive nature of the fine soy powder leaking from the seals.

The original packing-gland seal at this soy product manufacturer's plant lost product of up to ½ meter per day.

Identifying the problem

The ribbon blender was running 24 hours a day, 7 days a week, and the machine operators were finding a substantial amount of lost product leaking from the packing gland seals. This required daily removal and cleaning.

"The blender's conventional packing gland seals deposited a pile of wasted product over one-half meter deep every day," says Steven Vandevyver, the manufacturer's reliability engineer. "One cause of the leak was a 6-millimeter eccentric runout after the blender shaft had been broken and rewelded several times."

One consistent problem with ribbon blenders, say some experts, is that they almost never rotate true. The more hygroscopic the product, the more likely it is for them to rotate eccentrically because they build up a layer of compacted material on the bottom of the blender tub and the rotating agitators ride on that material, lifting it up.

One challenge in fixing the seal problem was that at the drive end, accessibility wasn't convenient for the technicians. The manufacturer also needed to find a solution to the leakage problem that would comply with ATEX – a directive consisting of two compliance codes established in 1994 directing manufacturers on the proper management and designation of explosive atmospheres. Yet another complication in the manufacturer's search for a solution was the atypical 11-inch blender shaft on the huge ribbon blender.

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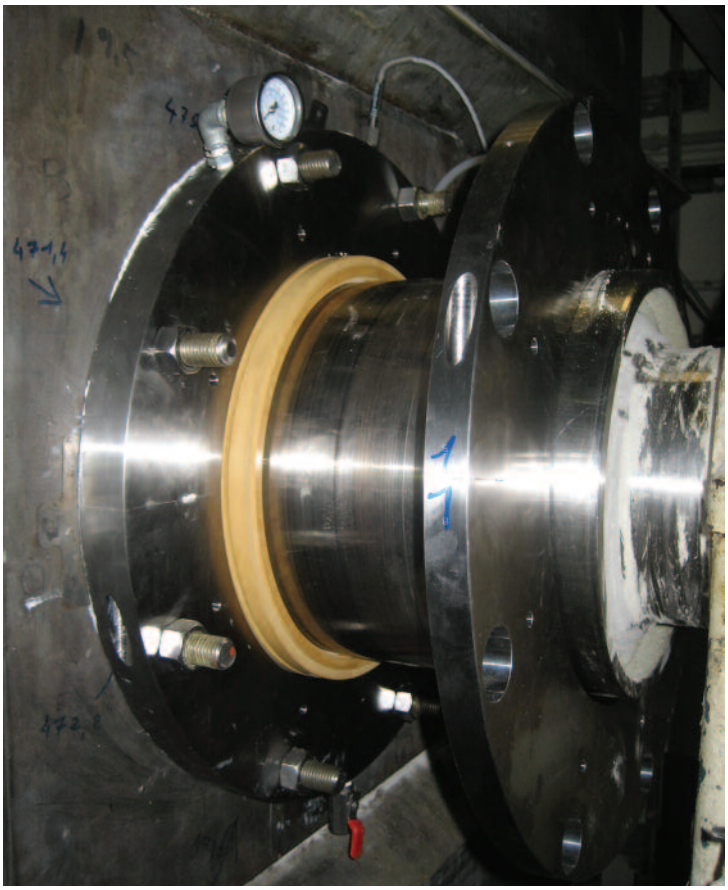

The new custom-engineered seals have their drive elastomer and rotors installed.

Seal research and former experience is key

Fortunately for Solae, searching for a solution to the sealing issue didn't take long because this manufacturer already had a strong level of satisfaction with a customized seal used on one of the plant's bag-filling machines. With this experience and some additional research, the manufacturer's reliability engineer determined that a similar seal should solve the ribbon blender's leakage problem.

After reaching out to the US-based seal supplier that provided the successful seal for the bag-filling machine, the manufacturer was connected with the supplier's Belgium-based distributor, Bekaert Seals. The distributor measured the manufacturer's machinery and submitted the requirements to the seal supplier's design staff to custom-adapt the supplier's MECO AH shaft seal to meet the soy product manufacturer's specifications.

Custom-designed seal

After receiving the specifications, the supplier designed a variation of its seal, which would allow up to 6 millimeters eccentric rotation of the blender's shaft. The supplier also ensured that the custom seal would meet ATEX requirements and fit the manufacturer's mounting-bolt pattern for its existing packing-gland-seal stuffing box.

The model AH shaft seal design is fully split, making it unnecessary to remove the bearing or drive assembly before installing the seal and drastically reducing replacement time. The seal is comprised of 2-inch stainless steel plate stators – one inboard and one outboard. The seal's inboard stator mounts against the machine and the outboard stator mounts to the inboard stator. Between the stators are two rotors and a drive elastomer, all of which turn with the blender's shaft. Air pressure between the two stators pushes pressurized air back into the ribbon blender so anything wanting to get out will meet a pressurized air force against it. This is dead-heading the air inside the chamber, creating virtually no leakage at all and with a pressure point of 0.25 bar, says the supplier.

With a maximum service temperature of 260ºC, the new seals operate on a plane perpendicular to the shaft, so there's no relative motion between the shaft and the seal. This alignment with the shaft eliminates shaft abrasion and the high operating temperatures of the former mechanical packing gland.

This type of custom-engineered seal is used in low to moderate abrasive powder processing, ideal for ribbon blenders. The design incorporates both a basic adjustment mechanism and monitoring provisions to allow operators to perform preventive maintenance before product leakage occurs. The new seal design is well-suited for food manufacturing applications where frequent product changes and washdowns are required.

Trouble-free seal eliminates waste, explosion hazard

In January 2012, the manufacturer installed the new non-drive-end seal, and in February it installed the drive-end seal. Installation was simplified because the seals were custom-designed to the manufacturer's ribbon blender specifications. The new seals created a tighter seal, eliminating product loss and eliminating the explosion hazard.

Once the seals' sacrificial face material begins to wear away, the seals can be adjusted by removing one of a stack of adjusting gaskets and reassembling the seals, a process that only takes a few minutes. Periodic adjustment of the

The new AH seal is completely assembled with grounding wires and static discharge brush installed to prevent dust explosion risks.

seals ensures that they'll operate for well over a year before overhaul is necessary.

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Purge air, pressurized between the seals' twin seal faces, aids not only in maintaining the seals' face pressure, but also allows operators to monitor the seals' performance and schedule maintenance before costly product leakage takes place, says the supplier. The fact that the seals aren't sealing around the circumference of the shaft the way the packing glands did eliminates any possible shaft abrasion. The lack of shaft abrasion also reduces the torque required to turn the shaft, because there's no longer the braking effect of packing squeezed around it.

Since installing the new seals, the manufacturer reports significant improvement and virtual elimination of the issues it had with the old packing glands. Only recently did the manufacturer install the first rebuild kit.

"The MECO seals have been running trouble-free for about thirteen months now," says the manufacturer's reliability engineer. "We can easily monitor the condition of the seals and, unlike the packing gland seals, they cause no wear to the shaft surface." PBE*I*

Note: Find more information on this topic in articles listed under "Mixing and blending," "Valves," and "Safety" in *Powder and Bulk Engineering/International*'s article index in the December 2012 issue, at *PBE/I*'s website, www.pbeinternational.com, and in books available on the website at the *PBE/I* Bookstore. You can also purchase copies of past *PBE/I* articles there.

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