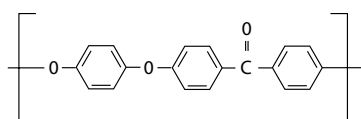


Technical information and applications for PEEK fabrics

A) Technical Information

Chemical structure



PEEK (Polyetheretherketone) is a semi-crystalline thermoplastic with a very stable chemical structure that offers critical advantages when compared to other materials. It belongs to the PAEK (Polyaryletherketone) polymer family.

High temperature resistance

PEEK is especially useful when process temperatures exceed the limits of conventional PA, PET and PP filters and where an alternative to metallic media is required.

Excellent chemical resistance

PEEK is very resistant to a wide range of chemical environments, even at elevated temperatures. The only environment which dissolves PEEK is concentrated sulphuric or nitric acid.

Hydrolysis resistance

PEEK can be used for thousands of hours in steam and high pressure water without significant degradation in properties.

Extended lifetime

PEEK is a strong, stiff and hard polymer and fabrics made from PEEK have good friction and wear properties. For this reason PEEK is probably the most universal «exotic» polymer. Filters made from PEEK are ideal for applications where the high temperatures or aggressive environments prohibit the use of «normal» polymers.

	Temperature Performance	Chemical Resistance	Dimension Stability	Gamma Radiation	Flex Fatigue	Abrasion Resistance	Relative Tensile Strength	Specific Weight	Costs
PEEK	1	1	1	1	2	2	2	2	4
PTFE	1	1	4	4	1	2	4	4	4
ETFE / E-CTFE	2	2	3	3	2	2	3	3	3
PVDF	2	3	3	3	2	2	3	3	3
PPS	1	2	2	2	3	3	2	2	3
PEN	2	3	2	2	3	3	2	2	1
PET	3	3	2	2	2	3	2	2	1
PA	3	3	3	2	1	1	2	2	2
PP	4	2	3	3	3	4	3	1	1
STAINLESS STEEL	1	2	1	1	4	1	1	4	3

1 = Excellent
2 = Good
3 = Acceptable
4 = Poor

Fig 1: Properties of PEEK versus other polymers and versus metal (stainless steel)

PEEK fabrics

The range of SEFAR® PEEKTEX fabrics is expanding rapidly. Sefar technical specialists are available to assist you with selecting the correct PEEK fabric for your application. Sefar recommends consulting with their sales personnel regarding current inventory and availability.

Fabrication technologies for PEEK filter components
 Sefar has developed a wide range of fabrication capabilities suited for PEEK fabrics:

Slitting

- Laser slitting
- Heat slitting

Stamping

- Cold stamping
- US stamping

Welding

- US welding
- RF/HF welding

Adhesive filter components

US-welded tubes

Sefar recommends consulting with their technical specialists regarding your specialised applications since new capabilities are added regularly.

B) Applications

Applications for Filter Element Manufacturers

1) Automotive fuel pump filters (replacement of wire cloth)

Automotive manufacturers have historically substituted wire mesh filters for polyamide filters in cars shipped to regions with hot climates. The polyamide polymer tends to swell in the hot fuel mixture. The wire mesh filters do not completely solve all their problems:

- Wire mesh exhibits poor fatigue resistance in dynamic stress situations and thus has a more limited lifetime.
- Use of wire mesh in a molded filter housing requires more expensive tooling to prevent damage caused by mold parting line shut-off on the steel

fibers of the mesh.

- Only specially alloyed metals can match the wide range of corrosion resistance available through synthetic fabrics.

In order to overcome the limitations of wire mesh filters, Sefar has developed PEEK filter fabrics that provide similar filtration efficiencies plus the added benefits of high temperature and chemical resistance.

Fabric solution:

17-35/22

Customers:

Injection molders for automotive industry

2) Biodiesel fuel filters

In the past decade, biodiesel has been gaining worldwide popularity as an alternative energy source because of its many benefits. However the standard fuel filters made of PA will degrade rapidly in Biodiesel. PEEK on the other hand has a much higher resistance towards Biodiesel and therefore guarantees a lifelong use of the fuel filter.

Fabric solution:

17-35/22

Customers:

Injection moulders for automotive industry

3) HPLC (high pressure liquid chromatography) columns

A chromatography column usually incorporates a security filter on the end of the column. Historically, wire mesh frits were used as security filters, but they affected the chromatography process by introducing metal ions into the liquid. SEFAR® PEEKTEX fabrics are synthetic and will not cause these types of problems. PEEK exhibits excellent resistance to a wide range of organic and inorganic chemicals, so it is compatible with virtually all solvents used in HPLC except sulphuric acid and 30% or greater nitric acid.

Fabric solution:

*(New development:
2 PEEK fabrics US bonded)*

Support fabric:

*PEEK 17-8000-W 154 or
17-8000-K 104*

Filter fabric:

*PEEK 17-2005-SK 012
(trial fabric)*

Customers:

Manufacturers of chromatographic columns, pharma companies etc.

4) Membrane spacer – Battery

Various types of materials are used by battery manufacturers to separate layers within a battery. The spacer materials must exhibit good chemical resistance to the acidic compounds and solutions used within the battery. Thickness and controlled porosity are also important characteristics. PEEK fabrics can be produced as thin as 50 microns compared to conventional 195 micron thick polypropylene spacers.

Woven fabrics offer critical advantages compared to other materials. The mono-filament fibers in woven fabrics will not shed and lead to premature battery failure, unlike paper or felt materials. Since PEEK woven fabrics are made from a thermoplastic poly-

mer, the edge cuts are clean and there are no sharp protrusions to cut or puncture the membrane and cause premature failure.

Although PEEK is not the standard polymer spacer material for every battery application, it certainly has a place in the new generation of high-tech products that combine compact size and high power density with high reliability.

Fabric solution:

PEEK 17-220/56, 17-35/22

Customers:

Manufacturers of batteries

5) Membrane Support

Woven mesh products are used in a wide variety of applications where fragile membranes are protected and supported. In some cases, membrane performance is enhanced by the presence of the woven fabric. For example, fuel cells contain polymer membrane acting as the electrolyte. Typical working temperatures range from 80 °C up to 150 °C. Manufacturers want high performance and efficiency, so the membranes are made very thin and become very fragile. Woven mesh supports the membrane, keeps adjacent membrane layers from touching each other and helps to prevent ruptures. Since overall size of the fuel cell is important, membranes and spacers must be as thin as possible.

Sefar open weave PEEK fabrics feature high burst strength, high temperature stability, excellent che-

mical compatibility and high percent open area – making them uniquely suited for this application. Because of its inherent strength, PEEK fabrics can be calandered to provide a smoother surface and reduced thickness. This further minimizes the possibility of damage to the membrane.

Fabric solution:

V-17-115x145/58

Customers:

*Manufacturers of membranes.
Used in fuel cells and other applications where high temperatures or aggressive chemical environments are present*

Applications for Healthcare Industry

1) Dialysis pump filter

Pumps are used to circulate the dialysis solution through the BiCart and hollow fiber devices. Any blockage of the pump would result in serious consequences, so a protective filter is used to capture fluid-borne particles. The typical configuration of this protective filter is a 50mm diameter disk with a silicone sealing ring which is mounted in the pump.

The entire circulation system is autoclave sterilized. Many filtration fabrics cannot withstand the rigors of autoclave temperatures and will shrink or become

distorted – reducing the level of protection for the pump. SEAFR® PEEKTEX fabrics have high temperature resistance as well as low moisture absorption – making them ideal candidates for this application.

Fabric solution:

17 - 2032 W 155

Customers:

*Dialysis pump
manufacturers*

2) Implant material

Woven fabrics are finding increased usage in human implant applications. Stents, grafts and soft tissue repair increasingly rely on the flexibility and durability of woven fabrics. Biocompatibility is an important consideration in these applications. Due to its stable chemical structure, PEEK is very inert and is generally recognized as a superior choice for implants. Unlike metallic implants, which can corrode or leach ions into surrounding tissue, PEEK will not react with any body fluids.

Fabric solution:

All SEFAR PEEK fabrics

Customers:

*Manufacturers of implants (artificial hernia, ligands,
heart valves etc.)*

Sefar makes no promise or warranty concerning the suitability of this material for use in implantation in the human body.



Applications for Food and Beverages.

1) Feed drying

Some types of animal feed (e.g. dog food, aquarium fish feed) are dried on belt dryers at the end of the production processes. The temperature rises above 150 °C. This is definitely too high for «normal» polymers like polyester. PEEK withstands this temperature without hydrolysis and is therefore highly suitable for such applications.

Fabric solution:

*17-300/36, 17-800/45,
17-1000/45*

Customers:

OEMs for drier equipment, animal feed producers

2) Food drying

Dryer belts are broadly used in many drying plants for the dehydration for the production of pastes, granules and powders for the food industry.

Due to the trend of running drying processes with higher temperatures (beyond 150 °C), the demand for PEEK belts is continuously increasing in many applications. One example for this development is the bread crumbs production. At the moment, customers uses PET fabrics at 150 °C. They now want to rise temperature to 190 °C. They require the same good shrinkage level and physical characteristics as PET, but double lifetime. PEEK is the only synthetic fabric which is capable to meet these requirements.

Also dryer belts for vacuum belt dryers are exposed more and more to higher temperature and more stringent hygienic cleaning prodedures.

The first point demands material with a higher temperature resistance, the latter needs a material which

is inert against hydrolyses. PEEK fulfills both requirements optimal. Examples for the use of vacuum belt dryers is the production of foodstuffs such as:

- Malted drinks
- Hydrolized vegetable protein
- Seasoning
- Chocolate crumb
- Fruit and vegetable powder
- Milk powder
- Baby food
- Coffee powder
- Instant cocoa drink etc.

Fabric solution:

17-300/36, 17-800/45

Customers:

OEMs for drier equipment, bread crumbs producers



Applications for Chemicals and Pharmaceuticals

1) Pharmaceutical products on centrifuges and disc filters

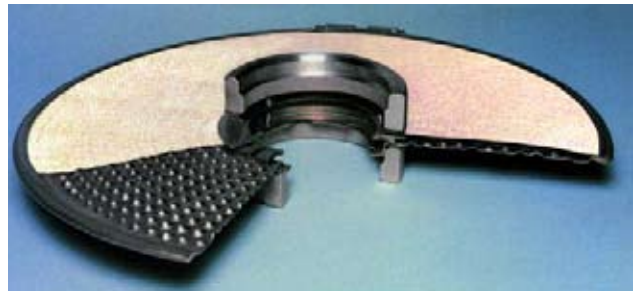
For the production of pharmaceutical intermediates the equipment needs to be sterilized routinely with steam at temperatures of up to 160°C for up to 30 minutes. PP, PET, PVDF, E-CTFE fabrics are not suitable for these high temperatures. PTFE is very expensive and not available in the desired quality for centrifuges and horizontal disc filters. Liners made of Hasteloy or titanium are very costly, difficult to get and often short-lived due to their low flex strengths. Filter liners of PEEK have the desired temperature stability, the required flex strengths, material compatibility (PEEK has one of the lowest contamination potentials and is therefore used as water pipes in ultra clean micro chip factories) and is competitively priced. In order to achieve success, customer conditions must be checked in detail and the fabrics have to be adjusted accordingly.

Fabric solution:

SEFAR TETEX MONO
 17-2005-W 022
 17-2005-K 012
 17-1200-W 043
 SEFAR TETEX DLW
 17-8000-K 039
 17-8000-SK 020

Customers:

OEMs (Centrifuges, horizontal disc filters) and pharmaceutical companies



2) Special chemicals on vacuum belt filters

Some producers of highly specialized chemicals have with good success started to use PEEK on vacuum belt filters (e.g. Pannevis vacuum belt filters), sometimes in combination with a drier. Vacuum filter belts of PEEK are better than short lived Polyester or difficult to handle PTFE belts.

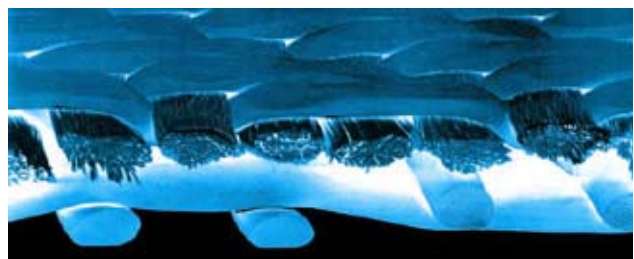
Results are more than convincing as service life has increased in one specific case from 2 to 3 weeks to over 8 months for the SEFAR® PEEKTEX solution, helping the customer to save an enormous amount of money and time. In order to achieve success, customer conditions must be checked in detail and fabrics have to be adjusted accordingly.

Fabric solution:

SEFAR TETEX DLW
 17-8000-W 154
 17-8000-K 104
 17-8000-K 039
 17-8000-SK 020

Customers:

Specialty chemicals producers



Outlook for PEEK filters

In order to increase filtering performance the filtration industry requires finer and finer pore sizes. The use of PEEK fabrics as a membrane support, for example for fuel cells, also depends largely on being able to utilize a very thin fabric and therefore reduce the overall thickness of the membrane. For this reason Sefar is concentrating on the development of the finest PEEK fabrics ever produced. Smaller mesh openings in woven fabrics can be achieved by special weave constructions and surface treatments, but primarily by utilizing finer yarns.

For this reason Sefar will continue to work on the development of even thinner PEEK monofilament yarns. The goal is to achieve the same dimensions and quality as for the established Polyamide and Polyester monofilaments.

The development of these new PEEK mono-filament yarns will enable Sefar to enlarge the PEEK range and produce the optimal filter media for all filtering applications, especially where high temperature and chemical stability are required.

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