EVERFLON ACADEMIC

Techyours

Cathay™ Fluoropolymer Films

As the fluoropolymer experts, Techyours™ offers a vast knowledge of diverse fluoropolymer technologies and superior customer service. Ourunrivaled expertise and willingness to provide custom solutions has made us a leading supplier of the highest quality fluoropolymer films.Techyours™ manufactures cast and Cathay™ PTFE and melt extruded PFA, FEP, ETFE, and PVDF films. These films are used inindustries that include composite molding, chemical processing, electrical, medical, architectural, and photovoltaic products.

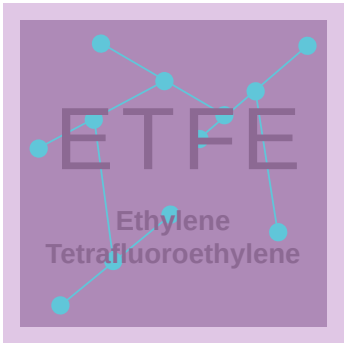
FLUOROPOLYMER

Introduction

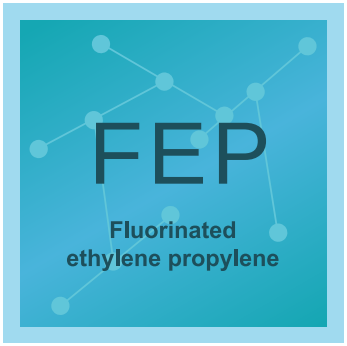
More than 70 years after the discovery of polytetrafluoroethylene (PTFE), fluoropolymers have become well established as an extremely useful material family in a variety of technical applications. In addition to PTFE itself, which cannot be processed with many of the conventional methods, utilised in plastics technology, a whole series of fluorothermoplastics that are flexible to handle has gained a place in everyday life. In film applications they stand out among other things by exceptional resistance to tear propagation and chemical resistance. Most visible for many consumers are fluorothermoplastic films in outdoor applications: PTFEderived fluorinated plastics such as ethylene-tetrafluoroethylene (ETFE) are used among other things in photovoltaic systems and architecture. Here they convince, for example, due to their high robustness and self-cleaning properties. Another advantage is the considerably lower weight compared to glass, which enables the design of more filigree load bearing structures or permits them in the first place.

Not least, these weather resistant films allow the realisation of very courageous and aesthetically pleasing architectural ideas. Also, the problem of heat buildup under transparent fluorothermoplastic roofs can now be solved, thanks to the new, multilayer optical films.

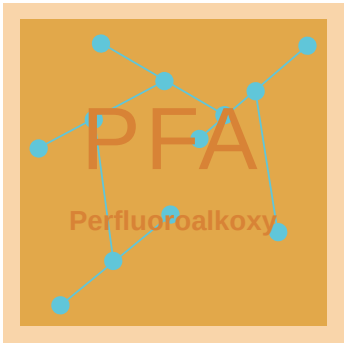
Typical materials



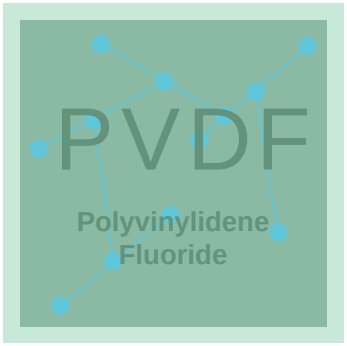
ETFE (ethylene-tetrafl uoroethylene) is a partially fl uorinated copolymer that is occasionally modifi ed by a third monomer to attain certain properties. The melting point ranges from 220 to 280 °C. ETFE is very transparent (transmission > 90 %), but can also be dyed if necessary, using pigments. Due to its high chemical resistance, ETFE withstands many aggressive media including cleaning chemicals, bird droppings and acid rain.



FEP (tetrafl uoroethylene hexafl uoropropylene copolymer) is comparatively soft, chemically inert and, like PTFE, characterised by good sliding properties. The main fi eld of application for FEP is wire and cable insulation, but it is also used in fi lms and adhesive tapes. It is characterised by an outstanding UV and visible light transmission. The refractive index of FEP is the lowest of all fl uorothermoplastics, approximately corresponding to that of water.



PFA, copolymers of tetrafl uoroethylene and perfl uoroalkoxyvinylethers, are closest to PTFE with regard to its physical and chemical properties but are suitable for injection moulding and screw extrusion. PFA can withstand temperatures of up to 260 °C – the highest continuous use temperature in all fl uorothermoplastic materials. Due to this PFA is an alternative to FEP where exposure to particularly high temperatures is required.



PVDF (polyvinylidene fl uoride), either as a homopolymer or as a copolymer with hexafl uoropropylene or chlorotrifl uoroethylene, can be processed at lower temperatures than other fl uoropolymers due to its lower melting point (between 135 and 175 °C, depending on the composition). Nevertheless, it is characterised by high mechanical strength and dimensional stability, good chemical resistance and low permeation rates. PVDF is therefore popular for use in applications such as surface fi nishing or surface protection, for instance for the refi nement of PVC surfaces. It is also used in anti graffiti films.

General properties

The Everflon™ fluorothermoplastic polymer family stand out from “classic”’ thermoplastic film materials due to their ability to withstand higher continuous use temperatures and because they have a higher fire classifi cation. This resistance to high temperatures covers the full range that plastics must withstand in outdoor applications – including areas in which heavy sunlight and a considerable accumulation of heat is to be expected. At the lower end of the temperature scale, several fl uoro thermoplastics are able to remain elastic even in conditions where other plastics tend to become brittle.

PTFE, PFA and FEP are characterised by a largely universal resistance to acids, bases and organic solvents that goes beyond that of polyolefi ns and PVC. ETFE is only sensitive to some ketones, amines and furans, although greater attention must be paid to theature of the media that comes into contact with PVDF. However, these materials are also resistant to most inorganic and organic acids, alcohols and other hydrocarbons.

Mechanical properties

A key factor for fi lm applications is the high tear propagation resistance of fluorothermoplastics. ETFE, in particular, achieves outstanding values here, making these films ideally suited for all applications where mechanical robustness is required.

Many fluorothermoplastics and the films made from them can maintain this extremely high property profi le in tensile tests over a wide temperature range. Although the tensile strength of ETFE, FEP and PFA decreases between room temperature and 200 °C, the elongation at break of PFA and FEP films generally remains constant. In the case of ETFE, it even increases considerably up to +150 °C.

Self-cleaning properties

Cathay™ Films made of fluoroplastics also benefit from their self-cleaning and dirt repellent properties. The surface tensions of the polymer materials decrease in the order PA>PET>PEEK>PE>PVDF>ETFE>PTFE.

This means that rain water rolls off the surface of the Everflon™ fluoropolymer and takes loose dirt with it. This effect can also be correlated with the contact angle that polar liquids, such as water, form with the surface of a fl uorothermoplastic; from angles of contact of around 90° upwards they are considered to be hydrophobic. Water forms a contact angle with PTFE of well over 100°; as the number of C-H bonds in the polymer increases, however, the contact angle reduces slightly (due to the increasing polarity of the polymer).

Resistance to heat and weatherability

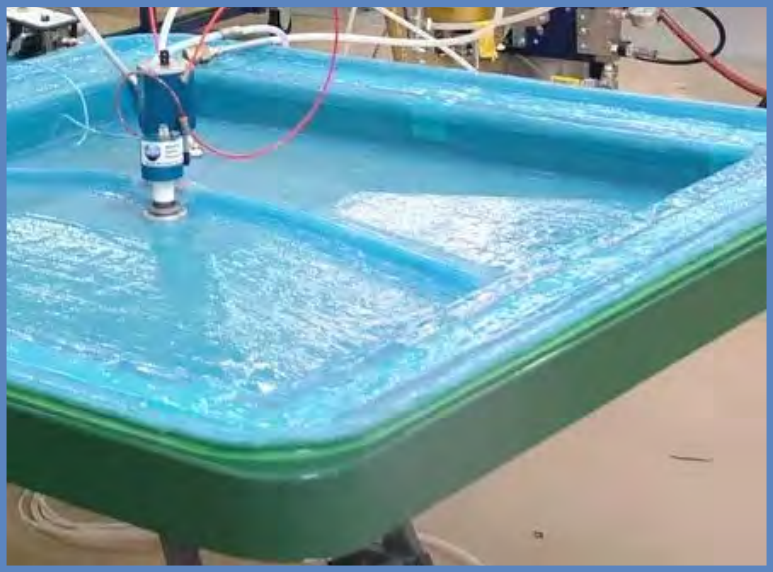
In a long-term test, the films made of FEP achieved the same or even better light and UV transmission values after 20 years of open air exposure and cleaning with ethanol as compared to new fi lms. Deterioration of the transparency due to material degradation can therefore be neglected.

Conversely, in the case of samples made of PC, PET, PVC and unsaturated polyester, signifi cant degradation effects were recorded in the same test (these included discolouration/ yellowness, formation of mould and embrittlement)

Cathay™ film's high resistance to mechanical influences also became apparent in longterm tests: None of the fl uoropolymer films examined, which were only 25 to 120 µm thick, showed any signifi cant damage after 20 years of open air exposure at two different locations in Switzerland.

Fluoroplastics still looked good after long term exposure to even more demanding conditions. In ageing tests carried out by Techyours, ETFE showed no detectable visual impairment after 10,000 hours of exposure to UV irradiation (xenon test 150) and with regard to their mechanical characteristics, the samples tested lost less than 10 % of
their performance.

Composite Molding Process



Techyours™ offers a complete range of composite process molding materials and products for the high-end composite molding industry, including mold release and vacuum bagging films.Our composite molding films are designed to withstand extreme temperatures while maintaining their release characteristics and are available in various colors to allow for easy identification. Techyours™ mold release films (R) for composite molding combine the chemical inertness and universal non-stick properties of PTFE polymers with maximum conformability and heat resistance. Our films can withstand the highest temperatures in the composite molding temperature range, making them ideal for use in the aerospace, wind turbine, and automotive industries.

Architectural and Greenhouses

Techyours™ ETFE (ethylene tetrafluoroethylene) films are melt extruded fluoropolymer films ideally suited for architectural applications. ETFE foils/films, also known as ETFE fabric membranes, can be heat-sealed, thermoformed, and laminated to various substrates. Techyours™ offers ETFE to create tensile membrane structures with exceptional transparency, elasticity, and durability around the world. It can be purchased in clear, printed, or colored varieties, all of which maintain excellent chemical, weather, and stress-crack resistance and low flammability. ETFE is currently one of the most sustainable materials on the market, since it can be 100% recycled after its long service life.

Techyours™ ETFE foils/films are designed to be the superior choice for your architectural projects both large and small. Because these films are UV transparent, they will not discolor or weaken structurally over time. Our Techyours™ ETFE films rival glass for its level of light transmission, while its light-weight properties mean it weighs only 1% of the equivalent amount of glass. Our Techyours™ ETFE architectural grade film is manufactured from 100% virgin premium grade ETFE resin, which makes it the superior choice for applications requiring visual perfection.

Techyours™ can provide a multitude of films/foils for use in the solar industry, including ETFE and PVDF films. The combination of excellent solar light transmission, UV resistance, and outdoor durability makes Techyours™ extruded films the materials of choice for front and back sheets of flexible PV panels and glazing of solar collectors. Due to their excellent dielectric performance, fire resistance, and high solar transmittance, PVDF and ETFE films are well suited for use in the back sheet and front sheet glazing of PV panels. They are used extensively as an external material for the back sheet, protecting the PV Module from the environment for an extended period. Techyours™ also offers plasma-treated surfaces for bonding or lamination.

Photovoltaic / Solar

Electrical / Electronics

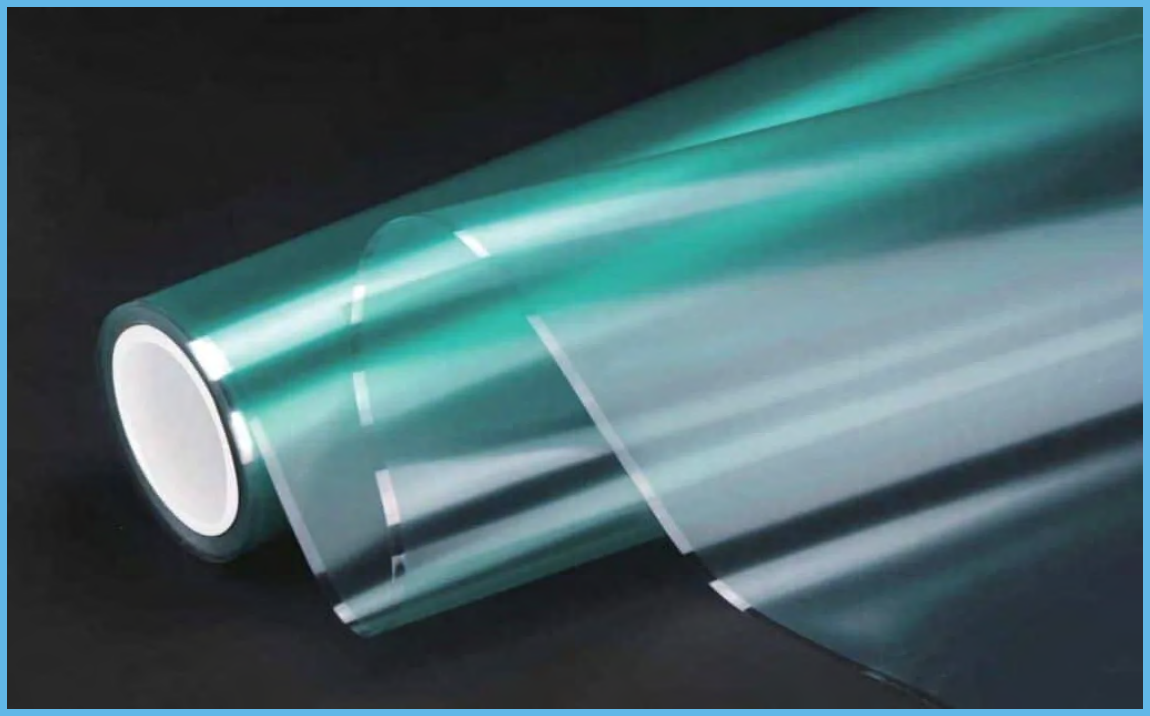
Techyours™ FEP, PFA, ETFE, Matte ETFE and cast PTFE fluoropolymer films possess a combination of excellent dielectric properties, chemical and temperature resistance, and weldability. These properties make our fluoropolymer films useful in many electrical applications, including circuit board laminates and high temperature insulation tapes for wire/cable wrapping. ETFE films/foils are used as release films for electronics, since they retain exceptional release abilities and moderate cushioning at high temperatures. ETFE films are also broadly used as cushioning/release media in Film Assisted Molding processes of semiconductors and integrated circuits. Techyours™ fluoropolymer films reduce release force when the integrated circuit is removed from the mold and increases productivity by removing the need to clean the mold between each use.

Medical / Pharmaceutical

Techyours™ manufactures cast PTFE, ETFE, and FEP foils/films for use as vial cap liners, septa and stopper applications, sampling bags, flexible culture bags, blood storage bags, 2-D fluid bags, and storage or transportation containers for the pharmaceutical industry. Our high-performance fluoropolymer films are chemically inert, have an unlimited shelf life, and can be heat sealed, adhesive-bonded or laminated.

Chemical Industry

Techyours™ maintains our status of first in fluoropolymer capabilities by manufacturing the highest quality materials and providing optimal solutions for the chemical industry including FEP, PFA, ETFE, PVDF, and PTFE films/foils as well as our patented Everflon™ material. Some applications of Techyours™ films include non-metallic expansion joints, roll covers, tank liners, floating roof seals, spray shields/ flange covers, protective face shields, rupture disc and chemical pump diaphragms. Highly pure chemicals can also be stored and transported in sampling bags and flexible containers made from Techyours™ high-performance fluoropolymer films. Techyours™ films can be customized to fit certain thickness and color requirements.



For more information about our company, products and service, please visit our website at www.everflon.com or www.everflonultra.com

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