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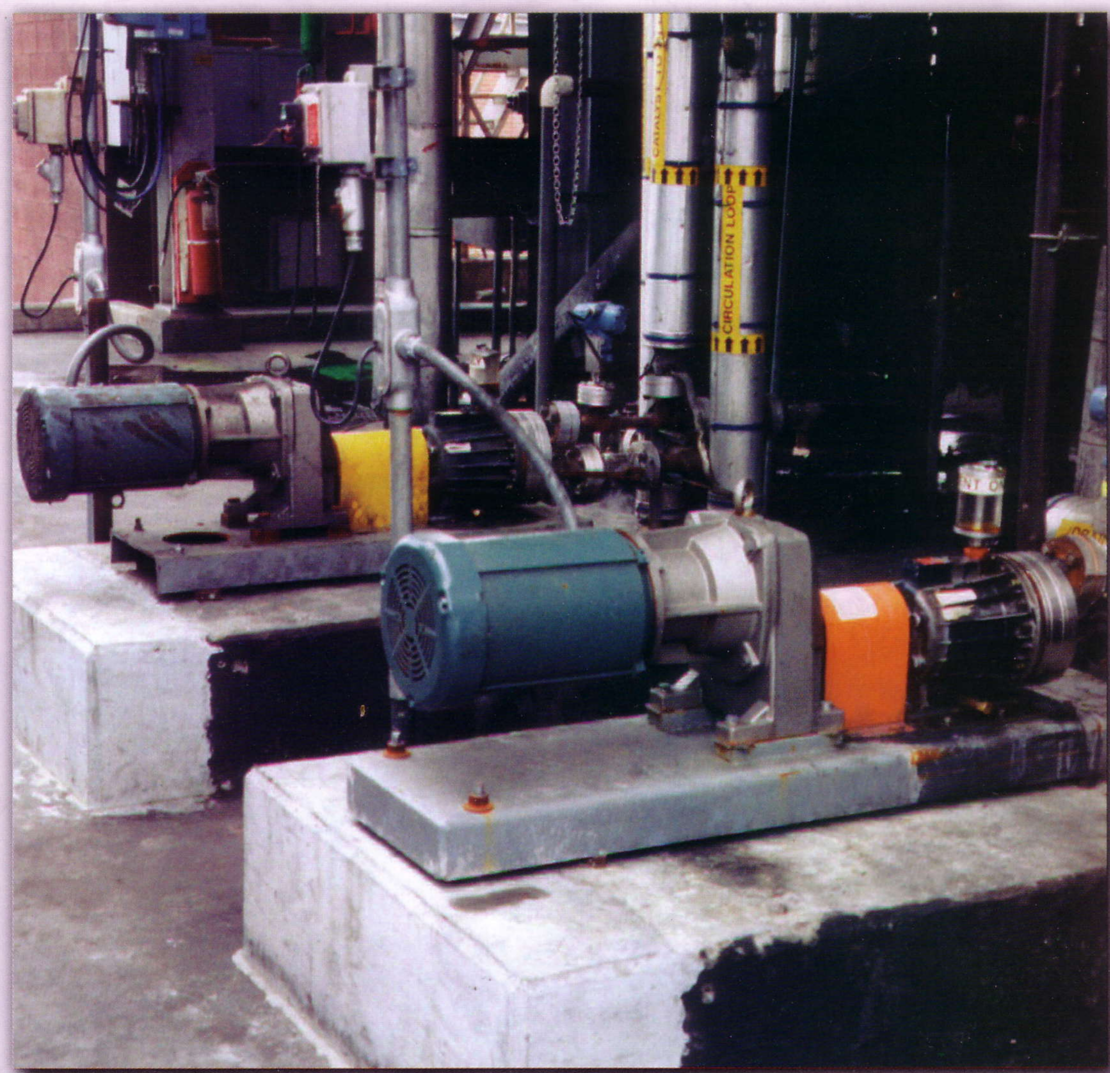

Hydra-Cell Pumps Handle Abrasive Catalyst Slurry With Ease

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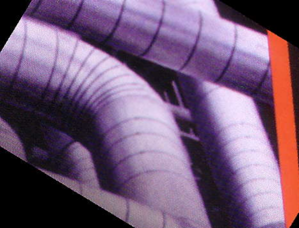

Problem-Solving Strategy at Solutia, Inc. Saves Thousands Using Hydra-Cell Pumps

Two bad pumps were costing this chemical manufacturer more than $100,000 a year in lost production and maintenance. A team approach solved the problem, and the payback took just five months.

By Jimmy Fowler
Mechanical Reliability Engineer
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At Solutia's Decatur, Alabama, plant, two simplex diaphragm pumps were the cause of many maintenance, operations and reliability headaches. One of the pumps is the primary pump; the other is a spare. Both were installed in 1972. The pumps operate with a suction pressure of 15 psig and a discharge pressure between 500 and 600 psig. The flow rate is controlled by a manual variable speed sheave drive with a flow range of 1.4 to 6 gpm. The pumps move a slurry of abrasive catalyst, organic chemicals and water. It was very common to take one pump down for maintenance only to rupture a diaphragm bringing the spare pump on line.

Operations and maintenance personnel knew that the pumps were unreliable and costly, but no one had ever analyzed the actual cost of operating and maintaining them. To determine the real cost of operating the pumps we tracked lost production costs and maintenance costs over a 12-month period. In that year we lost $71,000 in production and spent $64,500 in maintenance labor and materials for a total of $135,500. It was instantly clear that something had to be done to improve the reliability of these two pumps.

Step 1: Getting the Team Together

To attack the problem, we formed a team that included a mechanical project engineer, an electrical project engineer, two process engineers, a mechanical reliability engineer, the operations trainer and the operator team leaders. The team's mission was to look at the complete system, not just the pumps, and come up with a cost-effective way to replace the pumps and improve the overall reliability of the system.

Step 2: Identifying the Real Problems

The team discovered several pump and system problems that needed to be addressed to make the complete system reliable

- The single diaphragm design of the pump caused several problems in the process. Because the gate opened and closed on every stroke, the swing check valves in the discharge pipe failed frequently. The abrasive nature of the catalyst also eroded the valve gate and seat.
- The catalyst in the process settled very rapidly. When the pump is on the suction stroke, there is no velocity in the pipe, that is, the fluid isn't moving. Over time, as the catalyst settled out of the process, the pipe plugged with catalyst, causing the pump to run deadheaded. As a result, the diaphragm would rupture on the discharge stroke.
- Parts for the existing pumps were becoming expensive and delivery lead times

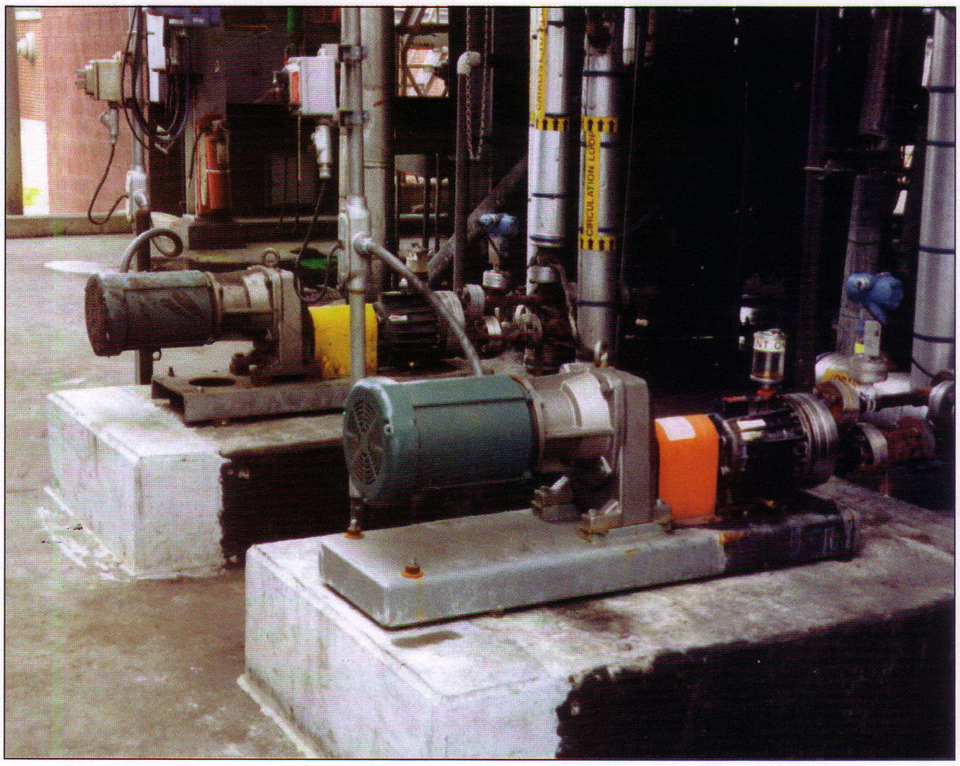

Photo 1. The new catalyst injection system

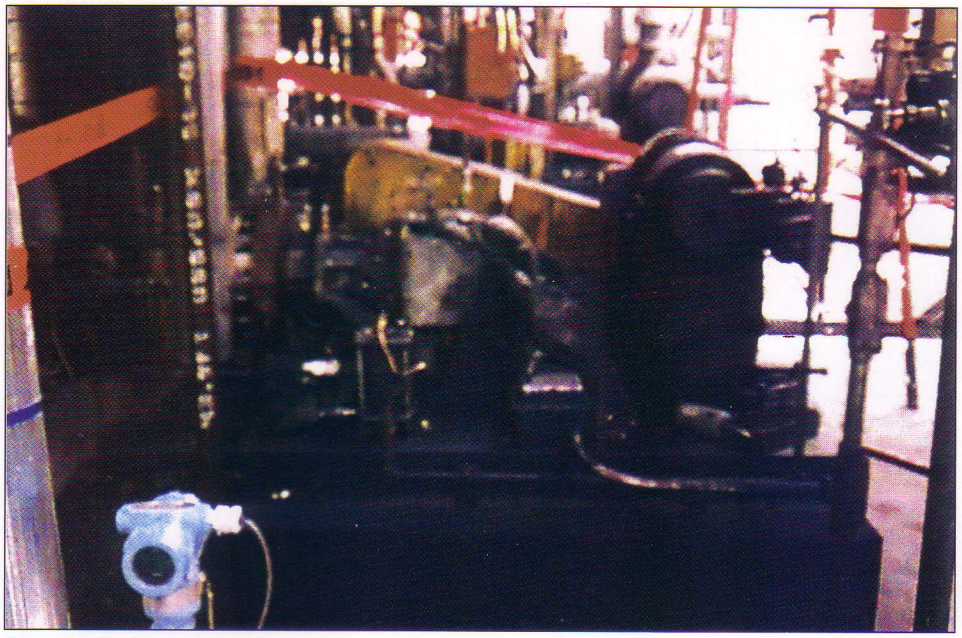

Photo 2. The old catalyst injection system

were often several weeks.

- The orifice inside the flow meter on the discharge of the pump was 5/16″. The orifice would frequently wear out, forcing us to run on bypass and give up control over the system. The orifice also became plugged, and when it did the pump's diaphragm would rupture.
- Troubleshooting problems was made impossible by the lack of pressure or temperature indicators.

Step 3: Defining the Scope of the Change

After identifying all of the items in the entire system that had caused problems, the scope of the project was refined to include replacing the pump, simplifying the piping, replacing the flow meter, and installing pressure and temperature indicators.

Step 4: Writing Specs and Evaluating Choices

The team wrote specifications for the pump and sent them out to vendors for bids. The entire team evaluated the bids by listing the advantages and disadvantages of each pump and discussing, in depth, which pump would be the best pump for our process. The main features that were evaluated were the pump's ability to handle abrasive solids, whether it could deliver a constant low pulse flow, relief valve options and safety, the pump's design on delivering the desired flow rate over the complete flow range, repair cost, ease of maintenance, ease of operation and reliability. Although initial price was considered, it was the least important factor in choosing the pump.

The Choice

The team chose a triplex diaphragm pump that would provide a steady low pulse flow to the process (Fig. 1). This would eliminate piping check valve failures and pipe pluggage. Large clearances in the inlet and outlet check valves enable solids to freely pass through the pump. The wide variety of materials of construction allowed the use of abrasive-resistant parts in the high wear areas. The pump is designed so that the diaphragms are hydraulically balanced, thus eliminating ruptured diaphragms. The sim-

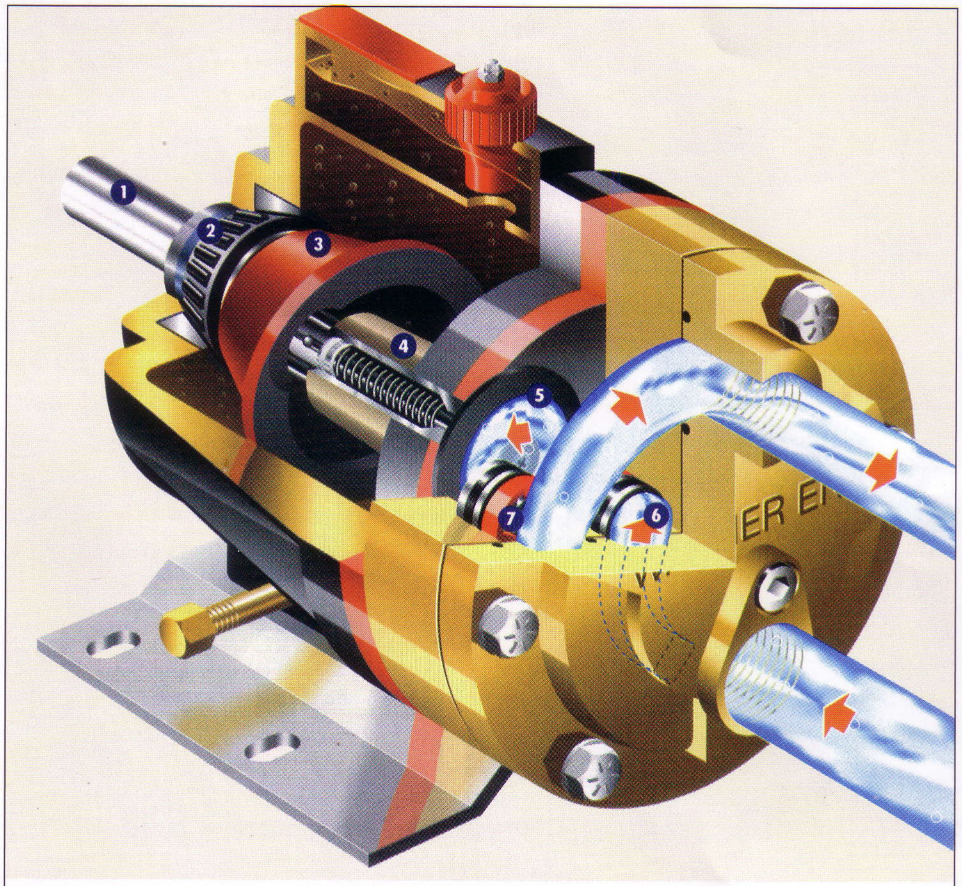

Fig. 1. The Hydra-Cell H-25 triplex diaphragm pump was chosen to replace the old pumps in the system.

1. Drive Shaft
2. Roller Bearings
3. Fixed-angle Cam
4. Oil filled Pistons
5. Diaphragm
6. Inlet Valve Assembly
7. Outlet Valve Assembly

ple construction of the pump enables mechanics to pull the pump, replace check valves and diaphragms, and reinstall the pump in just two hours. The pump speed is controlled with a variable speed motor and wired into our DSC (Distributed Control System), enabling us to control flow remotely. The vendor also allowed us to use the pump for a 90-day trial period. If we were unsatisfied with the performance of the pump for any reason we could return it with no questions asked. Plus, to purchasing's delight, the pump was also the least expensive of the pumps that were evaluated.

Reworking the System

The old piping had several unnecessary fittings, a pulsation dampener that was no longer in service, a three-way valve that leaked constantly, three redundant piping discharge check valves, and only a couple of bleeders, which were used to flush the pipe when it became plugged. The new piping eliminated the unnecessary fittings, the pulsation dampener, the three-way valve and two of the piping discharge check valves. Several clean-outs were added so someone can flush the pipe to remove the process fluid when the pumps need to be cleaned or taken down for maintenance. Temperature discharge pressure gauges were installed to enable troubleshooting of system problems. A Micromotion® flowmeter was also installed.

Payback

The project paid for itself in five months. The team turned the biggest headache in the plant into one of the most reliable systems we have. Gone are the piping check valve failures, pipe pluggage problems, diaphragm failures and the hassle of dealing with obsolete parts.

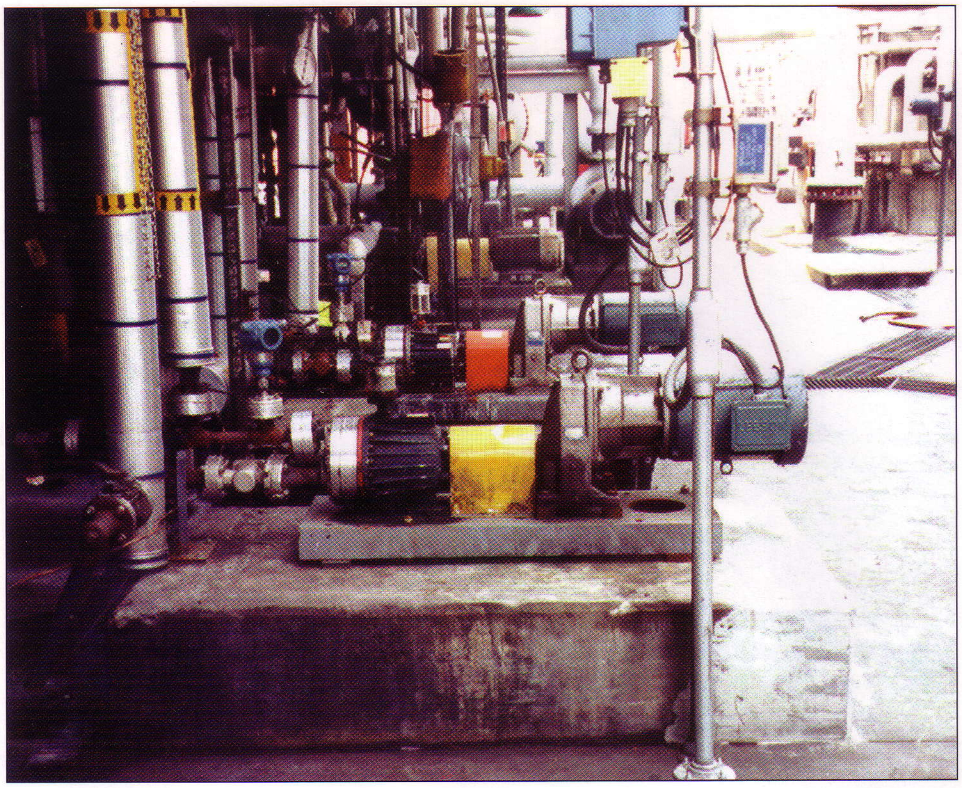

Photo 3. Installation of the first Hydracell H-25 and its spare

Why it Worked

The project was a success for two main reasons. First, the scope of the project was to improve the reliability of the complete system and replace the obsolete pumps with the best pump that would meet our needs. Second, the team was made up of the right people with the right backgrounds. Each member of the project team was able to contribute something in his area of expertise and took ownership of the project to achieve a common goal of improving pump and system reliability.

Jimmy Fowler has been the mechanical reliability engineer for Solutia at its Decatur, Alabama, plant for the past six years. He previously was employed as a maintenance and reliability engineer in a petrochemical facility for seven years and as a project engineer in a power plant for two years. Mr. Fowler is a graduate of Auburn University with a B.S. in mechanical engineering. Send your comments to jlfowl@-solutia.com

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