Q. How important is chemical resistance for selection of a pump packing?

A. Compression packings serve as dynamic seals on rotating or reciprocating machinery such as pumps, and static seals in valves as well. Packings have been effective seals in a mechanical coupling where some form of movement between the surfaces to be sealed is intended or anticipated.

Historically, most packing has been in the form of braided materials which are shaped by manually-adjusted compression to provide a controlled seal. More recently, molded materials have been successfully applied as well. In either case, its purpose is to contain a fluid under various operating conditions and then protect the immediate environment from contamination. The packing material must seal liquids or gases within an assembly (allowing for motion) and maintain this seal under various operating conditions.

Many environmental conditions and factors influence the sealing performance of packing. Packing must be carefully selected to meet specific application requirements. Packing effectiveness will be determined by its resistance to the environment and adaptability to the mechanical system in which it operates.

In order to ensure good performance over a reasonable lifetime, packing selection must consider the following criteria: the compatibility with the operating fluid, operating temperature and pressure, static or dynamic seal, shaft rubbing speeds and stuffing-box temperature.

In spite of the importance of all of them, let’s just focus on the packing chemical compatibility.

One of the most important characteristics to be considered is the chemical resistance of the packing to the sealed media. Compatibility is determined by whether its physical and chemical properties are adversely affected by exposure to the media.

Packing materials may respond in several ways to the chemical attack. For example, interactions involving swelling, shrinking, and physical degradation may occur and cause leakage and contaminations of the sealed fluid. Furthermore, a chemical reaction between the packing material and the sealed fluid can also occur resulting in corrosion.

Figure 1 below shows a packing that suffered chemical attack. Color change and material degradation can be easily observed when comparing a virgin packing with the same material after immersion in an aggressive chemical.

There are many types of packing materials. Each packing type is comprised of a unique material or combination of materials and construction designed to provide a seal in specific applications. There is a wide variety of materials that can be used, including cellulose, synthetic fibers such as carbon, aramid and polytetrafluoroethylene, as well as elastomers, flexible graphite, etc.

In general, manufacturers have catalogs that provide a chemical compatibility table with the most common fluids that can help a user to choose the right product for each application. It is important to note that there are many different kinds of fluids used in industry, and that the degrading affects of many fluids on packings increases as temperature rises.

As a rule, the higher the temperature, the more critical the selection of the proper packing. For fluids or conditions that are not listed by the manufacturer, the user should seek
technical assistance for that particular application. It may require an independent study to determine the compatibility of the packing material with the fluid at the operational conditions.

A number of analytical instruments are used to identify and screen potential materials for use in various pump applications. The information from these tests can be used to identify components, detect variations in formulation and infer performance of the final product. Many of these laboratory test procedures must to be conducted by an analytical specialist with the technical support department providing specific recommendations.

Example of a Packing Chemical Compatibility Analysis

Many analytical techniques can be used to determine the chemical compatibility of a packing material.

One of these techniques is Thermal Analysis. It involves characterizing materials by measuring changes in the physical or chemical properties resulting from controlled changes in temperature.

One of them is the Thermogravimetric Analysis (TGA) that can be used to evaluate packing chemical compatibility by the comparison of a material before and after being exposed to a fluid. The Thermogravimetric Analysis involves measurement of a weight change in a sample as it is heated or held isothermally at a specific temperature, in a controlled atmosphere.

This analysis allows determination of organic components, and also levels of inorganic fillers in a packing. In this way, the thermal behavior of a packing that has been exposed to the fluid is compared with a virgin sample to verify if there were changes in its composition.

Figure 2 on the next page shows the comparison of weight loss for a packing before and after immersion in the test fluid for one day at 176-deg F. In this analysis, it is possible to verify the difference in degradation behavior of both samples between 750-deg F and 1290-deg F.

In the sample immersed in the test fluid, major degradation begins at 750-deg F, while in virgin material it occurs at 930-deg F and the curve slope is different in that range, indicating chemical attack of packing by the fluid.

This is an example of a packing material that does not have chemical resistance to the test fluid. It should not be used in applications with this fluid at this immersion test temperature.

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Fluid Sealing Association

Sealing Sense is produced by the Fluid Sealing Association as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs, and reps. As a source of technical information on sealing systems and devices, and in cooperation with the European Sealing Association, the FSA also supports development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump systems technology issues on rational Total Life Cycle Cost principles.

The Compression Packing division of the FSA is one of five with a specific product technology focus. As part of their mission they develop publications such as the joint FSA/ESA Guidelines for the Use of Compression Packings and Pump & the Valve Packing Installation Procedures pamphlet. These are primers intended to complement the more detailed manufacturer’s documents produced by the member companies. In addition to English, they are available in a number of other languages, including Spanish and German.

The following members of the Compression Packing division sponsor this Sealing Sense:

- Advanced Energy Technology, Inc.
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Recommendation
Since the packing cost is insignificant when compared with the cost of down time or safety considerations, the choice of the right product is an important objective. The FSA members have facilities capable of evaluating the chemical compatibility of the products with most industrial media. When in doubt, it is advisable to consult the manufacturer for proper guidance.

Next Month: How can I troubleshoot bolted flange connection leaks?

We invite your questions on sealing issues and will provide best efforts answers based on FSA publications. Please direct your questions to: sealingquestions@fluidsealing.com.