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Basic Mechanical Seals

Operating principles & fundamentals behind rotary mechanical seals

Centrifugal and rotary positive displacement pumps require controlling of the pumped fluids desire to exit through the stuffing box, the area where the pump shaft enters the pump fluid end. When operating the pumped fluid within the stuffing box sees a pressure higher than the surrounding atmospheric pressure, and on static lift applications; during the priming cycle, the stuffing box will see a pressure below atmospheric pressure i.e., a vacuum. In either operating condition a mechanical seal will virtually eliminate the release of the pumpage to atmosphere and the entrance of air into a stuffing box when under vacuum.

A basic mechanical seal is not a complex device. It consists primarily of a rotary seal face with a driving mechanism which rotates at the same speed as the pump shaft, a stationary seal face which mates with the rotary and is retained using a gland or in some pump models an integral stuffing box cover, a tension assembly which keeps the rotary face firmly positioned against the stationary face to avoid leakage when the pump is not in operation, and static sealing gasket(s) and elastomers strategically located to complete the seal assembly.

The rotating and stationary sealing faces commonly referred to as primary seal members, are materials selected for their low coefficient of heat and are compatible with the fluid being pumped. Their extremely flat; lapped mating surfaces, make it extremely difficult for the fluid to escape between them. The fluid does however, form a thin layer or film between the faces and migrates toward the low pressure side of the faces. It is this boundary layer of fluid which is used and required to cool and lubricate the seal faces.

To prohibit leakage along the pump shaft through the inside diameter of the rotary and stationary seal faces the mechanical seal assembly uses o-rings, v-rings, wedges and packing. Commonly referred to as secondary sealing members these components of the seal are selected based on fluid compatibility, temperature, elastomeric qualities, and depending on the type and design of the seal they may perform in either a dynamic or static state.

Mechanical seal hardware represents the components required to apply mechanical tension to the rotating and stationary seal faces. This hardware; depending on seal design, can include springs, bellows, retaining rings, and pins. Not to be overlooked, hardware materials must be constructed of suitable metallurgy compatible with the fluid. An appreciation of seal driving hardware is also extremely important when sealing viscous products as ample torque to rotate the seal must be made available when the fluid is at its standing viscosity when starting a pump, and effective viscosity at operating conditions.

Mechanical seal selection should never be addressed as simple, easy or standard, as it is this approach which results in inadequate performance. A mechanical seal will only perform as well as all the sealing components combined and any options and auxiliary systems which may be required. Failure to properly address any portion of the mechanical seal chain could result in catastrophic failure, down time, considerable damage and expense, and most importantly personal injury and possible damage to the environment.

Specific pumping application requirements will determine the complexity of the seal design to achieve optimum performance. Mechanical seal configurations and options are as vast as pump models and designs. Addressing all the application parameters and fluid behavior characteristics will result in long trouble free mechanical seal service and enhanced pump and process performance.

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