SPECIFYING SEALS AND BEARINGS FOR MECHANICAL CONVEYORS

This article outlines how seals work and discusses application examples of seals and bearings used with mechanical conveyors.

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No application is routine, even for screw conveyors and bucket elevators, which are the workhorses of solids processing. As you specify the build details of your mechanical conveyors, remember to verify the compatibility of the auxiliary components, especially the seals and bearings.

These components, like the conveyors themselves, must be designed and built to suit the product and process. What type of seal should you use? What materials are inside the seal? What bearing material is best? By doing a little research upfront, you can learn which materials and configurations will work best in your application. This will not only extend the service life of your conveyors and components but will also give you better process performance.

Packing glands vs. mechanical seals

Packing glands are the most common shaft seal. They include a housing, or stuffing box, around the shaft that's packed with twisted or braided strands of material to form an annular seal. The packing gland remains stationary as the shaft rotates. Packing glands are relatively inexpensive and effective in most conveying applications, but they generate frictional heat as the shaft rotates. Also, abrasive products can combine with the packing material and erode the shaft. Packing glands also require a true-running shaft to seal properly.

Mechanical seals are superior to packing glands, especially in more demanding applications. A basic seal consists of a rotating, spring-loaded seal face that engages a mating, stationary face. Most mechanical seals have an additional elastomer seal between the rotating face and the shaft that prevents product (or unwanted atmospheric gas) from traveling along the shaft and past the seal. The elastomer seal in many mechanical seals also ensures that the rotating seal face turns with the shaft. Many seals can operate without a lubricant fluid, which is important when handling dry products. Mechanical shaft seals are more shaft friendly than packing glands and are better at tolerating shaft runout.

Seal maintenance

Mechanical seals are also rebuildable and safer to maintain than packing glands. The maintenance required varies according to the seal type, but worn rotors, gaskets, O-rings, and elastomers are common replacement items.

Many, if not most, mechanical conveyors use soft-face mechanical seals that don't require external lubrication. These are available with FDA-approved polymers and can include a ceramic to improve wear resistance. Look for seals with components that can be individually replaced. In cases where removing the bearing or drive is difficult, consider split designs. These enable you to quickly disassemble, clean, and rebuild the seals

FIGURE 1

Air-purged seals include pressure gauges that enable you to monitor the seal's internal pressure. Shown here is a horizontal screw feeder handling gypsum.

FIGURE 2

This ATEX-compliant soft-face seal has high inherent lubricity, eliminating the need for a liquid cooling barrier.

TABLE 1

Basic information for specifying conveyor bearings
Nominal housing dimensions
Bearing length
Shaft diameter
Shaft speed
Shaft Load
Operating temperature
Operating conditions (wet, dry, etc.)
Product characteristics

FIGURE 3

Ceramic and wood hanger bearings for use in abrasive applications.

without having to remove the shaft bearings or drive assembly. Seals used in explosive environments will usually include static-discharge brushes that electrically ground the shaft. These brushes wear out, and you must replace them periodically.

Some seals use a barrier fluid to pressurize the seal cavity. In those applications, you can monitor wear with a pressure gauge installed on the seal, as shown in Figure 1. A pressure drop could indicate that the seal needs adjustment or maintenance. Chronic or severe pressure drops could indicate a seal overhaul is needed.

Seals for explosion prevention

Shaft seals and other components give off heat and/or discharge static electricity as the equipment operates, and few processes warrant more attention to detail than those involving potentially explosive materials. While using a liquid barrier to cool the shaft seals is effective, this approach is usually unacceptable in dry processes. But alternatives exist. Figure 2 shows an ATEX-compliant soft-face seal that uses high-lubricity materials instead of a liquid cooling barrier.

The prescribed temperature and pressure limits of the machinery and process will guide your seal choice. These parameters vary considerably so each seal must be engineered individually. This will prolong sourcing and manufacturing, so plan accordingly.

Seals for sanitary applications also require special attention. See the sidebar for tips on what to watch for.

Bearings for abrasion resistance

Bearing materials vary greatly in their properties so determining which material has the characteristics best suited to perform in a given process is critical. Factors to consider are shown in Table 1.

Wood is a very shaft-friendly material, especially in abrasive and agricultural processes. That's because when an abrasive material invades the journal interface of a wood bearing, shown in Figure 3, it compresses. This enables the wood to capture and absorb the material into its surface, where the material gets covered with a film of oil. As a result, an abrasive that would typically destroy a shaft, instead, becomes a benign part of the bearing. Another benefit of wood is that it releases the lubricant when the shaft begins spinning and the journal interface becomes warm. When the shaft stops and the journal cools, the natural capillary action of the wood retrieves the lubricant.

For dry-running abrasion resistance, consider using hanger bearings made from a ceramic-PTFE composite, also shown in Figure 3. The combination of these materials provides the wear resistance of a ceramic with the dry lubrication of PTFE. This FDA-approved

FIGURE 4

A soft-face seal with an anodized aluminum housing and stainless steel stator installed on the 40-millimeter-diameter shaft of an inclined screw conveyor.

material can be used in a broad range of chemical environments, and the fully split bearings are serviceable in wet and dry processes.

Thinking ahead

Whether you're planning to install new equipment or replacing a seal, know your timeline for delivery so you don't waste time during commissioning or while you're shut down for maintenance. In other words, order early! It's better to request a "do-not-ship-before" date than to wait and attempt to align the timing of your order with the seal manufacturer's lead time. If you wait to get into the production queue, you run the risk of not meeting your schedule.

Keep in mind that the clock doesn't start ticking on your purchase order until the formal approval drawings are signed. Manufacturers of custom seals typically do not place orders for raw materials until that time. Additionally, the seals can't pass quality control until they are fully manufactured and assembled.

Starting early also gives you and the manufacturer time to review and approve the design specifications, including the steps taken to accommodate the abrasiveness, chemical properties, flow characteristics, and temperature of your product and process. **PBE**

Seals for sanitary applications

Seals in sanitary applications usually require stainless steel and FDA-approved plastics and other elastomeric materials. Which combination of materials is best will depend, as always, on a variety of factors. These include how hot the process becomes, how abrasive the product is, and how fast the shaft turns. Talk with vendors about your product and process or fill out the application data sheets they offer. Only then can they recommend the proper seal design for your machine and process.

Questions to consider include: Will the conveyor process a single material or a variety of them? What are the properties of the different materials? What about washdown procedures: How often will the conveyor be cleaned and what chemicals will be used? The answers to these and other questions will determine whether a stainless steel, aluminum, or nylon seal is most compatible and guide the choice of other components, including valves, gauges, and regulators.

For further reading

Find more information on this topic in articles listed under "Mechanical conveying" in *Powder and Bulk Engineering*'s article index in the December 2018 issue or the Article Archive in *PBE*'s website www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

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