Flexware®

Turbomachinery Engineers

A Veteran & Employee Owned Small Busness

Flexware Sleeve Seal

Case Study

The following Flexware® sleeve seal came out of service after three and one half years of very rough duty and it is in pristine condition. While just slightly scuffed on the seal ring bores, the seal ring bore dimensions were inspected and found to be within original specifications.

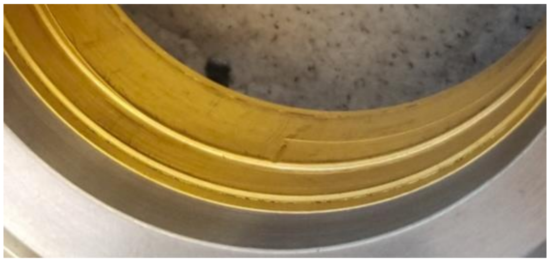

Figure 1. Photo of seal after three and one half years of rough duty. Note some scuffing marks but dimensionally per spec.

"The Lead millwright was happy with the ease of install."

The seal was cleaned up, new o-rings installed and returned to the warehouse for the next compressor overhaul.

Flexware® Gold Babbitt

Flexware® gold Babbitt is a highly superior Babbitt compared to lead or tin babbitt. It is exceptionally resistant to corrosive attack and will not cold flow like lead or tin Babbitt due to a hard sustained rub.

Bonding of the Flexware®gold Babbitt to the base metal is superior to that of tin or lead Babbitt. The Flexware® gold Babbitt is electroplated while the tin or lead Babbitt used on other sleeve seals is centrifugally cast.

High Contaminated Leakage Rates

High contaminated leakage rates in sleeve seals are caused by large seal clearances caused by:

a) Design
b) Seal rubs or
c) Babbitt corrosion

The seal leakage rates through the bushings are a function of the clearance cubed. This results in very large changes in leakage for very small changes in seal clearance. Thus, very tight clearances and strict quality control are crucial to superior seal leakage rates.

A seal rub can cause the lead or tin Babbitt material to cold flow. A hard rub can cause corresponding high localized temperatures softening the lead or tin Babbitt and allowing it to flow increasing the clearance. As the temperature of the lead or tin Babbitt increases, the lead or tin Babbitt softens well before the melting temperature. It becomes similar to soft butter at room temperature. Very slight pressure will deform the lead or tin Babbitt and increase the clearance.

With Flexware® gold Babbitt , the melting temperature (1945 F) is much higher than the industry standard lead or tin Babbitt (464 F) so it can take a hard rub much better than lead or tin Babbitt.

With corrosion of the lead or tin Babbitt, the material swells, causing reduced leakage and higher operating temperatures and eventually rubs. The rubs will cause localized heating of the lead or tin Babbitt. The material then can flow creating a leak path and high contaminated leakage.

Oil varnishing can lead to the same issues. Additives in the oil precipitate at high operating temperatures leaving deposits, tightening the clearance, reducing the cooling oil flow and raising the local temperature in an ever increasing spiral.

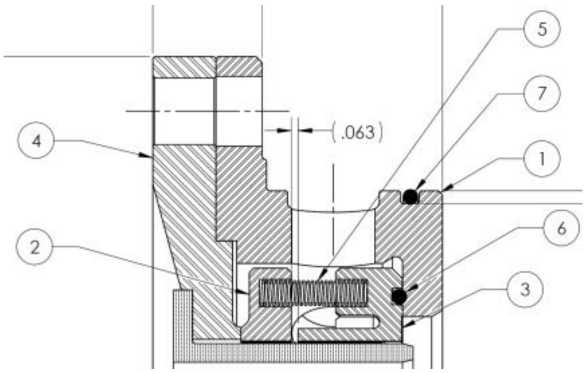

Figure 2. Flexware® cartridge sleeve seal: 1) inner hsg, 2) outer seal ring, 3) inner seal ring, 4) outer hsg, 5) springs, 6 & 7) O-rings.

Flexware, Inc., Jeannette, PA 15644, U. S. A.,

Ph 724-493-7906, sales@flexwareinc.com ,www.flexwareinc.com

If the clearance increases on the gas side (inner) seal, the contaminated leakage increases accordingly.

If the clearance increases on the breakdown bushing (outer seal ring) the seal oil supply to the seal will increase accordingly. This in turn increases the pressure drop from the seal oil differential control point (“T” connection, Figure 4) to the seal cavity and reduces the pressure drop across the inner seal ring. A side effect can be gas migration into the seal cavity and the seal “blowing gas”.

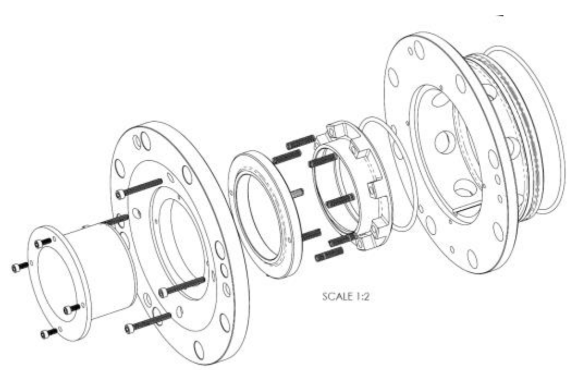

Figure 3. Expanded view of Flexware® cartridge sleeve seal.

Seal Oil System

The seal oil system must be in good working order and clean. Any debris in the system can get into the seal rings and cause scoring of the seal bores leading to increased contaminated leakage rates. To be sure the system is clean, it should be chemically cleaned by a reputable company prior to installing the new seal parts.

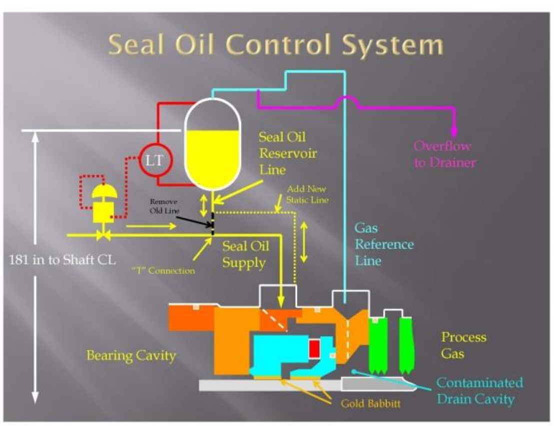

Figure 4. Seal oil control system. Add a new static line (yellow dotted line) to the overhead tank to improve controllability.

Chemical cleaning should include all supply and return piping, all tanks and system chambers. The system should then be filled with clean oil, preferably Mobil 797 turbine oil.

The overhead tank is located 181” above the shaft centerline and the oil control valve is set to control this level providing a 5 psi seal oil pressure above the compressor discharge end contaminated drain line. One problem with this is that there is a pressure drop from the “T” connection (Figure 4) to the seal cavity and this pressure drop is a function of the seal oil flow rate. This pressure drop reduces the 5 psid across the gas side seal ring and can result in gas crossing over into the seal cavity if this psid is reduced too much.

In order to prevent gas from entering into the seal oil, the “T” connection should be moved as close as possible to the seal oil cavity itself. Ideally, an additional line is drilled into the compressor seal housing to provide a static connection to the overhead tank. Alternately, the “T” connection can be moved closer to the compressor, just outside the seal housing.

In addition to moving the “T” connection closer to the seal cavity, consider reducing the cooling oil flow through the seal. The reduced flow rate will reduce the pressure drop to the seal and thus improve the differential pressure across the gas side seal. This is possible with the gold Babbitt as it can withstand much higher temperatures than the tin or lead based Babbitt.

Seal Replication & Replacement

The original OEM seal parts are sent to Flexware® where the parts will be measured and drawings completed for replacement parts. The inner and outer seal rings will be replaced with Flexware® seal rings and will have Flexware® gold Babbitt. The outer seal ring will have a similar configuration as the original OEM part but with a reduced clearance. The inner seal ring will be modified for improved cooling and will have a special windback groove with a clearance of 2 to 3 mils diametral for reduced leakage.

Springs separate the inner and outer seal rings and provide force on the inner seal ring o-ring to assure a seal between the inner seal ring and the housing.

Cost of Flexware® Gold Babbit Cartridge Sleeve Seal

The cost of the Flexware® gold babbit cartridge sleeve seal is very competitive with the original OEM sleeve seal and as a bonus, the cartridge seal is very easy to install.

Recommendations

The following is recommended to improve the overall long term seal life and reduced contaminated leakage rate to less than 10 gallons per day per seal:

1. Replace the existing OEM sleeve seal with a Flexware® cartridge seal that will fit into your existing cavity.
2. Reduce the oil flow rate to the seal to reduce the pressure drop from the “T” connection to the seal cavity by reducing the outer seal ring clearance.
3. Have Flexware® personnel present to assist with seal removal, assessment of parts removed and installation, testing and startup of new parts.
4. Clean the seal oil system to minimize the chance of scoring the seal rings.
5. If at all possible, move “T” connection closer to the seal cavity to assure 5 psid across the inner seal ring.