When and where do I apply lip seal technology in my process?

Because of the unique problems experienced with highly viscous fluids that can crystallize to form abrasive particles, as well as those with adhesive tendencies, an alternative to face seals is often preferred. Radial face or lip seals provide many performance advantages when these fluids are being pumped. Traditionally, lip seals have been used to seal low (7-psi to 10-psi) pressures, but newer lip seals designs now can seal 150-psi or greater on rotary equipment.

This relatively new version of the older technology has evolved because of the advancements in sealing element materials. The current lip-sealing devices are primarily designed for positive displacement pumps and centrifugal pumps up to 1750-rpm, but can be applied to other types of rotating equipment as well. They are offered in various designs from single lip seal to multiple lip cartridge versions. There are designs for vacuum and mixer service (incorporated with an expansion joint) that can combat excessive shaft movement from radial, axial, and angular vibration.

Lip seals are particularly effective in applications with process fluids such as adhesives, asphalt, polymers, caustics, chocolate, fuels, latex, molasses, oil, resins, soaps, syrups varnish, etc. These can be some of the most difficult pump sealing applications.

Guidelines for Application of Lip Seals

- High-Pressure Lip Seals should not be used where abrasives are present. Some products are only abrasive when they solidify. If this can be prevented with environmental controls, they can be sealed with the triple-lip seals. However, lip seals should not be used for inherently abrasive products such as titanium dioxide, lime slurry, or similar materials. These seals are designed to handle thick, viscous, solidifying, salting products, not abrasives.
- If you have a pump with high shaft whip (Flex Factor above 50), a lip seal will not be appropriate. However, special designs may be feasible for mixer seals.

High-Pressure Lip Sealing Technology

Any seal alone will not prevent a product's tendency to change state and cause sealing issues. In many cases environmental controls are recommended to circumvent this problem and enhance seal life.

Newer lip seals designs with dimensionally stable sealing elements have only one moving part (the seal sleeve/pump shaft). The seal has no springs to clog and the sealing element does not allow product between the stationary and dynamic sealing surfaces. There is a *positive seal* at the tip of the sealing element. The lubricity that is required to prevent excessive frictional heat is provided by a smooth hard-face coating on the shaft sleeve (typically chrome oxide) and the inherent lubricity of the lip material itself.

Materials for the sealing elements should have good lubricating qualities, not cold-flow, be chemically resistant and have good recovery (memory) characteristics through a wide temperature range. The memory characteristics can easily be checked by determining how snugly the sleeve is gripped by the lip seal when turning the shaft. If the sleeve is loose and/or easy to turn, the lip seal will probably leak at low pressure. The sealing material also should transfer frictional heat from the rotating surface and should not cause product contamination.

Most high-pressure lip seals with the newer dimensionally stable sealing elements are very sensitive to radial shaft movement, so it is important that the shaft is stable and the seal is mounted to the equipment absolutely concentric and square to the shaft. Correct seal installation can make the difference between three years service life and two weeks, or less.

Environmental Controls Improve Seal Performance

The versatility of the multiple lip high-pressure seal can be enhanced by various environmental controls. Many will not contaminate the process fluid and will offer an indication of when a new repair kit is required.

Some process fluids are heat sensitive, some are oxygen sensitive, and some solidify with moisture. To achieve

effective sealing of these products, one must first know what causes each to change state and act accordingly.

Example Products

1. In the case of clean *Asphalt*, heat will prevent solidification. For best results, inject 2-psi steam into and out of the seal ports (between the second and third sealing elements) to a drain. If steam is not available, plug the bottom seal port and use a standpipe of heat transfer oil.
2. In the case of clean *Latex* or *Water-Based Glue*, a simple water quench of only a few drips per minute (into the bottom of the seal and out the top) between the second and third sealing elements will work.
3. The adhesive *TDI* (toluene-2, 4 diisocyanate) is sensitive to moisture. The triple-lip seal has been used effectively with no environmental control, as has a standpipe containing a moisture free liquid that is non-hygroscopic.
4. When sealing *Caustic*, use the same arrangement as for latex.
5. *Sugar Water*, *Syrups*, and *Molasses* can be sealed the same as latex and caustic, but the water should be warm to prevent sugar adhesion to seal parts. **Caution** should be exercised to prevent overheating the quench water. Sugar will caramelize and discolor if overheated.
6. Most *Oils* and *Soaps* can be sealed by plugging the inlet and outlet ports with no environmental controls. Often, a user will put a tube with a petcock on the bottom port of the seal to indicate when the second sealing element is leaking, and thereby prevent slinging oil or soap around the workspace. The petcock can then be closed, and a repair kit scheduled without shutting down the process.

Conclusion

Lip seals with dimensionally stable elements are a viable option when sealing some of the more difficult pump system applications. This innovative technology has proven to provide an effective sealing solution in a variety of applications over the past fifteen years.

Some have been disappointed in this technology because they were unaware of the criticality of concentricity, shaft flex, and how the various environmental controls differ from those used for face seals. However, when applied within the manufacturer's published limits, with the proper seal design, expertly centered with the proper environmental controls, these seals can be real money savers.

Consult with the manufacturer to ensure that the lip seal you have selected for your service is acceptable under the required operating conditions. And, always follow good installation practices to ensure a long lasting, tight seal.

Next Month: *How long will my mechanical seal last?*

We invite your questions on sealing issues and will provide best efforts answers based on FSA publications. Please direct your questions to: sealingquestions@fluidsealing.com.

P&S

Fluid Sealing Association

Sealing Sense is produced by the **Fluid Sealing Association** as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs, and reps. As a source of technical information on sealing systems and devices, and in cooperation with the **European Sealing Association**, the FSA also supports development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump systems technology issues on rational Total Life Cycle Cost principles.

The **Mechanical Seal Division** of the FSA is one of five with a specific product technology focus. As part of their educational mission, they develop publications such as the *Mechanical Seal Handbook*, a primer intended to complement the more detailed manufacturer's documents produced by the member companies. Joint FSA/ESA publications such as the *Seal Forum*, a series of case studies in pump performance, are another example as is the *Life Cycle Cost Estimator*, a web-based software tool for determination of pump seal total Life Cycle Costs (LCC). More recently, the *Sealing Systems Matter* initiative has been launched. It is directed to support of the case for choosing mechanical seals that optimize life cycle cost, safety, and environmental compliance.

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