

FLOWSERVE

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Face to Face

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Charting progress

Flowserve Alliance

Pumps Up Savings

for BP Refinery

BP's Carson, Calif. refinery processes 265,000 barrels of fuel products a day, and is the one of the largest in the Los Angeles basin. Some 1,400 centrifugal pumps keep product and raw materials moving through the refinery. Many of the pumps are deployed in redundant pairs, so pump failures rarely threaten production. But failures are nevertheless expensive—typically it costs around \$5,000 to fix a single pump, says Machinery Engineer Steve Konig. About half that amount goes toward mechanical seal replacements; the rest is labor cost to isolate, repair and reinstall the faulty unit.

Konig and his colleagues reasoned that the best way to keep repair costs low was to prevent breakdowns from happening in the first place. The company spotted a second opportunity to reduce costs by cutting its inventory of mechanical seals. Lack of standardization had led to a proliferation of parts, and contributed to high MRO costs. "We recognized that if we concentrated on those two areas, BP would be ahead, so that's where we decided to focus our efforts," Konig says.

The refinery was already a Flowserve customer, with close to \$1 million worth of Flowserve seals in its parts inventory. Working locally with Senior Sales Engineer Jeff Butler, BP Carson entered into an alliance with Flowserve in 1999, and the two companies began to explore specific savings targets and ways the refinery could hit them.

Charting success

Together, Butler and BP Carson managers developed four key performance indicators—deliverables that would chart the effectiveness of the alliance. First was to increase mean-time-between-failures (MTBF) for mechanical seals by 45 percent over three years. Second was to cut BP's mechanical seals inventory. Third was to provide additional training for BP Carson mechanics and operators. And fourth was to provide timely delivery of seals and repair parts.

To set a performance baseline, Flowserve surveyed the 1,400 pumps, fed the data into a proprietary database called SIS (Seal Information System) and began generating monthly reports on MTBF for each pump. Maintaining the accuracy of the database is no trivial task. When work started, BP Carson's own historical repair records were not especially reliable. "Carson is a 75-year-old refinery," comments Konig. "Many modifications have been made over the course of time that have been documented in varying levels of detail."

Each month, Butler reviews the SIS reports with BP Carson to make sure the numbers are accurate. The information fed into Flowserve's SIS comes from work orders generated by BP Carson's computers. Misclassification of failures and ordinary clerical mistakes—duplicate work

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orders, for example—can throw the MTBF figures off, he says, and defeat the whole purpose of the record-keeping exercise, so making sure the figures are correct is important.

Apart from charting Flowserve's performance, the MTBF numbers also help BP Carson identify what Konig calls the company's "bad actors"—the pumps that fail frequently—and focus extra effort on resolving the root-cause of the recurrent failure.

The benefits of training

Often, Konig notes, poor performance is not only limited to misapplication or poor design, but to improper operation and installation. And that's where training becomes important. "If we can educate our operators so they can catch problems before a pump fails catastrophically, we can switch to the spare pump and schedule our work execution better," Konig says. "Ultimately, we want to uncover problems and resolve them before they lead to pump failure. Again, the cost saving comes from not having to pull the pump."

Flowserve operates separate training programs for BP Carson's maintenance personnel and operators. Maintenance people learn how mechanical seals work, what some of the critical specifications are, how to troubleshoot, and how to repair and reassemble the equipment. Operators learn how to spot problems that might lead to future pump failure. Butler leads most of the training, but BP Carson is also sending some of its people to Flowserve's training center at its headquarters in Irving, Texas for in-depth courses.

Often, notes Butler, early seal failure is a symptom of other problems—the wrong seal for an application, for example, or bad piping configuration. Misapplied seals, he says, are sometimes the result of inconsistent purchasing and lack of standardization. In BP Carson's case, Flowserve matched its specifications to the refinery's applications and drew up a list of standards for seal use. Apart from solving the misapplication problem, standardization also meant a smaller inventory of seals and repair parts at BP Carson.

In addition, Butler went into the field, examined each "bad-actor" pump and came back with recommendations for low-cost piping and operations changes that would prolong seal life.

Cost-effective recycling

Flowserve keeps BP Carson's inventory costs down by warehousing replacement seals and repair parts for the refinery. As used seals are removed at the refinery, they're returned to Flowserve. Flowserve refurbishes the seals and keeps them in its inventory. When the refinery needs replacements, the refurbished seals are shipped from Flowserve, which guarantees a minimum delivery time. Except for a small number of emergency units, BP Carson holds no

Flowserve inventory, and this has cut its overall inventory investment significantly.

There are other advantages that come with reducing inventories, says BP Carson Materials Supervisor William Rosborough. "We save on the cost of capital by not tying money up in inventory. We also don't have to pay taxes on inventory we don't own. We don't have inventory that sits on the shelves and becomes obsolete because it runs out of useful life for whatever reason." There are other savings, too. By consolidating most of its mechanical seal business with Flowserve, the refinery cuts fewer purchase orders and processes fewer invoices.

Although much of the relationship between BP Carson and Flowserve is contractual, what makes it succeed is Flowserve's unwritten commitment of support—Rosborough calls it the spirit of the alliance. "We know that since Flowserve is the preferred supplier under this agreement, it will go to extremes to support us," he says. "They go the extra distance to support the agreement. It also has to be a win-win situation, so we try to do things that will benefit Flowserve. It's a close interrelationship, rather than just a business deal."

Onsite support

Among the extras are Butler's services. Konig reckons the Flowserve representative spends about half his time at the BP refinery, providing engineering support, making sure the mechanical seals are being applied correctly, examining processes to ensure that they're not contributing to seal failures and coordinating parts turnaround between BP Carson and Flowserve's warehouse. "You can't put a price on that daily interaction and the value that affords us," says Rosborough.

Just 18 months into the alliance, BP Carson is already surpassing some of the goals it had expected to achieve in three years. Instead of reducing MTBF by the originally targeted 45 percent, the actual figure currently is close to 95 percent. Inventory levels are down by \$400,000 and Konig puts the total saving generated by the alliance so far at about \$700,000. Much of that, he notes, are recurring economies that will save the refinery maintenance dollars for years to come.

"The Flowserve Seal alliance has allowed BP's Carson refinery to remove costly inventory from our warehouse shelves with a high degree of certainty that Flowserve will provide us with a seal when we need it," says Konig. This, coupled with active measures to increase the refinery's MTBF (seal inventory surveys, bad actor lists, engineering design audits, training, etc.), has resulted in a demonstrable benefit to BP Carson's bottom line."

Adds Butler, "I think it's been a good experience. I think we both profit from it. And I think there's a lot more we can do over there." ●

Presenting...

Flowserve's circulator seal support systems

Flowserve circulators are seal support systems for use with API Plan 54. Designed to support pressurized double or dual seal arrangements, Flowserve seal support systems are engineered to extend seal life by circulating clean fluid between the seals at a certain pressure. Flowserve circulators provide maximum reliability for a full range of operating environments, and offer heat removal capabilities through the use of a heat exchanger. Custom circulator models are available upon request.

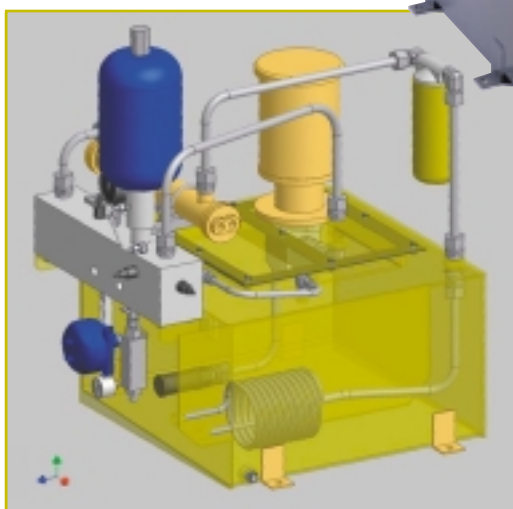
Circulator Specifications:

- A 25-gallon carbon steel reservoir with sloping bottom, baffle, and manway.
- A 1/2" x 0.049" x 20' 316 SS cooling coil mounted in reservoir.
- Aluminum gear pump to produce 1 or 4 gpm @ 40-400 psi with 100 SSU oil.
- A 1/2 H.P. or 1-1/2 H.P. 230/460 VAC, 3-phase, 60-hertz TEXP motor with motor adapter and coupling.
- Machined aluminum manifold with relief valve, check and pressure control valves, as well as extra ports for the addition of optional kits.

- A simplex filter with 10 micron spin on element and vacuum gauge.
- A pressure gauge with a range of 0-600 psi and a 2-1/2" dial.

Options:

- Heat Exchanger Kit. Includes a heat exchanger capable of removing 30,000 BTU/hr with a 4 gpm flow rate and all interconnecting piping to assemble onto existing unit.
- Safety Feature Kit. Includes a 1-gallon carbon steel accumulator with a Buna bladder rated for 3,000 psi, a dual-pilot operated check valve and all necessary piping and/or fittings to add to existing unit.
- Low Pressure Switch. Includes a SPDT explosion-proof pressure switch.
- Low Level Switch Kit. Includes an ultrasonic-type, DPDT, 120-VAC, explosion-proof level switch.
- *Note: All kits include instructions for field installation.*



Nearly all of the multiple seal applications at Mobil Oil's refinery in Torrance, Calif. are tandem seals. According to Rob Sonz, Reliability Engineer at Mobil, in the 1970s, the plant found a handful of mechanical seal applications that required pressurization in accordance with API Plan 53. The circulators that made this possible have been working well for the past 20-plus years. But, recently old age began to take its toll on one of the units. Rather than continue to rebuild and repair it, Mobil simply replaced it with a new Flowserve circulator because the application is mission-critical.

Pushing failure out of the picture

Handling abrasive slurries is easy with a pusher seal

Making kraft paper generates black liquor, a waste material. It is corrosive and has a significant concentration of suspended solids. Paper mills concentrate it from 15 percent to 65 percent. The thickened liquor can be burned and the heat recovered for the evaporation and concentration process.

The hot, corrosive, abrasive black liquor slurry is unforgiving. Mills typically use multiple seal configurations and rely on American Petroleum Institute Plan 54 for environmental control, which flushes the seal with an external source of cool, clean barrier fluid. This configuration, however, has two problems. If the barrier fluid pressure drops, process fluid can contaminate the barrier fluid stream. If the seal fails, uncontrolled quantities of barrier fluid can be injected into the process stream.

Modern paper mills have options, including the Flowserve SL-5000 single balanced multi-spring cartridge pusher seal, which is specifically designed for abrasive slurry services. It eliminates the need for the multiple seal arrangements and the associated flush. Its unique design exposes the seal faces to the pumped product to maximize heat dissipation, a feature that eliminates a common failure mode. A special shroud protects the rotor drive pin and the compression springs in the stationary portion of the seal from build-up.

The seal helps the environment because it does not consume water and reduces the need for waste water treatment.

Minimizing labor

Irving Pulp and Paper in Saint John, New Brunswick, is a century-old plant that produces 1,000 tons of kraft pulp daily. To keep the solid material in suspension, the plant uses a 500-gpm pump. The black liquor it recirculates has a solids content of 60 percent and a temperature of 210° F.

For most of its history, the plant operated on untreated lake water—the only available water supply. When mechanical seals were introduced, the plant had no choice of water to flush the multiple seal arrangements. The surface water supply proved to have unreliable pressure

and flow to meet the requirements for the seals. Additionally, there is entrained solids in the water. Suddenly, part of the normal routine during a semiannual shutdown was dismantling and cleaning the seals and associated flowmeters to remove accumulations of algae. Despite the use of various types of algacide, the problem persisted. According to Don Samis, recovery area maintenance supervisor, this was a troublesome recurrent problem that consumed too many maintenance dollars.

Mike Jennex, the Flowserve representative in Scarborough, Ontario, suggested Samis try a Flowserve SL-5000 split seal—which does not require a flush—to minimize those costs. Samis agreed, and Jennex had the seal installed in the spring of 1999.

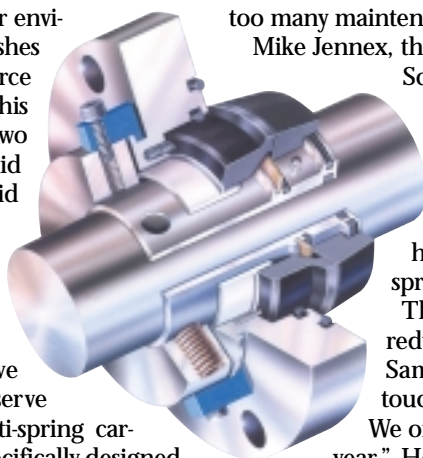
The SL-5000 has indeed reduced maintenance demands. Samis reported, “We haven’t touched it since it was installed.

We only change the grease twice a year.” He added, “The seal paid for itself within a year. The cost of one change-out is equal to the cost of the seal.”

Other plants, similar results

Consider Stone Container Canada, Inc., New Richmond, Quebec. “The plant originally used packing for the black liquor pumps,” notes Andre Berube, plant engineering and services manager. In the early 1990s, the company began exploring mechanical seals for non-critical applications, starting with dual seals, then single seals. Building on the success of these initial moves, the plant became comfortable enough with mechanical seals to consider them for more critical applications.

Laval Robichaud, mechanical foreman, says the typical Flowserve mechanical SL-5000 seal lasts two years or more in black liquor service. When the going gets tough, notes Robichaud, the key is in knowing how to apply and use seals effectively. Fortunately for Stone Container, Flowserve recognizes the importance of being able to provide the type of support that makes this possible. “Marcel Lajoie [the Flowserve representative for Quebec] solves problems,” adds Robichaud. “He provides good service and training.” ●



How to preserve a seal with a

There is more than one way to keep solids from getting between

The Achille's heel of any non-contacting gas seal is its sensitivity to solids in the process stream. Even an already well-engineered seal, such as the welded metal bellows type, is subject to the damage that suspended solids inflict. But, keeping solids away from the seal faces when the seal is idle is clearly the secret to designing a high-reliability seal.

Flowserve proved that it is capable of meeting this challenge when it developed the TARSEx bushing as an accessory for the Flowserve GX-200 non-contacting seal.

The name of the bushing is an acronym for "tapered annulus radial solid exclusion." Its purpose is to prevent solids from entering the face cavity even when the seal is static—in contrast to a standard tapered retaining plate, which resists solids only during dynamic operation.

Right the first time

While stationary, the TARSEx bushing rests against the retaining plate to provide a physical barrier to solids. In motion, grooves on the bushing's outer edge propel solids outward radially. Because the taper on the bushing matches that of the retaining plate, it forms a rotating annulus that enhances solids separation. The O-ring allows a pocket of gas to collect to further restrict the movement of solids.

Field testing of the TARSEx bushing at Dow Chemical's Alberta plant confirmed that the designers had it right the first time. What is reputed to be the world's largest ethylene plant is located in Ft. Saskatchewan, Alberta,

and has a annual capacity of 2.5 billion pounds. The Dow Chemicals plant was commissioned in late 1994 and employs about 1,200 people and covers 400 acres.

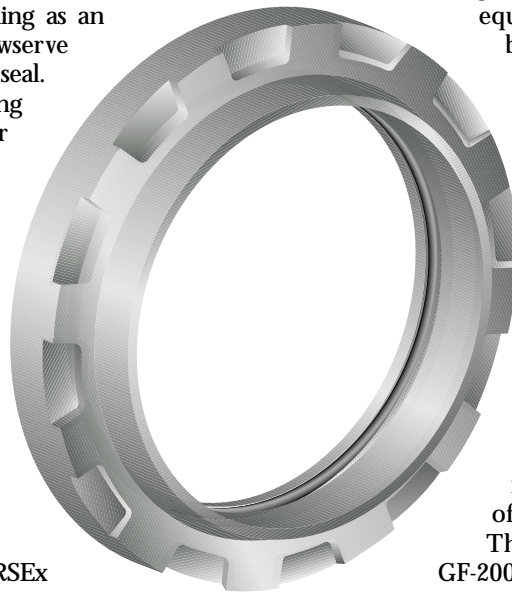
Since day one, the plant experienced problems with a particular set of back pull-out API pumps that move a material containing low levels of two impurities—benzene and a polymer. Because of the benzene content, fugitive emissions are a critical concern.

Originally, the pumps were equipped with SB-100 seals, but that arrangement had two problems—it did not prevent the release of fugitive emissions and seal life was short. Dow then tried GB-100 seals, a change that solved the emission problem, but the inboard seal's life was still only between 45 and 60 days. An investigation showed that the seal failure was related to accumulation of polymeric material.

The plant had a spare GF-200 seal that had been sitting in its storage area for two years.

In another attempt to solve the mean-time-between-failure issue, the plant installed the seal and pressurized it with nitrogen. This time the seal lasted four months, but that short life may be attributable to the perfluoroelastomer O-rings having taken a permanent set from being stored for so long.

Dow then tried a GX-200 double seal, but with a TARSEx bushing in the bottom of the stuffing box, a configuration that has been in use for just over a year. So far, the combination has not failed. Dave Williamson, Dow's senior reliability specialist, said, "We have yet to spend anything on maintenance—except



bushing

the faces

for oil changes—in the last year. We have three [TARSEx bushings] in the plant. I have yet to see one fail.” Williamson added, “The TARSEx bushing provides a pumping action in the stuffing box to prevent polymer buildup. There is absolutely no question the problem has been solved.” As far as payback, the relatively low cost of the TARSEx bushing saves the seal, making the payback extremely favorable.”

Overcoming process problems

Equistar Chemicals, Channelview, Texas, also suffered from a serious process problem. Its 600 employees produce approximately 400 million pounds of butadiene per year. One pair of tower bottoms pumps at the plant moves 231°F butadiene and solvent. This stream, however, has a bit of polymer in it. In only three to six months, the polymer clogged the wetted components of the seal and the unit would show signs of failure. When that happened, the plant would switch over to the standby pump to keep the process operating while the damaged seal was being repaired. The polymer, however, thickened as it cooled in the now idle pump. At ambient temperatures, it becomes nearly impossible to rebuild the cold, clogged seal.

The plant tried using the X-200 double liquid seal to solve the problem, but it, too, was prone to clogging. Alton Smith, the Flowserve representative from Deer Park, Texas, told Equistar Chemical about the TARSEx bushing

as a possible problem solution. Smith offered a process guarantee—if the seal didn't perform flawlessly for three months, he would not invoice Equistar for the GX-200 double gas seal and TARSEx bushing. There was no way the plant could lose.

Said Kyle Gee, senior maintenance engineer at the Equistar plant, “We had been spending \$20,000 per year on these pumps. I need to maximize pump availability, minimize maintenance cost, and maximize mean-time-between-failures.” He added, “The theory of having nitrogen behind the bushing to keep product out of the seal made sense.”

So far, it has made 13 months worth of dollars and cents for Equistar. With the TARSEx bushing in place, the troublesome bottoms pump has been operating continuously for more than a year and the plant has not yet had to switch over to the standby pump. According to Gee, plant management is thinking about fitting the standby pump with the same seal and TARSEx bushing, just in case. ●

