

Elimination of failure modes significantly increases durability

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Sealing of polymer dispersions (Latex)

Information **EN10091**



A typical tank storage area with transfer pumps

Preventing problems with mechanical seals that are used on pumps and reactors to handle polymer dispersions (latex) is a major engineering challenge. Essentially, the problem is that polymer dispersions are not thermodynamically stable, and they tend to coagulate. Polymer particles form compact agglomerations which can quickly bring the process to a halt. EagleBurgmann has developed a sealing strategy specifically for this difficult application, which provides a cost-effective, long-term solution.

One of ten EagleBurgmann Service Centers has been working on behalf of Infracor, which operates the Marl Chemical Park, to support all of the companies which are located at the site. Three of the 70 or so production facilities at the Chemical Park which receive support from the sealing solutions provider belong to PolymerLatex GmbH, a Joint Venture which was formed in 1996 by Bayer, Degussa and Röhm. PolymerLatex with 613 employees and a turnover of €516 million (2008) is one of the leading producers of synthetic latex. From its European production base, the company

supplies products to customers in the construction, molded foam, glove/latex dip, adhesives, paper, carpet and textile industries worldwide.

Latex is a dispersion of tiny polymer particles in water. The milky fluid contains about 50% water by weight. The diameter of the latex particles is in the order of ten-thousandths of a millimeter. The polymer core is surrounded by a polar shell which interacts with water, stabilizing the dispersion. Synthetic polymer dispersions are produced by polymerization of monomers in aqueous solution in a reactor. Mechanical seals are used on the pumps at all stages of the dispersion production process including raw material infeed, polymerization, dispersion processing and finished product tank storage. The pumps run continuously or discontinuously at different stages in the process.

Demanding application

The engineering challenge is to design seals for the pumps that are used to handle dispersions

(latex). The problems are particularly acute in process steps where the dispersion contains latex laden with residual monomers, for example during dispersion processing. All of the process stages in the latex production process run at low temperature and pressure. One major reason why more extreme production conditions are avoided is the fact that polymer dispersions are not thermodynamically stable and tend to coagulate, making 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 diffuses after only a few hours in between the sliding faces. The seals then open against the force of the buffer pressure. Ensuring that the shaft seals do not leak is particularly important in this difficult process step.

Causes of seal failure

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. Friction heat in the seal gap causes agglomeration of the polymer particles. When this happens, the seal gap opens and the seal may be destroyed. The buffer fluid can then 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 come up with a seal

design that prevents contact between the seal and the product. Because the pumps run continuously or discontinuously depending on the process stage, a different sealing solution was needed for the two different operating modes.

Customized sealing solutions provide the answer

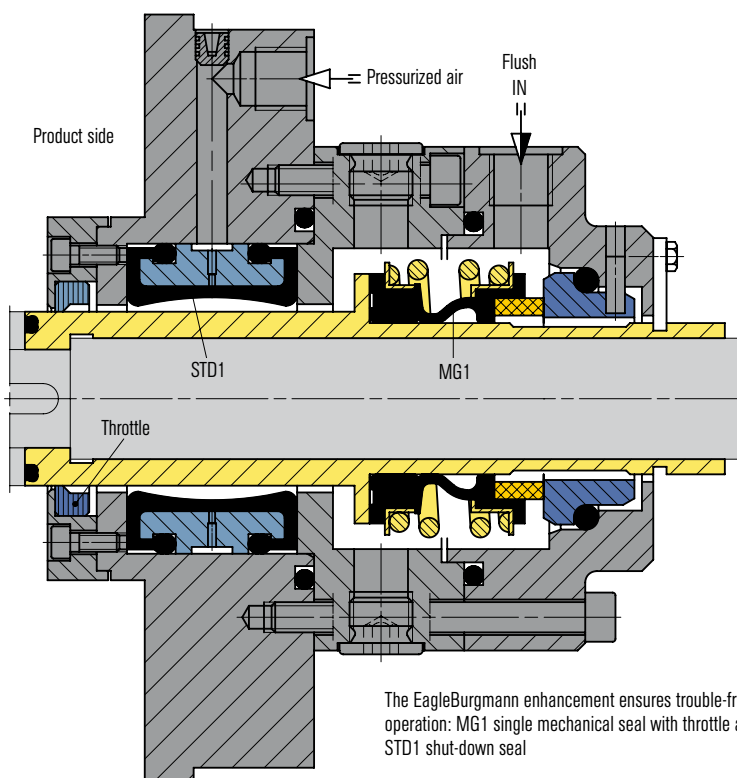
For discontinuous operation, the seal supplier chose an MG1/65-G9 single seal. To prevent contact with the latex, EagleBurgmann added a throttle so that the product-side seal can be flushed with clean water. Water is used in the production process anyway, so using it in limited quantities does not cause problems. To prevent flush water from totally flooding the pump when the pump is shut down and to ensure that residual latex in the pump does not penetrate into the mechanical seal, an STD1 shut-down seal was

installed in the cartridge seal. The seal is automatically pressurized with compressed air following a time delay after the pump is shut down. The bellows seal presses against the shaft, separating the medium from the mechanical seal. Flushing can remain activated during this operation. Nothing flows into the process during this time. Before the pump is started up again, the compressed air is automatically shut off, the bellows retracts from the shaft and the pump starts running. In trouble-free operation with external flush, seal service life now extends well beyond one year.

For pumps that handle latex that contains monomers, EagleBurgmann engineers developed an enhanced version of a seal which complies with clean air regulations (TA-Luft): a double Cartex cartridge seal with throttle for controlled flushing in the direction of the impeller. A knife-edge is placed on the product-side seal face to provide an added

margin of safety, ensuring that the mechanical seal does not fail due to insufficient flushing. No shut-down seal is needed because the pump runs continuously.

Development and optimization for this project included the rubber bellows single seal for discontinuous operation and the double cartridge seal with flush throttle ring on the product side and a knife-edge face. These mechanical seals also created an opportunity to optimize the pumps and significantly increase their service life. Due to shear forces, lumps can form behind the impeller, blocking the impeller and causing the motor to shut down as a result of overload. The back vanes on the impellers have now been removed, reducing shear forces and preventing agglomeration. These modifications along with other improvements which extend the total service life of the pumps were only possible in conjunction with the modified seal system.



The EagleBurgmann enhancement ensures trouble-free operation: MG1 single mechanical seal with throttle and STD1 shut-down seal



This type of pump with special EagleBurgmann cartridge seal is used at various stages in the process.



FLC flow controller

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

Efficiency and productivity gains

Eight seals are now running continuously and one is operating in discontinuous mode. The customer is completely satisfied with the results. "The level of collaboration between our company and the EagleBurgmann Service Center has been excellent since day one. Through a very constructive and professional joint effort, we very quickly developed initial prototypes which provide a solution to what appeared to be an intractable problem," said PolymerLatex Engineering Manager Christian

Scholten. Subsequent development work has been equally satisfactory. Service life in the most problematic process stage has been increased dramatically from just a few hours of operation to as much as 1 1/2 years. Based on the good results so far, PolymerLatex is planning to deploy additional modified Cartex seals at the plant. "The Service Center provides a local 'mechanical seal development resource' and 'a source of inspiration for improvement', offering us significant value-add. It helps us to achieve sustained technology improvement," added Scholten.

The service life of the seals currently installed is much higher (as much as 3 years in some cases) compared to the seals that were used previously. Even when pumps are removed and cleaned, in most cases the seals are reinstalled "without repair".

