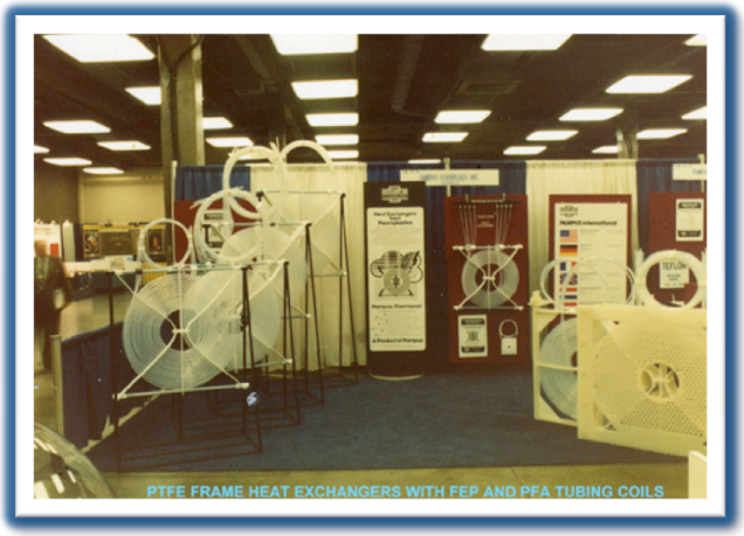
FLUOROTHERM POLYMERS INC

PTFE FEP PFA PVDF ETFE CTFE ECTFE

A Letter from Fluorotherm


PTFE FRAME HEAT EXCHANGERS WITH FEP AND PFA TUBING COILS

To Our Valued Customers:

Fluorotherm started out as a specialty manufacturer of fluoropolymer products in 1992, under the aegis of Norton Performance Plastics, now St. Gobain Performance Polymers. That was 16 years ago!

With a strong R&D background in fluoropolymers, gained by our key people during their employment with DuPont; we have continued to progress toward a wider product range to serve a broad range of applications in diverse markets.

Now, not only have we moved to expand our operations here in the US and overseas, but are responding to customer demand more than ever. Our newest products include:

- Expanded tubing line to cover a broad range of sizes in PTFE, FEP, PFA, ETFE and PVDF
- Immersion Coil Heat Exchangers in high temperature usage PVDF frames and either FEP or PFA tubing
- Custom fabricated tube products with flared, flanged, and custom shapes

We hope that you will join us in helping Fluorotherm pave a successful path for the future. We are grateful to all of our customers for their continued support.

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In This Issue:

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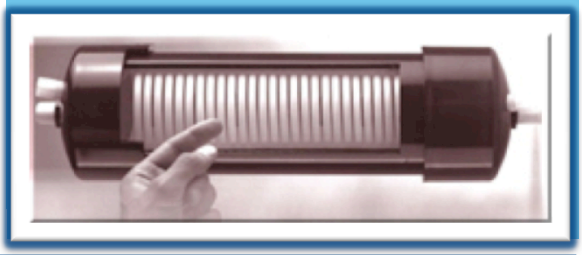

Overview of Fluoropolymers

The chemical structure of fluoropolymers (also called fluoroplastics) primarily consists of carbon and fluorine. The particular combination of these two chemical elements arranged along the molecular chain imparts a unique set of properties to these types of carbon-fluorine based polymers.

Commercially available fluoropolymers include:

PTFE (Poly tetra-fluoro ethylene) - A fully fluorinated polymer available in various unmodified and modified grades

FEP (Fluorinated ethylene propylene) - A fully fluorinated copolymer

PFA, MFA (Perfluoroalkoxy) - A fully fluorinated copolymers

ETFE (Ethylene tetra-fluoro ethylene) - A partially fluorinated polymer containing hydrogen

ECTFE (Ethylene chloro tri-fluoro ethylene) - A copolymer of ethylene and chlorotrifluoroethylene

PCTFE (Poly chloro tri-fluoro ethylene) - A copolymer containing chlorine

PVDF (Poly vinyledene fluoride) - A partially fluorinated polymer containing carbon-to-carbon double bond

These materials are also known by their trade names as follows:

PTFE, FEP, PFA - Teflon,® Neoflon®, Hyflon®

MFA - Hyflon®

ETFE - Tefzel®, Neoflon®

ECTFE - Halar®

PCTFE (or CTFE) - Neoflon® (originally Kel-F®)

PVDF - Solef®, Hylar®, Kynar®

Material Properties Comparison

In general, the chemical resistance of fluoropolymers is superior to most other families of plastics.

One of the most unique features is their chemical inertness, which varies between the different fluoropolymers. The fully fluorinated resins such as PTFE, FEP, PFA and MFA exhibit chemical inertness to a wider range of chemicals than do the partially fluorinated polymers (CTFE, ECTFE).

Usually, a better property in one or two areas is accompanied by a diminished property in others. For example, PTFE is better than PVDF in chemical resistance but it has lower mechanical properties at normal ambient temperatures.

On the other hand, the flex modulus of PVDF is considerably higher than PTFE, FEP, PFA or MFA. This makes tubing of PVDF considerably more rigid than the other materials; however it has higher tensile strength at ambient temperatures.

Fully fluorinated polymers (Perfluoropolymers) such as PTFE, FEP and PFA offer better thermal (higher use temperature) and chemical resistance properties than their partially fluorinated counterparts like ECTFE or PCTFE, but trade off mechanical properties (toughness, abrasion, cut through resistance) that ECTFE and PVTFE possess.

All of these fluoropolymers are generally acceptable for a wide variety of industrial and commercial applications.

Fabrication Effects

In general, it is safer to assume that fabrication procedures affect some properties of PTFE, FEP and PFA products. Certain physical properties such as tensile strength, permeability and dielectric strength vary with fabrication conditions. Examples of causes of these may be macroscopic flaws, microporosity (for PTFE) and crystallinity. The extent of the variation depends upon the specific conditions of fabrication.

Properties of PTFE, FEP and PFA that are relatively unaffected are as follows:

1. Chemical resistance
2. Long-term weathering
3. Non-stick
4. Non-flammability
5. Low dielectric constant and low dissipation factor
6. High arc resistance, surface and volume resistivity
7. Flexibility at low temperatures and thermal stability at high temperatures
8. Low coefficient of friction

Safety and Handling

Fluoropolymers such as PTFE, PFA, MFA and FEP, like other plastics, are subject to some degradation when exposed to temperatures above their melting point over a period of time. Fumes or gases may be given off as a result of pyrolysis from prolonged exposure of a given parcel of PTFE, PFA and FEP to temperatures well above their melting point. These fumes may result in polymer fume fever, symptoms of which pass off within 36 to 48 hours.

However, this scenario is not unlike the behavior of naturally occurring polymers such as rubber or silk, under similar thermal conditions.

Food Safety

PTFE and FEP resins meet the requirements of FDA Regulation 21 CFR 177 1550 and are accepted as safe for contact with food, and during processing and cooking. The National Sanitary Foundation (NSF) has found PTFE to be satisfactory for potable water supply use.

Reactivity with Other Materials

Although chemical inertness is a feature unique to fully fluorinated resins, there are some materials that do attack them. Among these are the alkali metals such as sodium and potassium. Strong fluorinating agents such as elemental fluorine and chlorine tri-fluoride react with PTFE, FEP, PFA and MFA.