

SEALING SENSE

How do I choose the right gasket for pumps in chemical service?

If a gasket is not compatible with the process media, chemical attack will begin to degrade it. Once this degradation begins, eventual failure of the gasket with resultant leakage is inevitable. A familiarity with the chemical resistance of various gasket materials is essential.

Figure 1 shows a failed gasket due to a chemical attack. Color change and material degradation can be seen near the gasket inside diameter.

With many categories of gasket materials available and variations within the categories, selection of a gasket for chemical service may sometimes be a little tricky. Gasket selection must be made with all the service conditions in mind, including temperature, pressure, nature of the fluid, as well as the design itself.

The service conditions should be checked against the temperature and pressure ratings for the gasket. Some services will immediately point to obvious gasket choices, but at other times there will be many gasket types that can handle the fluids, temperature, and pressure. Then how do you choose correctly?

The first question to ask is: "What type of gasket was this equipment designed to use?" The load available to compress the gasket is the most important of the many design considerations. Some considerations may not be as obvious, such as those for pumps or valves that utilize a groove for the gasket. Groove designs that are intended for a rubber O-ring may not be appropriate for other types of gaskets. Likewise, elastomeric gaskets can't be used to replace harder materials in some designs.

Some choices will be made simply because the valve or pump must be capable of handling all possible fluids encountered in the plant. In other cases, the service may require that the sealing materials comply with FDA regulations for food or pharmaceutical applications, or the unit may need to meet certain fire-safety requirements.

Some of the more common gasket materials for chemical services include rubber or elastomers, compressed non-asbestos (CNA), PTFE, flexible graphite, metals, and semi-metallic composites. Not all gaskets are manufactured from a single material so it is important to note that the chemical



Figure 1. Gasket showing chemical attack.

resistance of a filler-reinforced or composite gasket is limited by the least resistant component that is exposed to the process media.

For example, a filled PTFE gasket will be limited by the type of filler used since it is blended with the PTFE and is exposed to the process media.

Let's briefly touch on the characteristics of the various material types to help us with the process for selection of a chemically compatible gasket.

Elastomers/Rubber will seal under lower compressive loads, against larger flange imperfections, and often will provide an extremely tight seal. Elastomers are not always available for ALL fluids the equipment may see, and may not be rated for some higher temperature services, so a specific composition that is compatible with the process fluid must be selected.

Rubber gaskets are available in a wide range of compositions each of which has unique properties, chemical compatibility, and performance characteristics. Common compositions include natural rubber, styrene butadiene (SBR), chloroprene, EPDM, Nitrile (Buna-N), and fluoroelastomers. Fluoroelastomers or fluorocarbon rubbers (FKM) are resistant to a broad range of chemicals including

acids, alkalis, aliphatic and aromatic hydrocarbons, petroleum oils, and animal and vegetable oils. Consult your gasket supplier to ensure the proper selection for your application.

Compressed Nonasbestos (CNA) gaskets are a cost-effective choice for many fluids, especially in utility plant services. Many are appropriate for very high pressures, such as in split case pumps, for example. They should be installed with considerably higher compressive loads than the pure elastomer gaskets. Fiber and mineral reinforcements are bound together by an elastomer.

Fibers typically used are aramid, glass and carbon. Reinforcements are added to improve quality of fiber and binder. Mineral reinforcements can improve chemical resistance, sealing properties, and load-bearing characteristics. Binders include nitrile, chloroprene, SBR, EPDM, and chlorosulfonated polyethylene. Chemical compatibility is dependent on both the choice of binder and reinforcements. The chemical resistance of any CNA gasket should be discussed with the manufacturer to ensure compatibility.

PTFE is widely known for its excellent chemical resistance to virtually all chemicals, with the exception of molten alkali metals and elemental fluorine. PTFE gaskets are available in a wide range of forms including skived PTFE, microcellular PTFE, filled PTFE and expanded PTFE. As mentioned previously, with filled PTFE gaskets or any composite PTFE gasket,

the chemical resistance of both the PTFE and the filler must be considered. Some common fillers used in filled PTFE gaskets include silica, graphite, glass and silicon carbide.

In some gasket constructions, PTFE is used to envelope or encapsulate a gasket material with lesser chemical resistance. In these constructions, the PTFE provides a chemically-resistant barrier to the core material and the gasket has the same chemical resistance as that of the PTFE, since the core material is not exposed to the process media.

Flexible Graphite is a sheet gasketing material with the high temperature and broad chemical resistance characteristics of graphite. Flexible graphite is compatible with a wide range of chemicals from a pH of 2 to 14. Very strong oxidizing mineral acids such as concentrated sulfuric acid, concentrated nitric acid, classes of highly oxidizing organic chemicals such as nitrates, persulfates, perbenzoates and peroxides, and inorganics such as molten sodium or potassium hydroxide and chlorine dioxide can cause chemical reaction and should be avoided.

Above 450-deg C, air- or oxygen-rich environments will cause flexible graphite to oxidize, with resulting weight loss and deterioration of sealing properties. Oxidation-inhibited grades can go to higher temperatures. Flexible graphite is often combined with either metallic or nonmetallic insert materials to make a laminated gasket material that is easier to handle.

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 **Gasket** 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 *Metallic Gasketing Technical Handbook* as well as joint FSA/ESA publications such as *Guidelines for safe seal usage – Flanges and Gaskets* and *Gasket Installation Procedures*. These are primers intended to complement the more detailed manufacturer's documents produced by the member companies. The following members of the **Gasket** division sponsor this *Sealing Sense* series:

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When using these laminates, both the flexible graphite facing and the insert material need to be evaluated for chemical compatibility.

Metallic and Semi-Metallic gaskets are available in various forms and constructions, including solid rings, corrugated metal, spiral wound, and serrated metal with covering layers (SMCL), often called Kammprofile. All are available in a variety of metals. The stainless steel family provides improved corrosion resistance and the superalloys like Hastelloy® and Inconel® provide additional chemical resistance and higher temperature capabilities.

Sealing applications often require materials that endure very aggressive chemicals at high temperature with acceptable sealing performance for long periods. The addition of metal in a composite gasket design often accentuates the sealing capability with respect to stability, creep minimization, and load bearing capability.

Metallic types such as ring type joint (RTJ), corrugated, and some double jacketed gaskets (DJ) are used in high temperature, aggressive environments. Semi-metallics such as spiral wound, and SMCL gaskets are comprised of both metal and a soft sealing material. They enable the choice of a metal and filler with optimum chemical compatibility to maximize reliability and ensure safe operation.

Conclusion

With the wide variety of gasket materials available on the market, it is important to match the right gasket material with the chemical service to avoid a potentially catastrophic failure of the joint. Understanding the compatibility of the gasket material with the chemical media, under operating conditions, is essential.

The chemical resistance of materials also can change with increasing temperature. Consult with the gasket manufacturer to ensure that the gasket you have selected for your service is acceptable under the required operating conditions. And always follow good installation practices to ensure a long lasting, tight seal.

Next Month: *How can I apply expansion joints to plastic and fiberglass reinforced piping?*

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.

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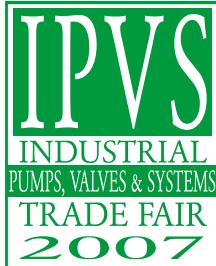
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