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EVALUATING THE PERFORMANCE OF MODEL MECHANICAL SEAL DESIGN

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ABSTRACT

Process industries that used pumps, to move the process from one location to another, find that the major reason for down time was the failure of the mechanical seal. Mechanical seals are the most economical way to control leakage from centrifugal pumps and mixers. The functions of these seals are twofold; they isolate the shaft housing from leaking process fluid and reduce leakage to the environment.

To ensure longevity, it is important that the contact surface of the static and rotating ring component of the mechanical seal operate at the lowest temperature possible. Also, the temperature at the contact surface is uniform. This is necessary to reduce waviness (deviation from flat) radial taper (deviation from flat in the radial direction) and thermo-elastic instabilities.

For mechanical seals, temperature is a measure of performance. Increase temperature corresponds with increase wear. This ultimately accelerates the leakage rate and ultimately failure. To prevent this, it is important to design mechanical seals, so that the interface temperature is kept at a minimum. Most design used a flush to as a heat exchanger to reduce the heat generated at the contact.

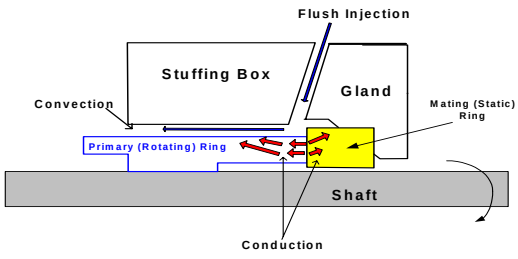

Figure 1 Flush as the heat exchanger

There are other designs that used a closed loop, independent of the flush to provide the coolant as a source of heat exchange. In practice the closer you can get the coolant, to the surface where the heat is generated, the better the performance of the seal. New designs were made that get the coolant as close as possible to the interface without damaging the structural integrity of the seal. These designs were for both the conventional and modified type.

Test was done as prescribed using the API manual. API Standard 682 has three criteria for testing mechanical seals. Dynamic phase, where tests are done at constant temperature, pressure at 3600 rpm.The test has to be done for over 100 hours and at base point conditions. Static phase, tests are done at constant pressure and temperature at zero rpm for four (4) hours. Cyclic phase, tests are done at variable temperature, pressure at 3600 rpm until equilibrium is established. A test rig was design that enables us to run tests that satisfy the API Standard 682 (API Standard Manual). Temperatures for the coolant at inlet and discharge were measured along with the temperature of the static ring at two locations. It is important that the surface temperature for the static ring is measured in more than one place so that you can ascertain, if the temperatures throughout the surface are uniform. To evaluate the performance of the model designs, tests were done and temperature measurement was taken. These measurements were for the existing conventional design and the new models. Measurements were taken using J-thermocouples, Stanford Research thermocouple reader and a Webdaq thermocouple reader. These instruments were attached to a computer and the results were analyzed and stored after each test.

Analyses of these results so far, show that the modified mating ring and the model fin ring have a more uniform temperature profile at the interface. Mat lab codes were used to calculate the heat generated at the interface. For a rotating cylinder, the heat transfer convection coefficient dominates and it varies depending on the size on the static ring and the speed of rotation (Buck, Gordon, S, Estimating Heat Generation, Face Temperatures and Flush Rate for Mechanical seals, John Crane Inc.).

Figure 2 Test rig used (Courtesy of Senior design 2003)

All of these factors along with the pressure within the stuffing box and the operating parameters for the pump are important for proper analysis. FEM analysis is being done to determine the heat transfer characteristics of the seal for comparison with experiments

Due to the fact that the model designs have a more uniform temperature profile, waviness and irregular wear profile are reduced. Also since the modified ring operates at a lower surface temperature within the same environment it life expectancy will be longer.

ACKNOWLEDGEMENTS

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