MECHANICAL SEAL PROBLEMS

IN

HIGH TEMPERATURE

HEAT TRANSFER SYSTEMS

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The use of mechanical seals in high temperature heating systems has gained universal acceptance as the preferred sealing method for rotary equipment. Even though the state of the art of mechanical application has progressed greatly in recent years, seal failure is still a common occurrence. Certain conditions can develop within the seal environment of a high temperature heating system that will increase the incident of seal failure. This bulletin lists our suggestions and experience for Therminol ® Heat Transfer Fluids relative to mechanical seal problems.

The most critical conditions that affect the service life of a mechanical seal are heat, pressure, corrosion, cavitation, and product characteristics. The Therminol fluids can have affect on, or be affected by, any or all of the above conditions.

Other conditions such as shaft deflection, bearing wear, vibration and poor installation can also affect the life of a seal, but these problems are usually minimized by proper pump selection for the intended service and proper maintenance.

Heat

Excessive temperature at the mechanical seal frequency leads to premature failure. The seal environment should not normally exceed 300°F. for most heat transfer fluid applications, including the Therminol fluids.

Common seal face materials, such as carbon, Stellite and Tungsten Carbide require some degree of fluid film lubrication. High temperatures decrease lubricity and the resulting friction and heat build-up can promote abnormal face wear. Therminol fluids provide excellent lubricating characteristics below 300°F.

Excessive temperatures can also cause vaporization of fluid at the seal face resulting in no lubrication and/or mechanical damage to face materials such as carbon. Therminol fluids are low vapor pressure high boiling compounds that do not normally vaporize over their use range. However, some thermal decomposition products of Therminols 55 and 66 are lower boiling components and could cause vaporization conditions at the seal face.

Dead-ended stuffing boxes provide little chance for fluid circulation and are frequently collection zones for abrasive or corrosive system dirt that can damage the seal faces.

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In addition to stuffing box and seal gland cooling to control seal temperatures, many high temperature pump suppliers offer a seal flush system which provides a cooled, filtered supply of the pumped fluid to the seal faces.

Seal flush systems have minimized mechanical seal face wear in many high temperature applications. We suggest seal flush systems be considered where Therminol fluids are used.

Pressure

Hydraulic seal face loading depends on the stuffing box pressure and type of seal used. Generally a single, inside, unbalanced or partially balanced seal is used in high temperature Therminol applications. Excessive face pressure, either hydraulic or installation imposed, can reduce face lubrication, increase frictional heat build-up, and cause face distortion resulting in reduced seal face life.

Pressure surges and hydraulic shock created by automatic valving within the system can also have a damaging effect on seal life. While not a common problem, proper valve selection and operation of the system hydraulics can minimize this type of overload on the seal faces.

Corrosion

Many heat transfer fluids can create -- through decomposition or contamination -- a corrosive environment at the mechanical seal. Therminol fluids do not normally create corrosive conditions within the heating system. And, even though most heating fluids are miscible when added together, certain chemical incompatibilities can result in a corrosive environment at the seal.

Acidic conditions can result in the formation of acidic metal salts which can be abrasive to seal faces when present in the fairly quiescent environment of a dead ended pump stuffing box.

When corrosive conditions develop along with corrosion by-products that affect seal characteristics, the system fluid should be changed to a fresh charge.

A flush of the corrosive system may not necessarily resolve the problem since fresh fluid can loosen existing system soil. A more effective cleanout of the system may be necessary to remove the corrosive products along with other system soils.

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The seal flush mentioned above can also be effective in minimizing excessive seal wear by removing harmful corrosive deposits.

Therminol 55, 66, 77 and 88 do not, in themselves, give rise to corrosive products that would affect seal performance.

Cavitation

Cavitation -- the formation and collapse of vapor pockets from fluid near its vapor point or from low boiling components in the fluid -- does not normally have a direct effect on mechanical seals.

However, frequent or continuous cavitation at the pump can bring about pressure variation (discussed above), shaft deflection, vibration or mechanical shock damage to seal components.

An effect similar to cavitation, entrained gases or rapid liquid to vapor phase change, can produce a chattering effect on the seal causing face damage and leakage.

System design, with attention to NPSH* requirements of the pump, usually corrects cavitation problems.

Many heat transfer fluids form lower boiling components on thermal or oxidative decomposition that can result in cavitation conditions.

Therminol 55 and 66 can form low boilers from thermal damage. Venting a slip stream of pumped fluid to a nitrogen or CO_2 inerted and outside vented expansion tank will relieve low boilers from the fluid. Any vented material should be collected for proper, non-polluting disposal. Inerting prevents oxidation damage to the fluid.

The seal flush system -- mentioned above -- provides a continuous venting of the stuffing box in addition to cooling and, even, filtering of the flush box.

Product Characteristics

Characteristics of the heat transfer fluid, such as system dirt pickup, decomposition products, chemical compatibility, sludge formation, oxidation resistance, vapor pressure and lubricity can have an effect on mechanical seal performance.

*Net Positive Suction Head

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Abrasive particles are a major contributing factor to seal failure, particularly particles under 200 mesh size. These particles, other than rust and scale usually found in the piping system, can be: thermal decomposition products such as salts, oxides and tars; carbonaceous oxidation products from certain types of fluids; dirty and dusty environment external to the seal; or combinations of these.

Rust and scale usually found in the pipework are frequently loosened by heat transfer fluids and circulated throughout the system. Filtration is effective in removal of these particles.

Decomposition products from certain fluids can create conditions that are detrimental to seal performance.

Acidic decomposition products, for example can not only catalyze further decomposition of the fluid, but establish a corrosive seal environment discussed earlier.

Oxidation products from many fluids develop into abrasive carbonaceous deposits that can seriously affect seal face wear. Air contact should be minimized with those fluids having oxidative instability. Cold or inerted (nitrogen) expansion tanks will reduce oxidation problems and potential seal problems from oxidation residues.

Many fluids are chemically incompatible with one another in heating applications. Certainly, any change of heating fluid or top up with another fluid should be thoroughly evaluated to preclude seal and other system problems.

Most heat transfer fluids are capable of forming high boilers and tars on thermal decomposition. These tars have a sludge-like characteristic and tend to be abrasive to the seal faces.

We have observed this sludge-like deposit as an uneven coating on mating seal faces which prevents sealing of the surfaces and resultant leakage.

All Therminol fluids are low vapor pressure, high boiling compounds. Vaporization of the fluid is not expected under conditions of proper pump selection and operation. Low boilers of Therminol 55 and 66 can develop occasionally from over-heating or excessive oxidation. Venting of the system, as discussed in the section on Cavitation, generally resolves the immediate problem. Certainly, we suggest attention to operating conditions that might bring about low boiler formation, e.g., air contact or over-heating.

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Lubricity of clean Therminol fluids has been shown to be adequate for seal faces, even at seal environment temperatures above 300°F. Some work on uncooled seal applications using improved face materials shows reasonable lubricity at pumped fluid temperatures approaching the fluid boiling point with 75°F. However, we suggest seal environment temperatures be maintained below 300°F. for long term service.

Virtually all heat transfer fluid systems generate dirt or debris with use that can affect seal performance. We suggest you contact your mechanical seal or pump supplier to determine how seal failures can be minimized.

In summary, we feel a clean and cool mechanical seal environment is a prerequisite to satisfactory seal service in high temperature heating systems.

As a heat transfer fluid supplier, we welcome the opportunity to work with you and your seal or pump supplier on application of the Therminol fluids.

Attached is a partial listing of pump and seal suppliers for high temperature heat transfer systems.

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