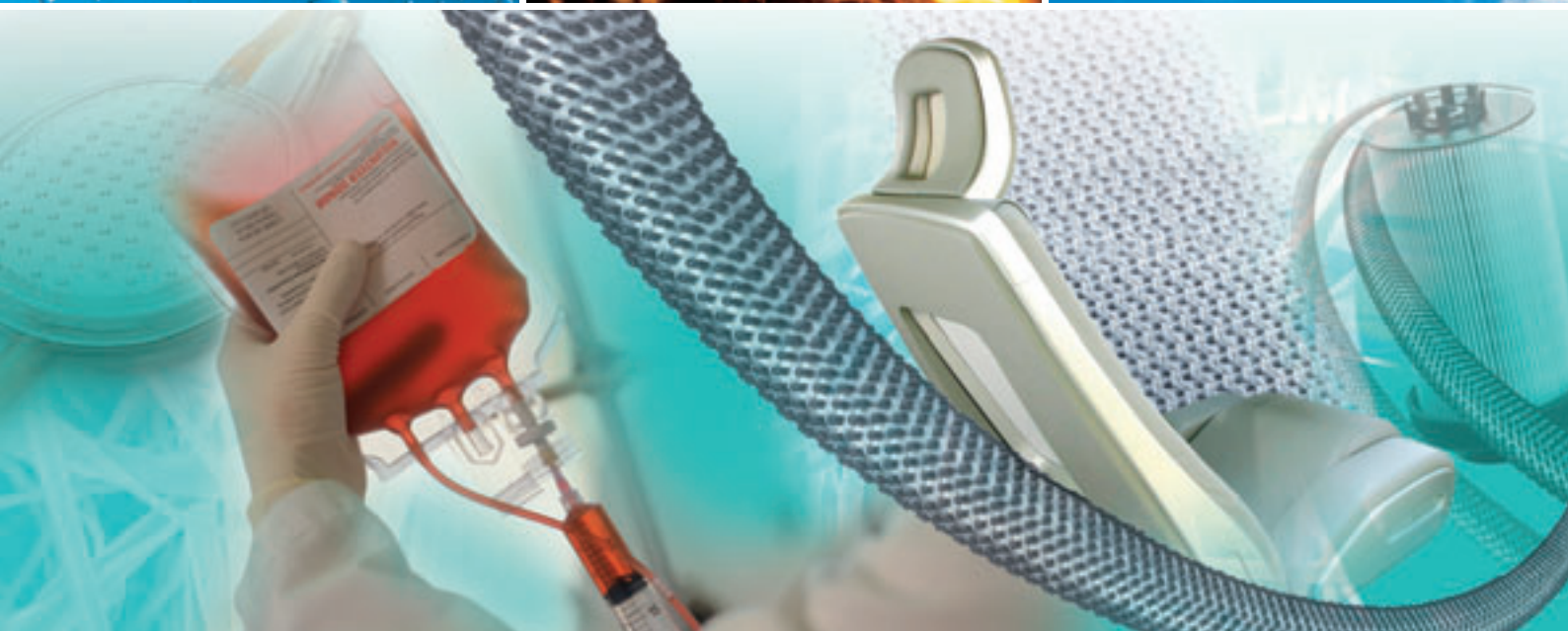


# Technical textiles

High-performance plastics for versatile and challenging functions



# Materials with unlimited possibilities

Technical textiles and composites are penetrating an increasingly wide range of applications today because of their innovative potential. In these various applications, they are fulfilling many different functions such as:

- + Filtration of liquids (e.g. fuels, oils) or gases (e.g. industrial flue gases)
- + Insulation and protection from high temperatures or mechanical forces (e.g. cable sleeves, protective clothing)
- + Reinforcement (e.g. elastomer hoses, structural components) and support (e.g. seat upholstery)
- + Transport (e.g. conveyor belts)

Higher requirements and strict environmental and safety regulations mean that increasingly many of these functions can only be fulfilled with especially developed engineering polymers. Plastics from Ticona are often used as the base manufacturing material for fibers, filaments or films. Processed into nonwovens, fabrics, prepregs and others, they find application in products such as high-performance filters or composite components.

## Excellent properties

Ticona supplies a broad portfolio of high-performance polymers for technical textiles and composites. These especially developed plastic grades with different viscosities can be easily processed on conventional melt spinning machines and extruders because of

their very good melt stability and high purity. In addition, excellent chemical resistance, thermal stability, insulating and mechanical properties help them meet continually increasing requirements in a wide variety of industries.

## Dual protection for the environment

Engineering polymers also make it possible to develop recycling-friendly solutions for an entire element. Fortron® PPS, for example, is used to make high-performance filter media, but can also be employed in numerous other components, including supporting elements, end screw connections and seals, which can be injection molded from the same plastic. Since the complete filter system consists of a single material, it is easy to recycle.



# Strong polymers for growing markets

Many industries today already rely on the performance of technical textiles and composites made from high-performance plastics by Ticona. The following are just a few selected examples:

## Elastomer hoses – outstanding performance under the hood

In the new generation of hydraulic hoses for vehicle power steering systems and charge-air hoses for turbo diesel engines, high-tenacity multifilaments made from Fortron® PPS high-performance plastic are used to reinforce the elastomer hoses. Thanks to the reinforced layer made from PPS multifilaments, which combines high strength with good elongation under varying pressure loads, oscillations, vibrations and noise can be effectively reduced and driving comfort increased. In charged-air hoses, the Fortron® PPS reinforcing material provides the required operating strength at high turbocharger pressures and temperatures up to 200 °C, ensuring reliable and continuous engine performance.



Elastomer hoses reinforced with high-tenacity Fortron® PPS multifilaments withstand the harsh environments under the hood.

Monofilaments made of Riteflex® TPC-ET offer new possibilities for modern and light-weight seat design.

## Seat fabrics for increased design freedom

In designing seats – whether for cars, aircraft or the office – it is important to strike the right balance. Often, the priority is to save weight and space while optimizing recyclability by reducing materials and using the fewest possible plastics. At the same time, these requirements must not be fulfilled at the expense of comfort or functionality. Seat-supporting textiles produced with elastic filaments made from Riteflex® TPC-ET enable designers to replace the usual metal springs, upholstery and/or foams. These thermoplastic



polyester elastomer grades are characterized by high, rubber-like resilience and fatigue resistance. Thanks to their good abrasion resistance, durability and aging resistance, Riteflex® TPC-ET filaments are suitable not only as a supporting layer within a multilayer seat structure but also as an upholstery covering material.





Due to excellent resistance, filter bags made of Fortron® PPS staple fibers are used for flue gas filtration in power plants.

## Filter systems for environmental protection

Besides the automotive industry, other highly challenging application sectors in which technical textiles are used include the chemical and energy industries. In these applications, Ticona plastics have to withstand high temperatures and aggressive chemicals such as solvents, flue gases, hydraulic oils and fuels.

In many gas and liquid filtration processes, for example, nonwovens made from Fortron® PPS are used because of their excellent chemical resistance at high temperatures and product purity. In meltblown nonwovens with basis weights of 10 g/m<sup>2</sup> to 400 g/m<sup>2</sup> or gradient filters, PPS ensures a very long filter service life despite extremely challenging conditions.

In waste incineration plants and coal-fired power stations, the characteristic strengths of polyphenylene sulfide are also exploited, including good resistance to acid gases and hydrolytic resistance at operating temperatures of up to 200 °C. Filter bags made from PPS staple fibers are therefore state-

of-the-art technology for separating air pollutants and dust particles from industrial flue gases.

For filtration of fuels and oils in the automotive industry, the thermoplastic polyester Celanex® PBT is used. This material offers the advantages of very high flowability, a wide processing window and low shrinkage. For example, meltblown nonwovens with very fine fiber structures (<1 µm) can be produced, which are also highly suitable for laminating to cellulose filter papers. These PBT nonwovens offer a long service life, excellent filtration efficiency and outstanding resistance to aggressive media. Other applications for special grades of Celanex® include binder fibers, e.g. for thermal bonding of spunbond nonwovens. This permits environment-friendly solutions that avoid the use of chemical binders.

## Tough: Paper machine fabrics and food conveyor belts

High-tenacity, tough mono- and multifilaments made from Fortron® PPS are used to produce woven,

abrasion-resistant filter screens and conveyor belts that operate under high-temperature conditions, such as in drying paper or transporting food products. The high-performance materials used possess very high mechanical properties combined with chemical and hydrolytic resistance. In addition, various special grades have obtained all the required food contact approvals (e.g. FDA). Due to their excellent heat resistance, conveyor belts made from Fortron® PPS filaments can run at higher speed and so shorten the drying process. This results in improved productivity.

## Composites – a strong bond

The aviation industry makes very high demands on the materials it uses to comply with the strict safety requirements specified by the regulatory agencies.

Aircraft manufacturers therefore make specific use of the advantages offered by composites based on Fortron® PPS. In the Airbus A380, for example, long-fiber-reinforced composites with a PPS matrix are already being used in the wing leading edge, ailerons and other structural components.

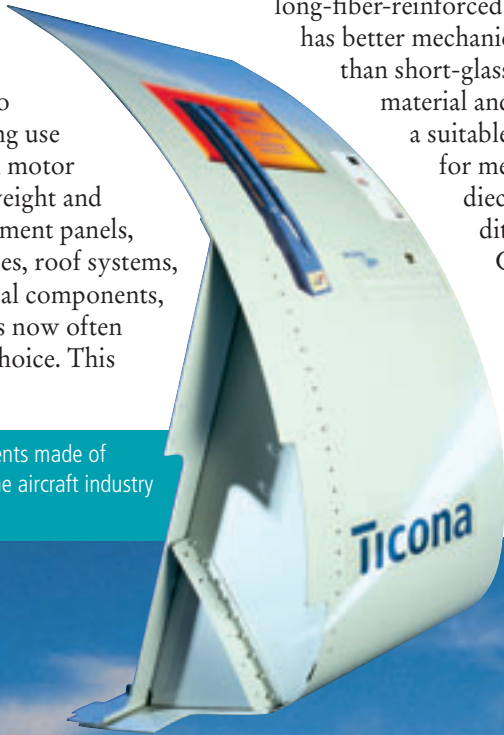
Fortron® PPS monofilaments provide a longer life for conveyor belts due to very good hydrolysis and mechanical properties.



Composites based on Fortron® PPS have excellent inherent flame retardancy, low smoke density and a high oxygen index (Limited Oxygen Index/LOI > 50%). They are resistant to kerosene, hydraulic oils and deicers. Compared to aluminum, PPS composites have excellent mechanical properties, withstand extreme temperature variations, and permit weight savings of up to 50 percent.

Automotive manufacturers today are also making increasing use of composites in motor vehicles to cut weight and costs. For instrument panels, front end modules, roof systems, gearbox and pedal components, Celstran® LFT is now often the material of choice. This

Composite components made of Fortron® PPS help the aircraft industry to reduce weight.



long-fiber-reinforced thermoplastic has better mechanical properties than short-glass-fiber-reinforced material and is therefore a suitable replacement for metals or pressure diecastings. The additional plus with Celstran® LFT: its high impact resistance results in an excellent crash behavior.

### Ultra-high purity for medical technology

The US Food and Drug Administration (FDA) and European regulatory agencies specify very high requirements for engineering plastics used in medical applications. Biocompatible, especially tailored MT® polymer grades offered by Ticona meet the relevant approval criteria, are suitable for different sterilization methods and can therefore be used in the medical sector, e.g. for filter applications.



Ticona MT® grades comply with the demanding regulations of the medical technology market.



# Polymers for many potential applications

Polymer	Properties
<b>FORTRON® PPS</b>	
Polyphenylene sulfide	<ul style="list-style-type: none"> <li>• Very good processability for melt spinning and extrusion</li> <li>• Temperature resistance up to 200°C</li> <li>• Very good chemical and hydrolysis resistance</li> <li>• Inherent flame retardancy</li> <li>• Good fiber-matrix adhesion for composites, e.g. with carbon, glass and aramid fibers</li> <li>• Excellent mechanical properties</li> <li>• Low smoke density</li> <li>• High limited oxygen index (50)</li> <li>• Special grades: FDA, food contact</li> </ul>
<b>Vectra® LCP</b>	
Liquid crystal polymers	<ul style="list-style-type: none"> <li>• Unreinforced grades for melt spinning / extrusion</li> <li>• Temperature resistance up to 240°C</li> <li>• Very good chemical and hydrolysis resistance</li> <li>• Inherent flame retardancy</li> <li>• High limited oxygen index (38)</li> <li>• Excellent mechanical properties for high tenacity fibers and filaments</li> <li>• Low creep</li> <li>• Excellent cut resistance of fibers and filaments</li> <li>• Very good electrical insulation &amp; barrier properties</li> <li>• Low water absorption</li> </ul>
<b>Celanex® PBT</b>	
Thermoplastic polyester	<ul style="list-style-type: none"> <li>• Wide range of viscosities</li> <li>• Excellent flowability with high melt stability for meltblown nonwovens</li> <li>• Production of extremely thin fibers possible (&lt; 1 µm)</li> <li>• Wide processing window</li> <li>• Higher crystallinity and lower shrinkage than PET</li> <li>• Good resistance to high temperatures and chemicals, e.g. fuels, oils</li> <li>• Special grades: FDA, food contact</li> </ul>
<b>Riteflex® TPC-ET</b>	
Thermoplastic polyester elastomers	<ul style="list-style-type: none"> <li>• Wide range of hardness: Shore D 25-77</li> <li>• Very high resilience</li> <li>• Excellent fatigue resistance</li> <li>• Very good chemical resistance</li> <li>• Maintain property profile over a wide temperature range from -40 to +120°C</li> <li>• Easy, cost-efficient processing</li> <li>• Specialties: UV resistance, halogen-free flame retardancy, colors, FDA, food contact</li> </ul>
<b>Celstran® / Compel® LFT</b>	
<p>Long-fiber-reinforced thermoplastics matrix: consisting of standard/engineering polymers, e.g. PP, PA, PBT and high-performance plastics such as PPS</p> <p>Reinforcing fibers: aramid, glass, carbon, stainless steel filaments (30 – 60% content)</p>	<ul style="list-style-type: none"> <li>• Excellent mechanical properties and crash behavior</li> <li>• High impact and notched impact strength</li> <li>• Low creep</li> <li>• Mechanical property profile is maintained over a wide temperature and climate range</li> <li>• Special electrically conductive grades for shielding and static charge dissipation</li> <li>• Recycling concept</li> </ul>

# ons in technical textiles

## Further processing

- Mono- and multifilaments
- Short fibers and staple fibers
- Binder fibers
- Meltblown/spunbond nonwovens
- Staple fiber nonwovens
- Films

## Applications (selected)

- Filters for aggressive gases, e.g. flue gas desulfurization units
- Filters for aggressive liquids, e.g. fuels, oils, solvents
- Dryer fabrics and conveyor belts for a wide variety of applications
- Reinforcement of elastomer hoses
- Cable sleeves, insulation materials, gaskets
- Flame-retardant protective clothing
- Composite components in the aviation industry, e.g. wing leading edge, ailerons, seat elements

- Mono- and multifilaments
- Short fibers and staple fibers
- Meltblown/spunbond nonwovens
- Staple fiber nonwovens
- Films

- Ropes and belts
- Reinforcement of rubber goods, e. g. tires, drive belts, hoses
- Flame-retardant and cut resistant protective clothing
- Insulation materials
- Sports equipment, e. g. sail cloths
- Reinforcement of composites

- Mono- and multifilaments
- Staple fibers
- Meltblown/spunbond nonwovens
- Staple fiber nonwovens
- Binder fibers
- Films

- Filtration of a very wide variety of gaseous and liquid media, e.g. fuels, oils
- Insulation materials
- Thermal bonding of spunbond nonwovens

- Elastic mono- and multifilaments
- Staple fibers
- Meltblown/spunbond nonwovens
- Staple fiber nonwovens
- Films

- Seat support and upholstery fabric for virtually any form of (car) seat to bedroom furniture
- Cable sleeves
- Elastic filter fabrics
- Conveyor belts
- Wide variety of hoses
- Medical applications, e.g. infusion tubes

- Composite components
- Extruded semi-finished products, e.g. sheets, tapes
- Blow molded parts
- Injection molded parts

- Components exposed to high mechanical stresses (metal replacement)
- Structural components of all types, e.g. instrument panels, front end modules, roof systems, seat and pedal components
- Colored visible parts
- Hard-soft combinations
- Outsert molding

## Plastics know-how at first hand

Ticona, a business of Celanese Corporation, is a leading global manufacturer of engineering polymers. For many years, the company has been established in key markets for injection molding applications, such as the automotive, electronics and telecommunications industries and medical technology. Because of their outstanding performance, the plastics used in these sectors also offer highly promising potential for other technologies and applications – particularly for extrusion. Through the targeted development of special polymer grades, new applications have been opened

up over the last few years in the area of fibers, nonwovens and films for technical textiles and composites.

Ticona is more than just a raw material supplier. As a polymer manufacturer, Ticona provides a comprehensive technical service for its customers. This includes not only in-depth project consulting but also support in material selection and development and recommendations on optimizing production processes. In the area of injection molding, customers also receive assistance with component and mold design and CAE calculations.

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