



AGC

Fluon+™ Functional Fluoropolymers for Innovations in Composites



Fluon+™

Your Dreams, Our Challenge

Introduction

The need for weight reduction and energy saving is a key driver for the growth of lightweight materials and lightweight structures. AGC has adopted its established product range of functionalised thermoplastic fluoropolymers, Fluon+™, to enhance properties and performance of composite systems.

Features

For decades AGC's Fluon® fluoropolymers have been widely used in demanding industries where other polymers reach their limits.

Automotive	Oil & Gas
Aerospace / Military	Electrics & Electronics
Chemical	Architectural & Construction
Medical	Additives
Renewable Energy	Food & Pharma

All Fluon® fluoropolymers provide outstanding properties:

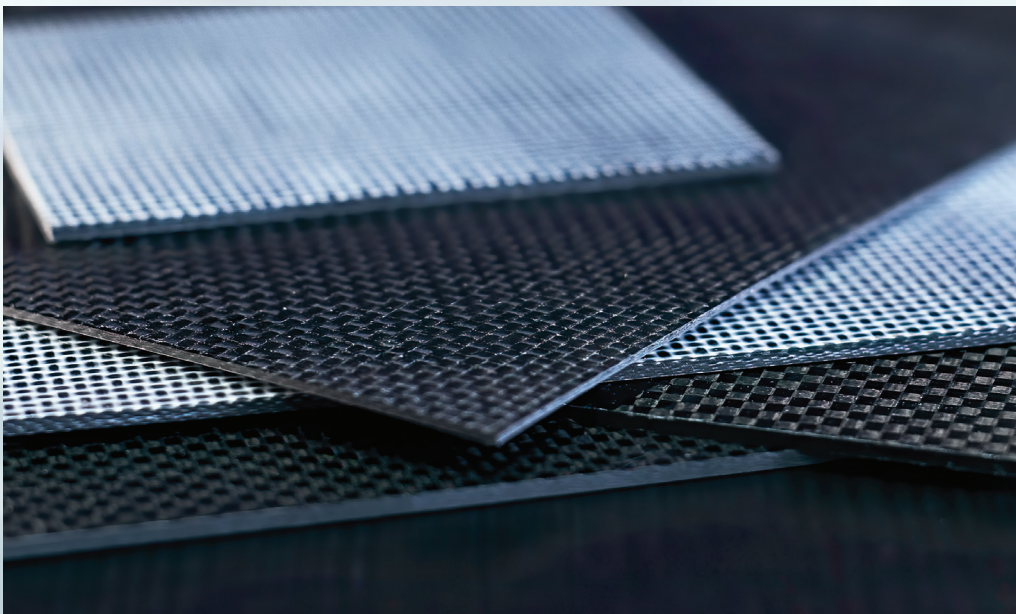
- Chemical inertness
- Thermal stability (-200°C up to +260°C)
- Non-stick
- Low friction / self-lubricating
- Dielectric properties
- Weather resistance / non-aging
- UV resistance
- Non-toxic

Fluon+™ for Composites

Using polymers modified with functional groups is a common technology in the composites industry. There are various reasons:

- Allow fibre-matrix adhesion
- Improve mechanical properties of matrix materials
- Allow new composite design

Based on its long experience in functionalising fluoropolymers, AGC has extended this technology for use in thermoplastic or resin based composites.

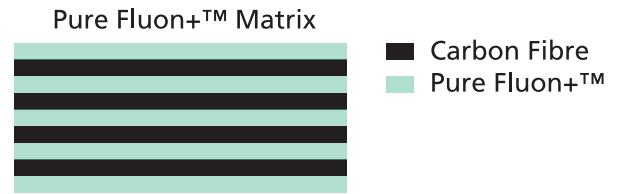


Fluon+™ functional fluoropolymers allow various innovative multi-material solutions

There are multiple options to use Fluon+™ for the optimisation of composite systems:

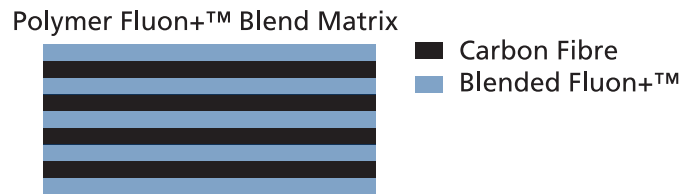
Matrix material (Fluon+™ composite)

- Wear performance
- Chemical resistance
- Flame retardance
- Low water absorption
- Vibration damping



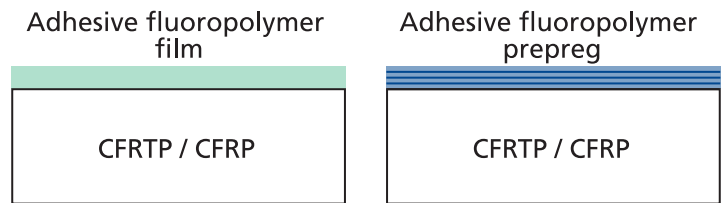
Blend into polymer matrix (PA, PPS, PEEK, etc.)

- Wear performance
- Chemical resistance
- Impact strength
- Low water absorption



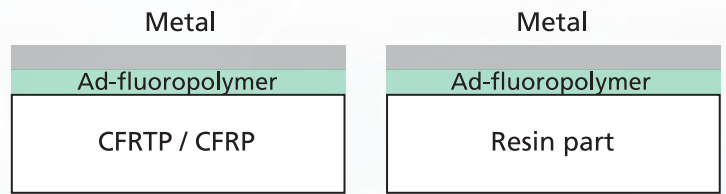
Film for surface modification / protection

- Wear performance
- Chemical resistance
- Flame retardance
- Low water absorption



Adhesive and protective layer for metal sandwich constructions

- Chemical resistance
- Prevent galvanic corrosion



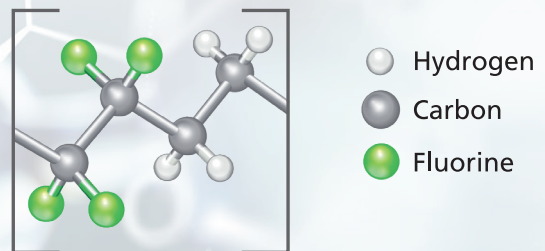
Fluon+™ is available based on two different fluoropolymers

ETFE (Ethylene Tetrafluorethylene)

ETFE is a semi-fluorinated thermoplastic fluoropolymer that provides a good balance between mechanical and chemical / thermal properties.

Grades available:

- Fluon+™ LH-8000
- Fluon+™ AH-5000
- Fluon+™ AH-2000

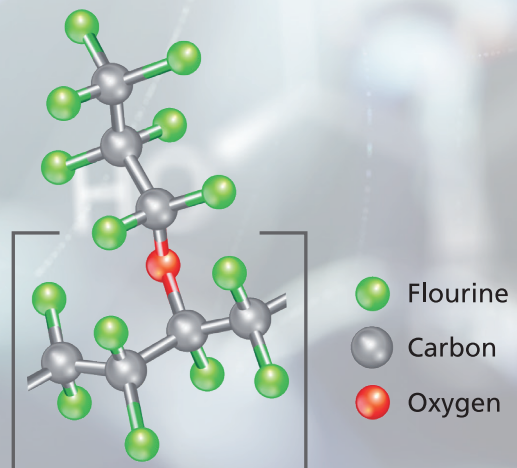


PFA (Perfluoroalkoxy Fluoropolymer)

PFA is a fully-fluorinated thermoplastic fluoropolymer that provides superior chemical and thermal properties.

Grades available:

- Fluon+™ EA-2000



Granules & Powder

Fluon+™ based on ETFE and PFA grades is available as thermoplastic granules (diameter ~2mm) or in powder form (D50 20-50µm). Fluon+™ based on PFA is also available as an ultra-fine powder D50 2-3µm.

Film (+/-50µm) can also be provided on request for trials.

Typical Use

Fluon+™ based on ETFE		Upon Request	
	Granular	20-50µm powder	2-3µm powder
Film extrusion	x		
Compounding	x	x	x
Coating		x	x

Fluon+™ based on PFA			
	Granular	20-50µm powder	2-3µm powder
Film extrusion	x		
Compounding	x	x	x
Coating		x	x

Processing

The reactive group in Fluon+™ will only react with other functional groups starting at temperatures of about 180°C. Below that temperature it can be considered inert in most environments.

Best adhesion results can be achieved in the molten stage at higher viscosities of the polymer with moderate pressure applied to allow best reactivity of the reactive groups. Fluon+™ is available in a wide range of melting points.

Some specific measures need to be considered when processing fluoropolymers. Whereas Fluon® ETFE (in particular grades with lower melting point) has moderate corrosiveness in the molten stage, Fluon® PFA does not require any component being in contact with the melt to be corrosion resistant. For further advice please see the relevant technical information as well as the SDS.

Outlook

AGC is continuing its development work in the field of Fluon+™ products. Aspects of this work will be the impact of Fluon+™ additives on the increase of matrix polymer melt viscosities. This can be interesting for composite impregnation as well as injection moulding of fibre reinforced plastics such as organo sheets.

Property	Test Method	Units	Fluon+™ based on ETFE			Fluon+™ based on PFA
			LH-8000	AH-5000	AH-2000	EA-2000
Functionalised			yes	yes	yes	yes
MFR	ASTM D3159 (297°C ; 49N)	g/10mins	78*)	26.4	25	-
	ASTM D3307 (372°C ; 49N)	g/10mins	-	-	-	10 - 30
SG	ASTM D792	-	1.75	1.76	1.78	2.14
Melting Point	AGC DSC	°C	180	226	240	298
Tensile Strength (23°C)	ASTM D638	MPa	44	55	49	40
Elongation at break	ASTM D638	%	417	430	429	330
Flexural Modulus	ASTM D790	MPa	959	810	793	580
MIT (Flex Life)	ASTM D2176	No. Cycl.	1 x 10 ⁵		1 x 10 ⁵	1 x 10 ⁵
Izod Impact (23°C)	ASTM D259	J/m	no break	no break	no break	no break
*) MFR	(265°C ; 5kg) (235°C ; 2.16kg)	g/10mins	37 4.8			

For further information and technical support or to request a guide for the safe handling of fluoropolymers please email fluonplus.info@agc.com.

AGC Chemicals Europe, Ltd.

Hillhouse International
Fleetwood Road North
Thornton-Cleveleys
FY5 4QD
United Kingdom
Tel: + 44 (0) 1253 209560
www.agc.com

AGC Chemicals RUS

Russian Federation, 121596
Moscow, Gorbunova Street 2
Grand Setun Plaza, Bldg. 204, BC
5th Floor, Block B, Office B 504
Tel: +7 918 555 34 37
Tel: +7 495 411 65 66

AGC Inc.

Shin-Marunouchi Bldg. 1-5-1
Marunouchi
Chiyoda-ku
Tokyo 100-8405
Japan
Tel: +81-3-3218-5875
www.agc.com

AGC Chemicals Americas, Inc.

55 E. Uwchlan Avenue
Suite 201
Exton, PA 19341
USA
Tel: +1 610-423-4300
www.agcchem.com