FLUOROPLASTIC ENCAPSULATED O-RINGS: CHEMICAL RESISTANCE vs. PERFORMANCE

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TECHNOLOGY UPDATE

In evaluation of product for system applications, specification of encapsulated O-rings is frequently made due to the increased range of chemical resistance they exhibit over standard elastomer materials. Moreover, encapsulation materials have been used quite successfully in a variety of seal and gasket applications. While this is true, the use of encapsulated *O-rings* is not without a tradeoff. Seal performance may be reduced or even require periodic replacement. This is primarily due to the differences between "plastics" and "elastomers" and to the functional design application of an *O-ring*.

Encapsulation can be made with a wide range of fluoroplastic resins. Solid fluoroplastic O-rings are generally made from PTFE (polytetrafluoroethylene). Most encapsulation is made with either FEP (fluorinated ethylene propylene) or PFA (perfluoroalkoxy copolymer) resin around an elastomer core. As "plastics" these materials are subject to permanent deformation or "creep" when compressed, have low resiliency and exhibit increased hardness that can prevent sealing in the presence of particles or surface imperfections. In contrast, an elastomer exhibits "elastic" properties under compression, is highly resilient and can form around particles or minor imperfections to a greater degree. The use of an elastomer core in an encapsulated O-ring improves fluoroplastic performance, but does not duplicate the sealing performance of an elastomer for *O-ring applications*. In addition, fluoroplastics used in encapsulation are generally less resistant to surface scratches than most elastomers.

An O-ring functions as a seal by being compressed between mating surfaces comprising the walls of a cavity or "gland" in which the O-ring is installed. Opposing surfaces of the O-ring are "squeezed" between the gland walls creating a zero-clearance, thus blocking the flow of fluids. O-rings in thermoplastic valves generally function either as a static (non-moving) seal, such as a valve end connector O-ring, or as a dynamic (moving) seal, such as a valve stem O-ring.

Encapsulated O-rings tend to function better in static rather than dynamic applications where no movement is experienced beyond the initial compression. Even so, their lower resiliency may require repeated adjustment in thermoplastic valve applications where temperature expansion and contraction forces are present (such as having to frequently tighten valve union end connectors). Problems with encapsulated O-rings may be more prevalent in dynamic sealing applications, such as stem seals. This is especially true if abrasive materials such as sediment, crystallization particles, or even pipe shavings from system installation are present. These can work their way into the O-ring sealing area resulting in scarring to the fluoroplastic surface that can contribute to premature seal failure.

Specialty elastomers, such as Kalrez® or Simriz®, are perfluoroelastomers with chemical resistance virtually equivalent to PTFE. PFA and FEP fluoroplastics. However, these are significantly more expensive and may be cost prohibitive. Where a basic, broad range of chemical resistance is the focus, high quality fluorinated elastomers (such as FKM) should be considered as a viable alternative to fluoropastic encapsulated O-rings. Specific compatibility should be determined in all cases. Some, more common elastomers such as a quality grade of ethylene propylene rubber (EPDM or EPR) may be even more suitable.

In summary, the extended life expected from fluoroplastic encapsulated O-rings due to chemical resistance must be weighed against their potential performance downside. Specifiers need to be aware of the limitations of these encapsulated O-rings in thermoplastic valve applications. Where possible, elastomer O-rings should be specified. When encapsulated O-rings are determined essential, Spears® will provide a properly adjusted valve, but without warranty due to the limitations of this type of seal. Valves with double O-ring stem seals, such as a Spears® True Union 2000 Industrial Ball Valve, should be used to provide a back-up seal and allow O-ring replacement if required.

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