Special Seal Surmounts Latex Problem

Custom design provides a cost-effective long-term solution for pumps

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PREVENTING PROBLEMS with mechanical seals used on pumps handling synthetic polymer dispersions (latex) is a major engineering challenge. Essentially, difficulties arise because the polymer dispersions are not thermodynamically stable and tend to coagulate. Polymer particles form compact agglomerates that quickly can bring the process to a halt.

A leading manufacturer of synthetic latex had to contend with this challenge at its three production facilities at the Marl Chemical Park, Marl, Germany. The latex maker turned to the EagleBurgmann service center at the site; that center, one of ten the company operates, has existed at the chemical park since 2001 to support all the firms and the 70 or so production facilities located there. The service center acts as a local "mechanical seal development resource" and helps inspire ideas for improvement.

The manufacturer produces the dispersions by polymerizing monomers in aqueous solution in a reactor. The resulting milky fluid contains about 50% water by weight and latex particles with a diameter on the order of ten-thousandths of a millimeter. The polymer core is surrounded by a polar shell, which interacts with water, stabilizing the dispersion.

Mechanical seals are used on the pumps at all stages of the dispersion production process, including raw material in-feed, polymerization, dispersion processing and finished-product tank storage. Problems are particularly acute in process steps where the dispersion contains latex laden with residual monomers, for example during dispersion processing. All stages in the production process run at low temperature and pressure, to avoid thermodynamic instability that leads to coagulation, which makes the medium difficult to pump. Adhesiveness, which is desirable in the finished product, can cause leakage or total failure of the seals. Latex adheres to the warmest surface (the seal faces) and after only a few hours diffuses in between the sliding faces. The seals then open against the force of the buffer pressure. Ensuring the shaft seals do not leak is particularly important in this difficult process step.

Double mechanical seals are pressurized with buffer fluid. The buffer pressure acting in the direction of the product side (latex) decreases in the seal gap. As a result, latex and the buffer medium intermix on the product side. Heat from friction in the seal gap prompts agglomeration of the polymer particles. When this happens, the seal gap opens and the seal may be destroyed. The buffer fluid then can leak out or latex can penetrate into the buffer chamber, causing the seal to fail. To avoid this scenario, the EagleBurgmann engineering team had to design a seal that prevents contact between the seal and the product.

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THE SOLUTION

For pumps handling latex that contains monomers, EagleBurgmann engineers developed an enhanced version of a seal that complies with clean air regulations (TA-Luft): a double Cartex cartridge seal with throttle for controlled flushing in the direction of the impeller (Figure 1). A knife-edge placed on the product-side seal face provides an added margin of safety, ensuring the mechanical seal does not fail due to insufficient flushing. The flush throttle ring on the product side and the knife-edge face were optimized. (No shutdown seal is needed because these pumps run continuously.)

The modified seal system opened up an opportunity not previously possible to optimize the pumps (Figure 2) and significantly increase their service

SEAL DESIGN

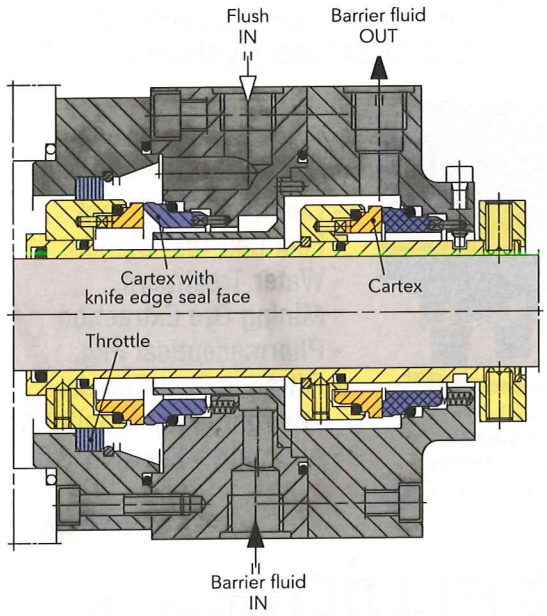

Figure 1. Custom seal features a throttle for controlled flushing as well as a knife-edge on the product-side seal face.

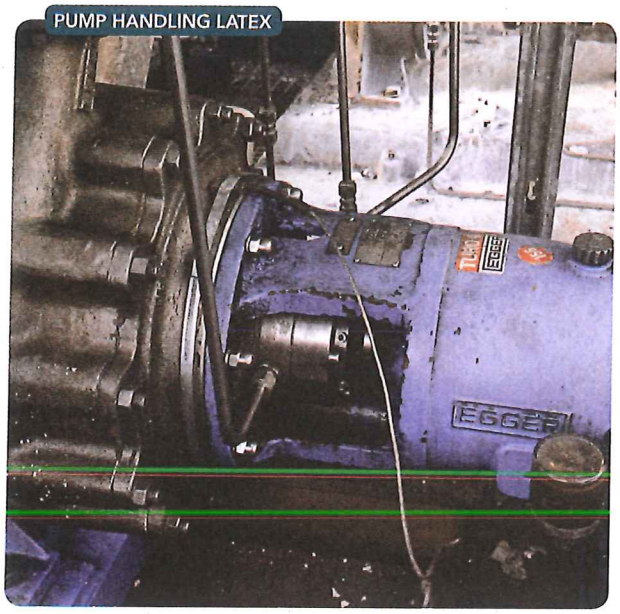

Figure 2. Various stages of the process rely on this type of pump, now upgraded with a custom mechanical seal.

life. Due to shear forces, lumps can form behind the impeller, blocking it and causing the motor to shut down as a result of overload. To combat this, the back vanes on the impellers were removed, reducing shear forces and preventing agglomeration.

The operating mode of the seal also is unusual because there is no pressurized buffer system. An external water supply is used simultaneously for the buffer and flush system. The central water supply affords high availability. An EagleBurgmann FLC flow controller ensures a constant, defined flush flow, which does not depend on pressure.

SIGNIFICANT BENEFITS

In close collaboration with the latex manufacturer, we quickly developed initial prototypes that provide a solution to what appeared to be an intractable problem and then successfully performed subsequent development work. Service life in the most problematic process stage has been increased dramatically from just a few hours of operation to as long as three years. Based on these results, the customer has deployed modified Cartex seals in about 30 pumps and intends to install additional seals. Even when the pumps are removed and cleaned, in most cases the seals are reinstalled "without repair."

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