FLOWSERVE

# PFA vs. PTFE: Debunking The Myth

***Claims that PFA is more permeation resistant than PTFE are not only wildly exaggerated, they're totally false.***

*For some time now, competitive butterfly valve manufacturers have made the argument that PFA provides better resistance than PTFE to permeation. The proof they offer is a photomicrograph of thinly skived PTFE film which has been enlarged to a 5,000 x magnification and purports to show microvoids. The conclusion they arrive at, then, is these "voids" provide permeation paths.*

This conclusion, as you will see in the presentation which follows, is both inaccurate and misleading. Moreover, it reveals a serious misunderstanding of permeation which is a complex molecular process – not a mass transport of fluid through cracks or continuous voids.

## Fact:

***All fluoropolymers permeate but some allow permeation at a greater rate for given chemicals than others.***

So, how can you tell which fluoropolymer will work better in a given service? It can only be determined by hard application data... actual field experience.

Here's what the experts say:

"The comparative permeability of PTFE, FEP and PFA can be determined only with appropriate end-use testing of the parts involved."[1]

"Permeation data relative to chemical handling are very limited because *there is no universal laboratory protocol* (our emphasis) for measuring permeation that generates data applicable to all situations."[2]

"Because so many variables affect the results, lab data are often misleading for the selection of fluoropolymer material, particularly the use of thin film permeation for thick liner applications."[3]

*Note: Flowserve introduced the CPI's first fluoropolymer lined butterfly valve in 1965. Since then, no one has collected more application and service information than Flowserve.*

***Finding microvoids in thinly skived fluoropolymer film is no more meaningful than finding holes in slices of Swiss cheese. For just as the block of cheese is solid so is the fluoropolymer liner. In fact, if you were to photomicrograph alloy castings poured to ASTM E441 Level 1 standards at 5,000 x magnification you would find microvoids resulting from the size and pattern of grain boundaries. These voids have no effect on the permeability of the casting…or the liner.***

## Fact:

***No one fluoropolymer has proven to be more or less permeation resistant than another.***

"The combination of polymer characteristics and fabrication aspects make predicting PTFE, FEP, or PFA as the best for a given permeant in a given service virtually impossible. Nor have we data (or have I ever seen any) which would allow us to say that either PTFE, PTFE FEP, or PTFE PFA is generally superior or generally inferior in comparative permeation performance."[1]

"With few exceptions, the differences in permeability among fluoropolymers have little bearing on the end-use performance of fluoropolymer lined piping or equipment."[3]

*Note: Flowserve offers seat liners made from PTFE and Sentinel™, a proprietary fluoropolymer.*

# Debunking The Myth

## Fact:

***Liner thickness is the single most important factor affecting permeation of fluoropolymer materials.***

"Permeation is inversely related to the thickness of the liner. If there were no other considerations, thicker would be better."[2]

"Increasing the thickness of the polymer (liner) being permeated reduces the permeation rate."[3]

*Note: Flowserve butterfly valves maintain a minimum thickness of .125 in, easily the thickest liners available today. (See photos at right.)*

## Fact:

***The design and manufacture of the liner significantly impact fluoropolymer permeation rates.***

"Minimizing permeation…starts with the selection of the proper resin and resin grade. It continues with appropriate component design and concludes with carefully controlled fabrication."[3]

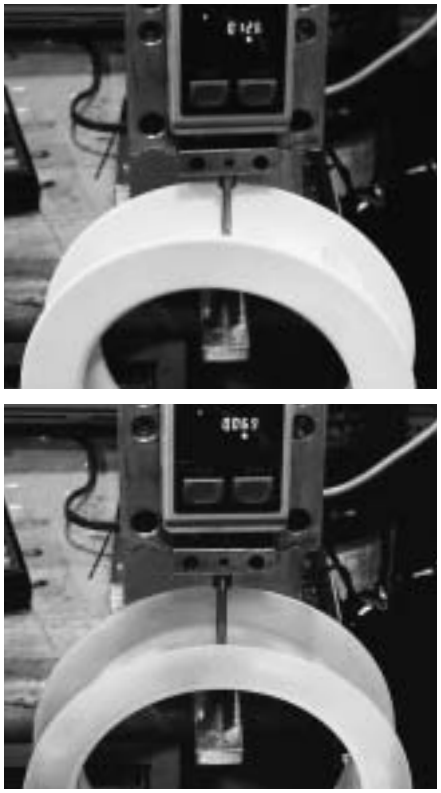
*Note: Flowserve uses unfilled virgin resins exclusively to produce its PTFE, PFA and FEP fluoropolymers. Quality control procedures include melt flow rate, specific gravity, tensile strength, dye penetration and 20,000 volt spark testing.*

## Conclusion:

According to the experts at DuPont, who not only produce fluoropolymers but also manufacture lined equipment, it is impossible to make claims about the superiority of one fluoropolymer material over the other in the area of permeation resistance. Moreover, factors including liner thickness, resin quality and fabrication expertise are far more significant than the choice of material in the control of permeation. And lastly, only actual field service experiential data are reliable criteria in selecting the best material for a given service.

As the world's oldest and largest manufacturer of fluoropolymer lined equipment, no one has more experience or more real world application data than Flowserve. This, combined with our utilization of the highest grades of virgin, unfilled resins, exacting process controls, the thickest liners available to the CPI and the most sophisticated manufacturing techniques, enables Flowserve to offer its customers the highest performing, most permeation resistant fluoropolymer lined valves in today's marketplace.

Note: For more information about comparative PTFE and PFA performance data request Bulletin V-21, Sentinel™ Seats.



*The top photo shows a Durco PTFE liner while the bottom photo shows a competitive PFA liner. It can be easily observed that the Durco liner is almost twice as thick and, thus, is more permeation resistant.*


*References:**

*[1] Letter from J.F. Imbalzano, Ph.D., The DuPont Company, to R.J. Brown, Engineering Manager, Flowserve Corporation, May 6, 1994.*

*[2] "Using Fluoropolymers to Resist Permeation of Corrosives," N.L. Hall, Specialist Consultant, The DuPont Company, "Chemical Processing" magazine, May 1994.*

*[3] Technical Information Paper: "Basis of Permeation and Environmental Stress Cracking in Relation to Fluoropolymers," J.F. Imbalzano, D.N. Washburn and P.M. Mehta, The DuPont Company, May 1996.*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