

White Paper

PTFE and PFA

Similarities and Differences



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Introduction

The purpose of this document is to define and compare two of the most used fluoropolymers, PTFE and PFA, in industry globally and clarify the differences between them.

Defining PTFE and PFA

Polytetrafluoroethylene (PTFE) is a synthetic fluoropolymer of tetrafluoroethylene that has numerous applications. The most widely known PTFE formulation is sold under the brand name of Teflon®. PTFE was discovered by DuPont Co. in 1938.

Perfluoroalkoxy alkanes (PFA) is a copolymer of hexafluoropropylene and perfluoroethers. It was developed after the discovery of PTFE by the same producer (DuPont Co.). One commonly known PFA formulation is Teflon PFA.

PFA has very similar properties to PTFE, though the biggest difference between PTFE and PFA is that PFA is melt-processed. This is accomplished through conventional injection molding as well as screw extrusion techniques.

Area of use

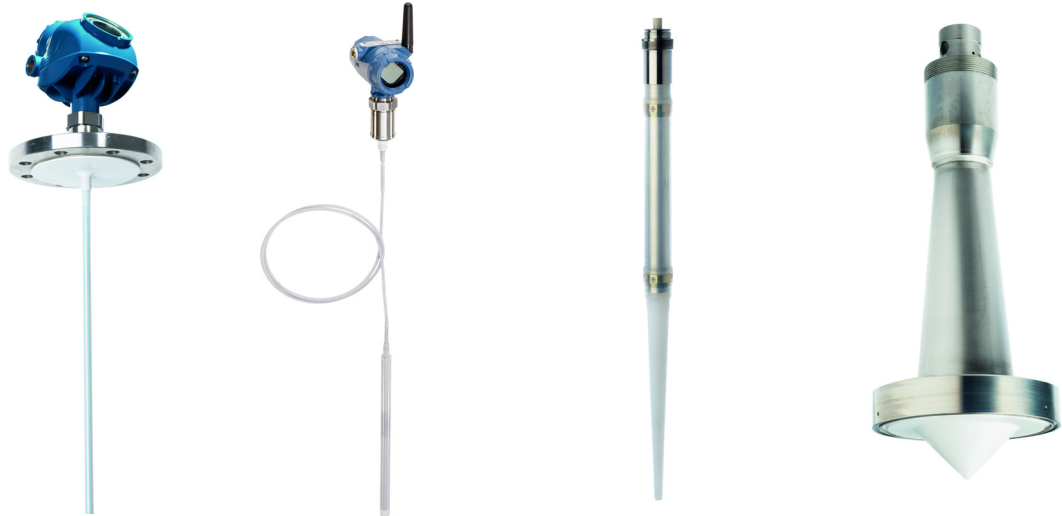
PTFE is popularly used as a non-stick coating for pans and many modern items of cookware. PTFE is often used in containers and pipes for handling reactive and corrosive chemicals. This is because it has non-reactive properties. Another practical application of PTFE is as a lubricant. Used in this way, PTFE helps to reduce friction within machinery, minimize the “wear and tear,” and improve energy consumption.

PFA is generally used for plastic lab equipment because of its extreme resistance to chemical attack, optical transparency, and overall flexibility. PFA is also often used as tubing for handling critical or highly corrosive processes. Other applications for PFA are as sheet linings for chemical equipment. Because of its properties, it can facilitate the use of carbon steel fiber reinforced plastics (FRPs) as replacements for more expensive alloys and metals.

Devices used for level measurement are frequently exposed to harsh tank atmospheres. Aggressive media, such as acid, can corrode probes and parts in contact with the product. Viscous and sticky products are other level measurement challenges. These can cause build-up on the wetted parts of the transmitter and increase the risk of affecting the measurement. Wetted parts coated in PTFE or PFA materials provide a good resistance to corrosive products and are an effective solution for avoiding contamination caused by product build-up.

Water based products can cause condensation on the antenna, that might affect the level measurement. Due to the hydrophobic properties of PTFE and PFA, the measurement will remain unaffected in case droplets of water build-up on the antenna parts.

Figure 1. Level Measurement Devices Coated in PTFE or PFA Material



Differences between PTFE and PFA

PTFE, being a fluorocarbon solid, is hydrophobic, meaning that it is less easily wetted by substances containing water. Also, PTFE possesses a very low coefficient of friction when in contact with solids.

PFA is superior to PTFE in terms of flexibility particularly when it comes to tubing applications. On the other hand, PFA's flex life (i.e., capacity to endure repetitive folding) is lower than PTFE.

PTFE is slightly more resistant to heat than PFA. PFA is more affected by water absorption and weathering but is superior to PTFE when it comes to salt spray resistance.

PFA has the same dielectric constant as PTFE as well as a very similar dissipation factor; yet PFA has a dielectric strength three to four times higher than PTFE.

Table 1. PTFE and PFA Comparison⁽¹⁾

Property	PTFE	PFA
Service temperature	-95 °F/500 °F -71 °C/260 °C	95 °F/500 °F -71 °C/260 °C
Thermal conductivity	.19 W/MK	.25 W/MK
Tensile strength	3,600 PSI (17,237 KP)	4,000 PSI (20,684 KP)
Specific gravity	2.13 - 2.25	2.12 - 2.17
Hardness	55	55
Cold flow	>10% 6.9 MPa (1,000 PSI) @25 °C (73 °F) at 1,000 hrs.	>2% 6.9 MPa (1,000 PSI) @25 °C (73 °F) at 1,000 hrs.
Flexural modulus	345 - 620 MPa 50,000 - 90,000 PSI	590 - 625 MPa 85,000 - 90,000 PSI
MIT Folding endurance	1 x 10 ⁶	5 x 10 ⁵
Chemical properties	Inert	Inert
Electrical resistivity	>1018 OHM/CM	>1018 OHM/CM
Water absorption	<.01%	<.03%

Takeaway

Both PTFE and PFA show outstanding chemical properties for resistance to corrosive agents, non-solubility, and non-flammability. Both are virtually identical in terms of their electrical properties for dielectric, dissipation, and surface resistivity.

Even in critical melting point (service temperature) ratings, both materials have identical properties. In fact, they differ significantly only with regard to cold flow (PFA better than PTFE) and folding endurance (PTFE better than PFA). PFA has a higher creep resistance but PTFE can withstand a higher degree of multiple folding.

References

- DifferenceBetween.net/Science/Chemistry-Science/Difference-Between-PFA-and-PTFE
- Glenair.com/Conduit/Pdf/c/PFA_PTFE_Properties_Comparison.pdf
- Mrsbme.com/Library/Articles/Goulds/Pumpinfo/Fluoropolymers.pdf

1. Note that the values in this table are informational. Deviations may be present in case of consulting different suppliers.

For more information, see:

California Olive Ranch Accurately Tracks Inventory with Guided Wave Radar and Coriolis Technologies [Proven Result](#)

Hesse Lignal Improves Process Control with Non-Contacting Radar [Proven Result](#)


Measuring Ammonia with Radar [Technical Note](#)


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