Ask the Expert

The Ask The Expert column will give readers the opportunity to have their valve concerns addressed, find out the answers to their pressing valve challenges and ask for feedback on application issues. If you have a questions that you need answered, please feel free to contact s.bradley@kci-world.com with the email subject: Ask The Expert.

If you are an individual with extensive valve expertise that you believe the Valve World readership could benefit from, please contact our Editor-in-Chief to become a future featured Expert.

This month our Expert is Phil Mahoney - Manager of Research & Development, Stationary – A.W. Chesterton.

Q Can PTFE packing be used for low emissions service in valves?

A It most certainly can. PTFE is a unique material in that it is inert to most chemicals used in industrial processes, its coefficient of friction is one of the lowest of any sealing material and it has proven it can effectively seal VOC's to very low levels when used in a properly designed valve. This makes it an ideal choice as a universal packing to seal a majority of applications below 450°F. There are several variations of PTFE packings in the market today: V-ring stacked sets and braided, off the spool packing (the latter will the focus in this article). PTFE packing can provide low emissions service to less than 100 ppm in VOC's, often down to levels equivalent to background levels found in the atmosphere. The challenge for the end-user or valve manufacturer is selecting the proper packing for their application, and making sure the packing will perform to their requirements.

Q How does PTFE packing get qualified for Low Emissions (Low E) service?

A With today's environmental compliance challenges, proving that a sealing device can perform to specific levels has to be based on data and standard test protocols. Currently there is not an API type test for PTFE packing similar to API 622, 'Testing of Process Valve Packing for Fugitive Emissions' which is the protocol typically used to qualify packing for valves that can be used in high temperature service. However, there are protocols that could be considered 'good engineering practice' that can provide useful data that allows end-users to confidently select a packing. As an example, running a modified API 622 emissions test protocol by reduced the temperature to 400°F (or other limit specified in plant specifications) is a sound methodology. This test method uses methane as the test gas monitored in accordance with EPA Method 21 using the same number of thermal and stem cycles as the API 622 test standard. Using an industry accepted test protocol with a minor change to the temperature to reflect normal use of PTFE is a clear example of what could be deemed acceptable as 'good engineering practice'.

Another option to consider is ISO 15848-1 which is a valve type test, not a packing type test. This protocol is used to qualify a valve design with a specific packing type for low emissions service and covers both rising stem and rotary motion. The standard is not specific to a packing type, and does have a 200°C (392°F) temperature classification which is applicable to PTFE based packing. The recently released updated standard now has a defined method for testing with methane and monitoring via sniffing, and therefore should also be considered another example of 'good engineering practice'. Note that as a valve type test, equivalency between packing models and types could only be determined if tested in the same valve. This is because of the variation in design criteria between valve manufacturers can have an effect on the performance of the packing.

Q What limits the applications where PTFE packing can be used?

A Even with their excellent chemical compatibility, low friction and ability to seal VOC's to very low rates, there are limitations to PTFE as a packing material. The most obvious one is temperature. These packings are typically rated to a maximum of 450-500°F by the manufacturer which obviously limits the range of applications it can be used in. With a melting point of around 620°F, PTFE packings are not generally considered 'fire-safe', meaning they would not be able to maintain a seal in a system in the event of a fire; plant specifications may exclude their use in services where there is a risk of a fire occurring (i.e. in high temp, flammable services).

PTFE also has a relatively high coefficient of thermal expansion compared to the materials used in the stuffing box, and it can be prone to cold flow depending on how it is made. In applications where there are temperature cycles, the stress on the packing can vary significantly as it expands and contracts relative to the stuffing box, stem and gland. When the packing expands due to the temperature, the stress on the packing increases which can then lead to extrusion past clearances that are always present in a stuffing box. This extrusion leads to some loss of the applied stress on the packing. As the temperature drops and the packing shrinks, the applied stress decreases even more. The end result – as the applied stress drops, leakage from the packing set increases. The simple correction to increased leakage is to re-tighten the gland bolts.

The scenario described above is relatively easy to address, making PTFE packings a viable low emissions seal with a long service life. The thermal behavior of the PTFE isn't something that can be altered significantly, but the valve design itself has a direct impact on the performance of the packing. A properly designed stuffing box with minimal clearances between the stem, stuffing box and gland reduces pathways for extrusion. Stem concentricity to the stuffing box helps ensure even loading on the packing set. Stem and stuffing box finish can affect sealability. Where space permits, the use of live-loading (springs applied to the gland bolts) can help maintain a more constant stress and increase service life. Last but not least, the installation of the packing has to be done properly and consistently to ensure the highest performance.

PTFE packing is definitely a viable low emissions sealing solution. The right product in a well-designed valve can provide long term service to very low leakage rates.