

Welcome to our Online Seminar

„Celanex[®] PBT XFR –
- Flame Retardant Halogen- and Antimony-
Free Thermoplastic Polyester –
The New Product Family of Ticona“

June 15th 2005

Presenter:

Mr. Sean Kemp, Business Manager General Industries

- 1. Introduction**
- 2. Environmental and Regulatory Aspects**
- 3. Market and Requirements**
- 4. Celanex XFR**
 - a) Flame Retardant System**
 - b) Tests and Properties**
- 5. Processing**
- 6. Summary**

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1. Introduction

Celanex **XFR**

- Flame-retardant PBT (Polybutylene terephthalate)
- Halogen-free flame retardant system
- Product family with currently 4 grades
- Complies with environmental and recycling standards
- Easy processing
- Suitable property profile for many market segments
- At present no comparable product range on the market

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 - a) Flame Retardant System
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2. Environmental and Regulatory Aspects

Possibilities for customers and OEMs

- Company “IMAGE“
- Company policies for environmental protection and safety
- Environmental aspects / manufacturer’s responsibility for products



- Comply with legislative requirements

2. Environmental and Regulatory Aspects

Legal requirements

RoHS (EU directive 2002/95/EC)

- Restricts the use of certain hazardous substances in electrical and electronic equipment
- Article 4: “...that, from July 1st 2006, new electrical and electronic equipment put on the market may not contain...
 - ◆ lead
 - ◆ mercury
 - ◆ cadmium
 - ◆ hexavalent chromium
 - ◆ **polybrominated biphenyls (PBB)**
 - ◆ **and polybrominated diphenyl ethers (PBDE)**“

➔ **Ticona Europe plastics do not contain any of these substances**

2. Environmental and Regulatory Aspects

Legal requirements

WEEE (= Directive on Waste Electrical and Electronic Equipment)

- Regulates the handling of used equipment from private households and commercial / industrial sector.

Deadlines

- From 08/13/2005 – Production according to WEEE regulations
- From 12/31/2006 – Meet take-back obligations (recycling)

Implementation

- Producers have to finance collection and disposal / recycling of used equipment
- Selective treatment of materials and parts of E/E equipment according to article 6, paragraph 1
- Parts containing brominated flame retardants must be labeled

2. Environmental and Regulatory Aspects

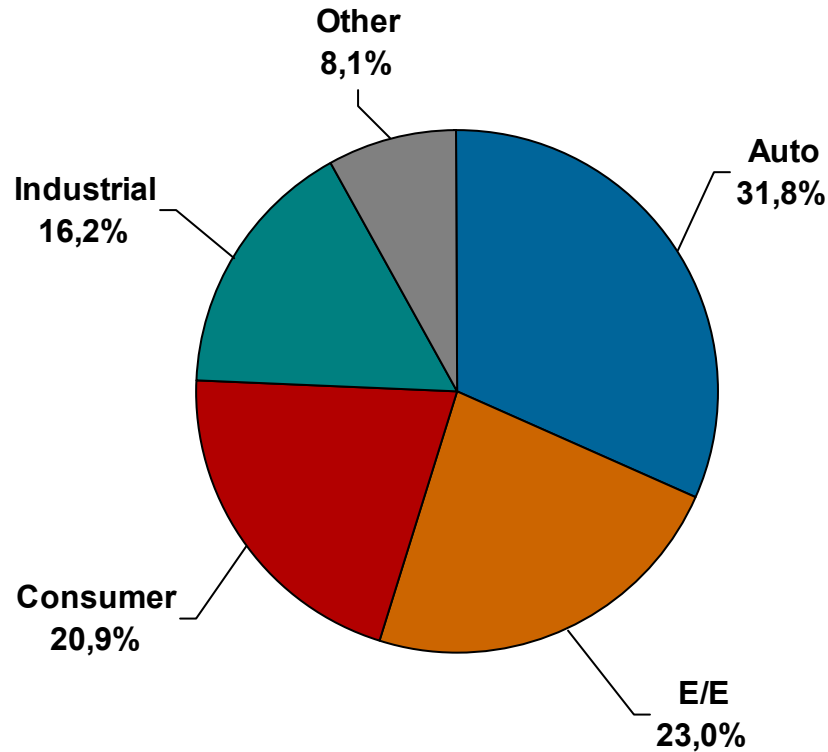
Celanex XFR compliance

	Celanex XFR 4840	Celanex XFR 4840 GF10	Celanex XFR 6840 GF20	Celanex XFR 6840 GF30
RoHS (no PBB, no PBDE)	✓	✓	✓	✓
WEEE no brominated FR)	✓	✓	✓	✓
TCO '99 (no Cl, no Br)	✓	✓	✓	✓
Blue Angel (F ≤ 0,5%, no Cl, no Br)	✓	✓	✓	✓

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3. Market and Requirements

Polyester consumption in Europe



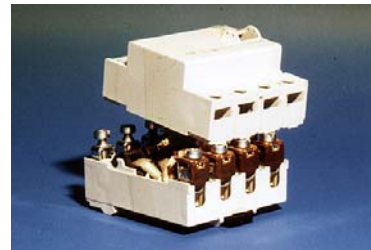
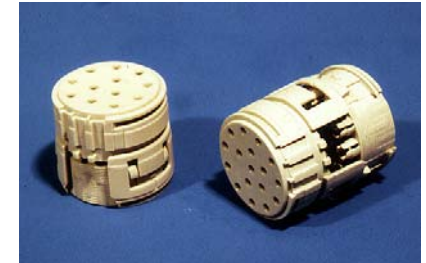
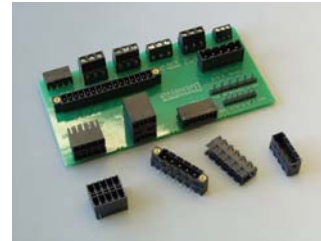
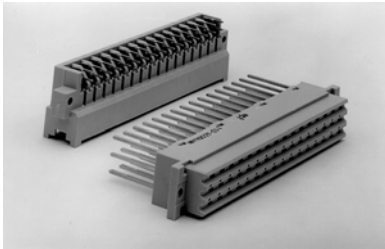
XFR is suitable for 20% of the PBT market !

Source: Treuhand-Studie 2004

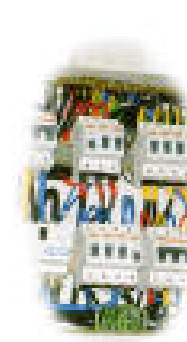
3. Market and Requirements

Typical applications

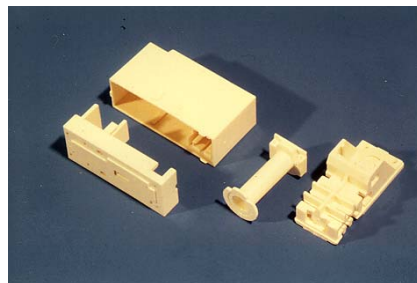
Connectors



Installation



Relais



Motor parts



3. Market and Requirements

■ Low voltage

(up to 9 V)

e.g. connectors, relais, bobbins

■ Medium voltage

(110V or 220V)

e.g. appliances (motors, pumps), lighting, connectors

■ High voltage

(as of 350V)

e.g. connectors for industrial motors, pumps

Electronical parts / components

UL 94 VO (0,8 mm)

- Good flowability
- Low outgassing
- Colors

Lamps / LEDs

- UL 94 (1,6 mm)
- GWFI 650°C
- UV stable

Appliances

- UL 94 (0,8 mm)
- GWIT 775°C
- High TI (UL)

Electrical installation

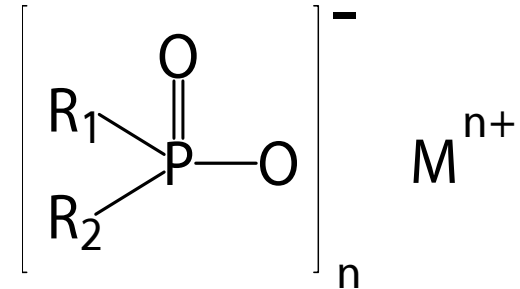
- UL 94 VO (1,2 /1,6mm)
- High CTI (> 400 V; / 600V)
- High Temperature Index (TI UL)

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 - a) **Flame Retardant System**
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4. Celanex XFR

Flame retardant system

Organic phosphinate
plus synergistic nitrogen compound



- New, halogen-free flame retardant system
- Joint development by Ticona and Clariant
- Polyester compounds with this flame retardant system are marketed exclusively by Ticona

4. Celanex XFR

Property profile

- **Very good flame retardant efficiency**
 - ◆ UL94 V-0 down to 0,8 mm
 - ◆ First complete product family with 0 – 30% glass fiber reinforcement
- **High thermal stability**
 - ◆ Easy processing, i. e. no emissions, especially no toxic phosphines
 - ◆ Excellent heat aging resistance
- **Flame retardant system is similar to a mineral filler and therefore shows extremely low migration**
 - ◆ No corrosion of electrical contacts
 - ◆ Stable insulating properties at long-term thermal loading
- **Colorless**
 - ◆ Excellent colorability of polyester compounds

4. Celanex XFR

XFR advantages over halogenated FL-systems for PBT

- No chlorinated or brominated compounds
- No antimony-based compounds
- No segregation and separate disposal (WEEE)
- No corrosive fumes in case of fire (HCl, HBr)
- Ca. 8 % lower density of compounds
- Very good electrical properties of compounds (CTI 500 – 600)
- Excellent UV-stability

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Tests and Properties

- I. **Flammability tests**
- II. **Electrical tests**
- III. **Mechanical tests**
- IV. **Other properties**

Flammability tests *(This list is not exhaustive)*

■ E/E

- ◆ Open Flame

UL94 (HB, V-0, V-1, V-2)

IEC 60695-11-10 (HB 40, HB 75, V-0, V-1, V-2)
UL94 (5VA, 5VB), IEC 60695-11-10 (5VA, 5VB)
IEC 60695-2-2 (Needle flame test)

- ◆ Glow Wire Test

IEC 60695-2-11, -12, -13 (GWT, GWFI, GWIT)

■ Building Industry

- ◆ Building material

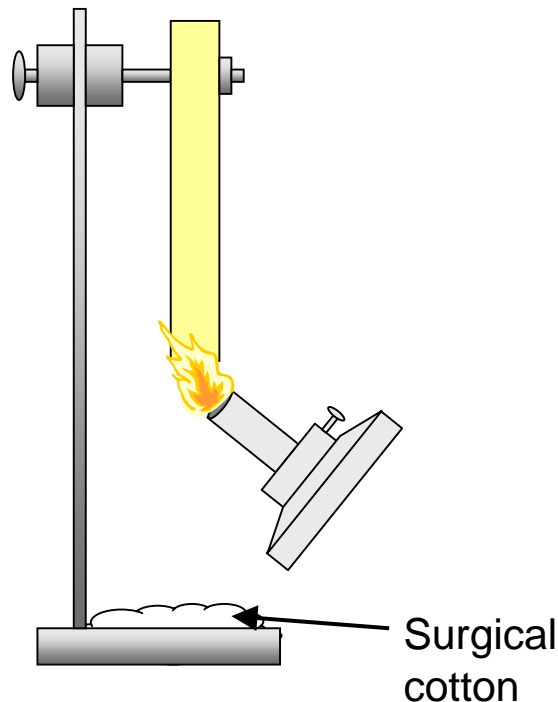
EN ISO 1716 (Calorific value),
EN ISO 1182 (Non-combustibility test),
EN 13823 (Single burning item (SBI) Test)
EN ISO 11925-2 (Small flame test)

■ Transportation

- ◆ Automotive
- ◆ Railway vehicle
- ◆ Airplane

FMVSS 302 (Burning rate)
NF F 16-101, DIN 5510, BS 6853, prEN 45545
(Burning behavior, Smoke density/ -toxicity)
FAR

UL94 vertical flammability test



Class	After flaming	Burning dripping
V-0	≤ 10 sec.	No
V-1	≤ 30 sec.	No
V-2	≤ 30 sec.	Yes
N.c.*	$\leq > 30$ sec.	Yes

5 test bars, each bar is tested twice

** N.c. = no classification*

➔ **Celanex XFR grades reach UL94 V-0 down to 0,8 mm wall thickness**

4. Celanex XFR

Status UL

QMFZ2 Component - Plastics Tuesday, April 12, 2005 E42337

TICONA GMBH
POSTFACH 15 61 KELSTERBACH 65444 DE

Material Designation: **XFR 6840 GF20**

Product Description: QMFZ2 Component - Plastics Monday, May 02, 2005 E42337
pellets.

TICONA GMBH
POSTFACH 15 61 KELSTERBACH 65444 DE

Color **M** Material Designation: **XFR 4840 GF10**

NC Product Description: QMFZ2 Component - Plastics Friday, April 29, 2005 E42337
pellets.

TICONA GMBH
POSTFACH 15 61 KELSTERBACH 65444 DE

Material Designation: **XFR 4840**

CTI: - IEC Dielectric Strength (kV/mm): 17
ISO Tensile Strength (MPa): -
ISO Tensile Impact (kJ/m²): -

NC Product Description: Polybutylene Terephthalate (PBT), designated "Celanex" furnished as pellets.

Report Date: CTI: - IEC Dielectric Strength (kV/mm): 17
UL94 small-scale test data for parts of end-product devices and appliances

Color	Min. Thick. (mm)	Flame Class	HWI	HAI	RTI Elec	RTI Imp	RTI Str	IEC GWIT	IEC GWFI
NC	0.75	V-0	3	0	75	75	75	-	-
	1.5	V-0	2	0	75	75	75	-	-
	3.0	V-0	2	0	75	75	75	-	-

CTI: 0 IEC CTI: - HVTR: 0 D495: - IEC Ball Pressure (°C): -

Report Date: 4/18/2005 Underwriters Laboratories Inc®

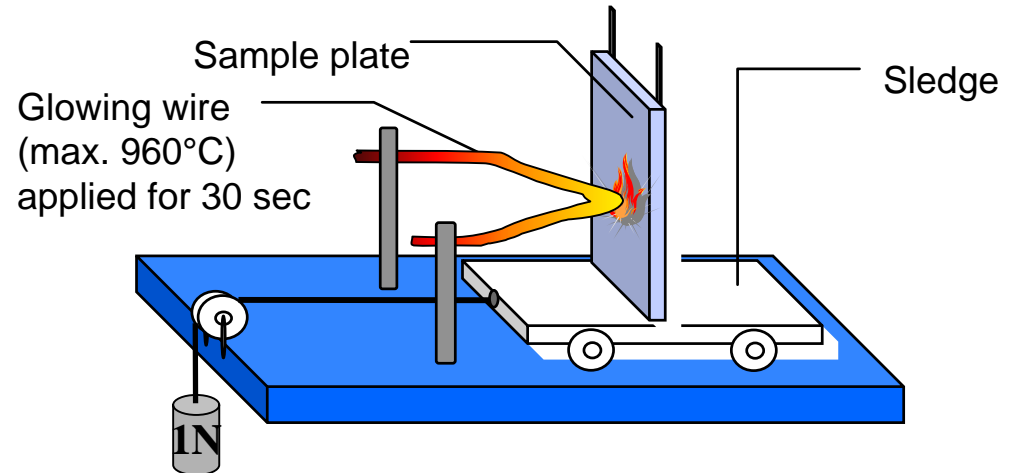
UL94 small-scale test data does not pertain to building materials, furnishings and related contents. UL 94 small-scale test data is intended solely for determining the flammability of plastic materials used in components and parts of end-product devices and appliances, where the acceptability of the combination is determined by ULI.

4. Celanex XFR

Status UL

UL File Number	Grade	UL94 flammability class Natural color	UL94 flammability class all colors	Short term properties acc. to UL746A	Long term properties acc. to UL746B
E42337	Celanex XFR 4840	✓	✓	✓	2006
	Celanex XFR 4840 GF10	✓	ongoing	ongoing	2006
	Celanex XFR 6840 GF20	✓	ongoing	ongoing	2006
	Celanex XFR 6840 GF30	ongoing	ongoing	ongoing	2006

Glow wire testing



GWT

(IEC 60695-2-11)

- Tested on parts
- No inflammation/glowing, *or*
- No burning dripping and flame extinguishes within 30 sec after removal of the glowing wire

GWFI

(IEC 60695-2-12)

- Tested on sample plates
- Highest temperature
- ◆ No inflammation *or*
- ◆ No burning dripping and flame extinguishes within 30 sec after removal of the glowing wire

GWIT

(IEC 60695-2-13)

- Tested on sample plates
- Highest temperature + 25°C
- ◆ No inflammation *or*
- ◆ Flame extinguishes within 5 sec during application of the glowing wire

* Burning < 2 seconds simplified part approval according to IEC 60335-1

4. Celanex XFR

Glow Wire Test Results

	Celanex XFR 4840	Celanex XFR 4840 GF10	Celanex XFR 6840 GF20	Celanex XFR 6840 GF30
GWFI (sample plate 1 - 4 mm)	960°C	960°C	960°C	960°C
GWIT (sample plate 1 - 4 mm)	700 - 725°C	725°C	725 - 750°C	750 - 800°C

GWIT at 750°C (tested on parts)	Depending on wall thickness ignition > 2 seconds possible, but burning time after removal of glow wire less than 30 seconds
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Tests and Properties

- I. Flammability tests
- II. Electrical tests**
- III. Mechanical tests
- IV. Other properties

Comparative tracking index (CTI)



Celanex XFR 6840 GF30:

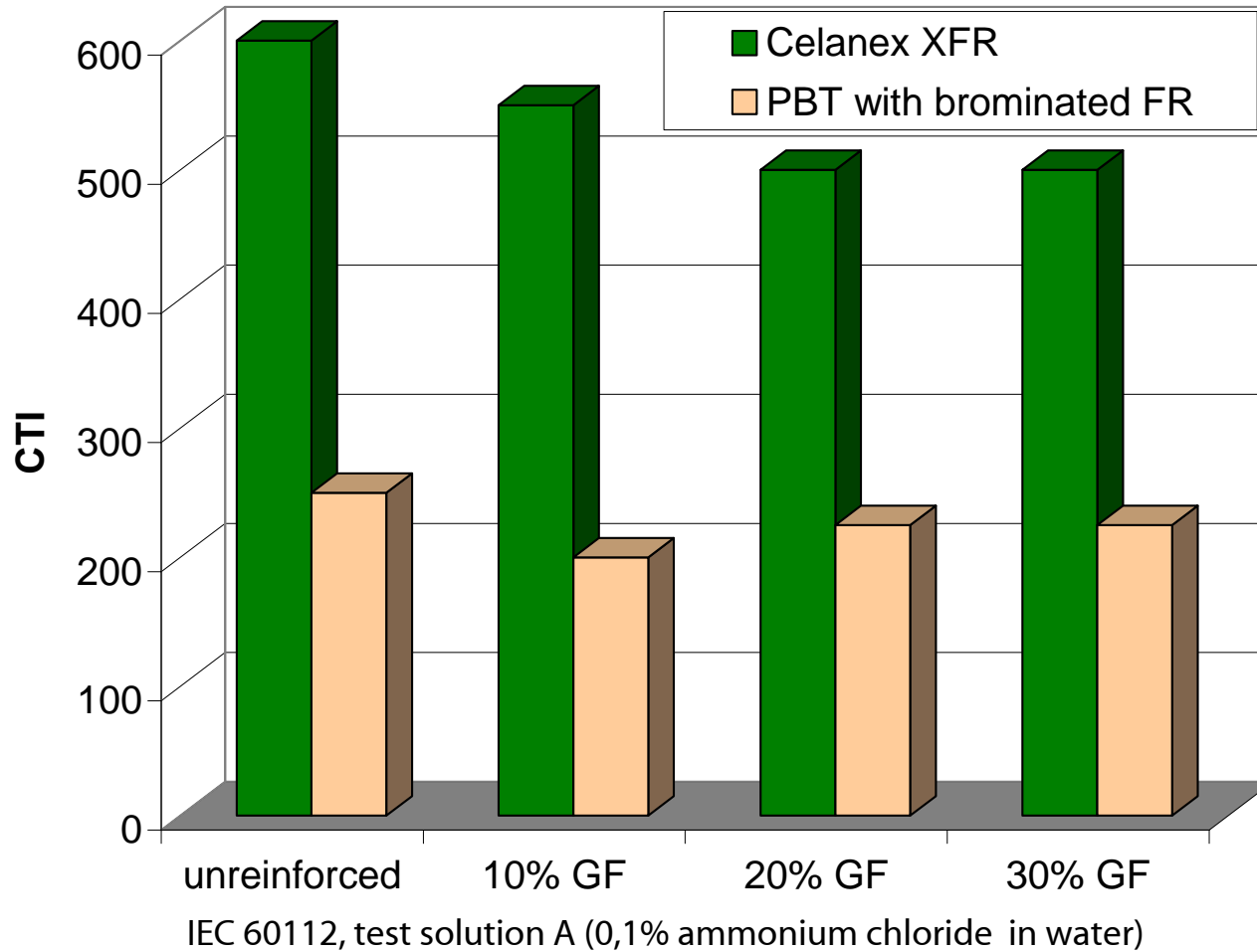
After **50** drops
test solution A at 500 V



**PBT GF30 with brominated
flame retardant:**

After **3** drops
test solution A at 500 V

Comparative tracking index (CTI)



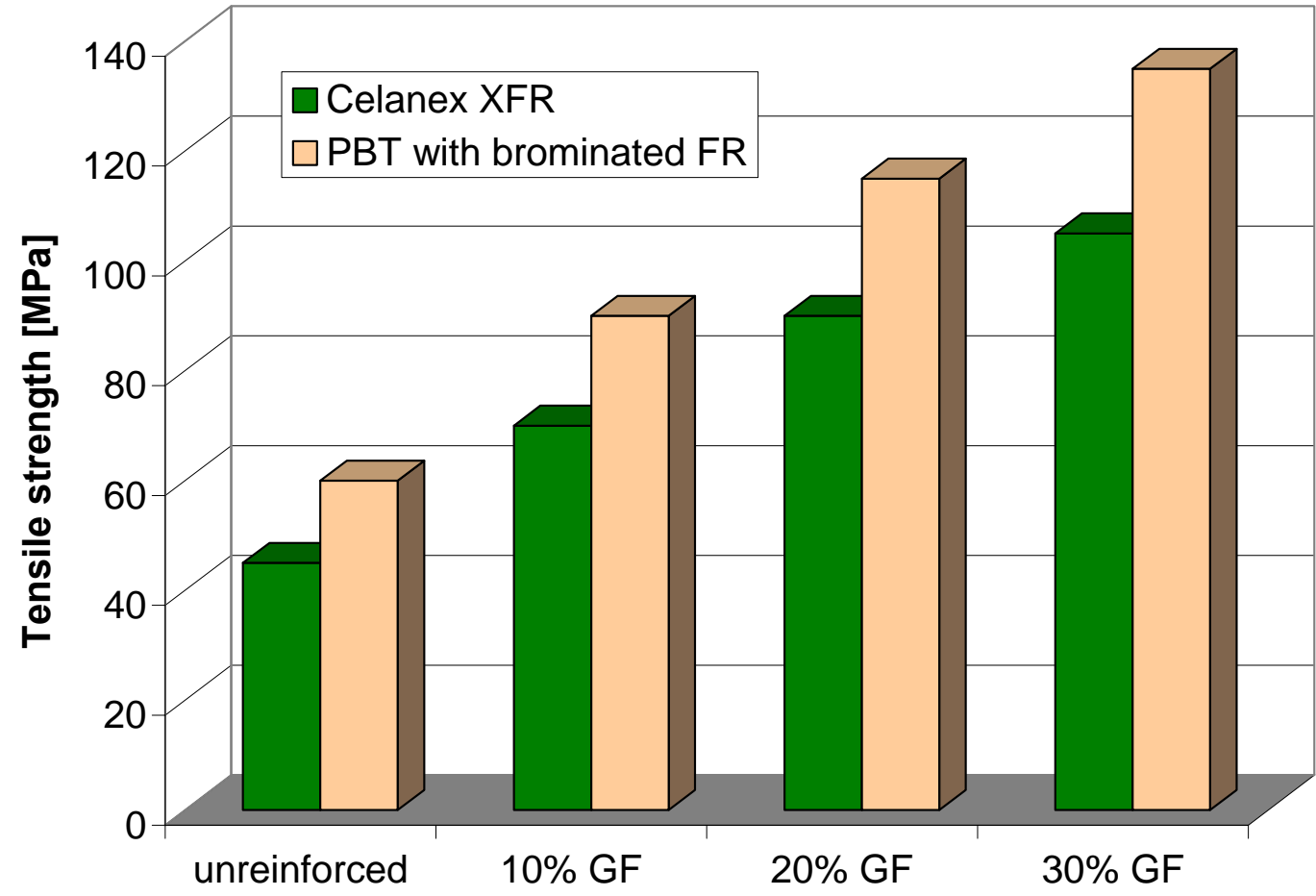
4. Celanex XFR

Tests and Properties

- I. Flammability tests
- II. Electrical tests
- III. **Mechanical tests**
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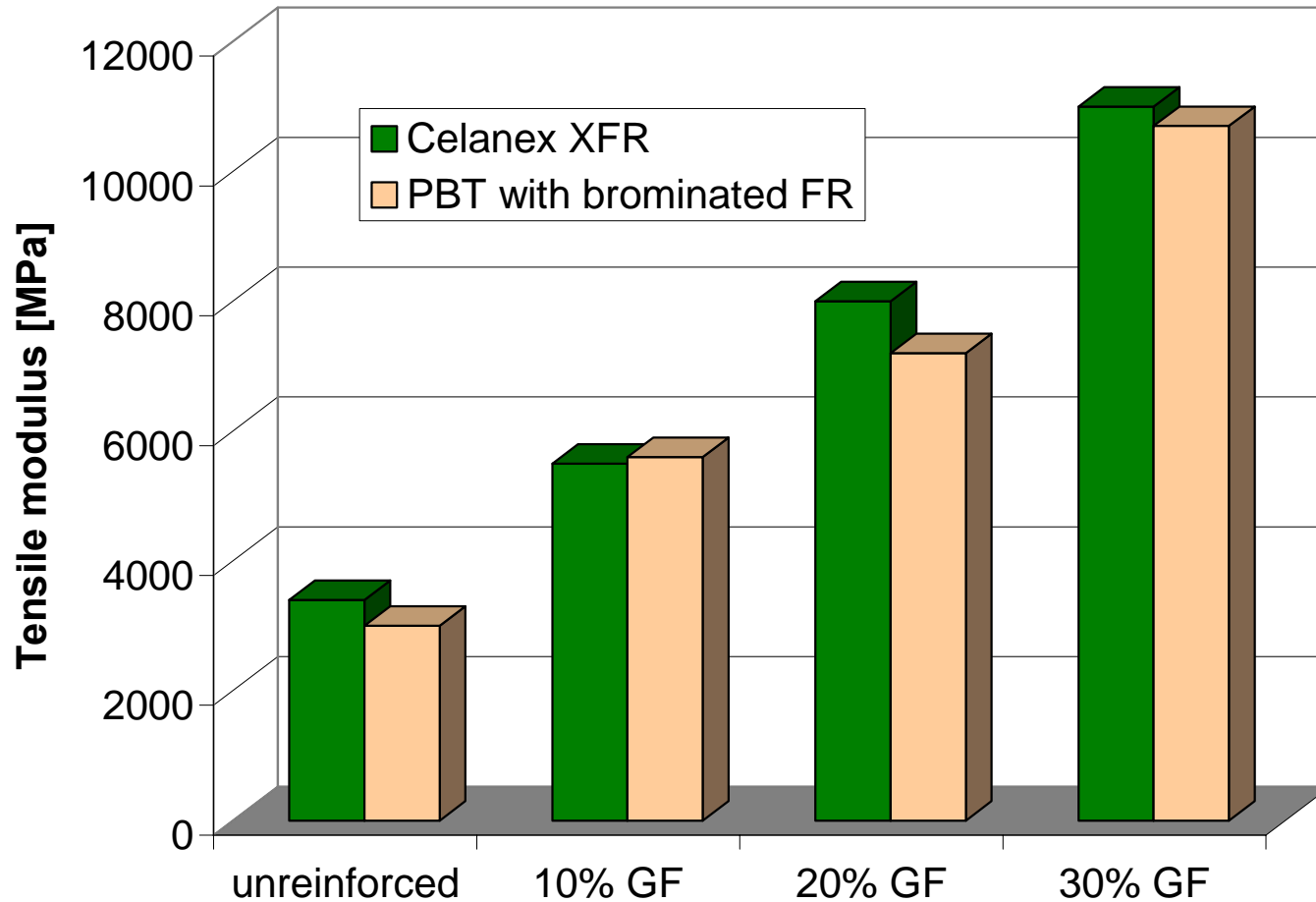
4. Celanex XFR

Tensile strength at break

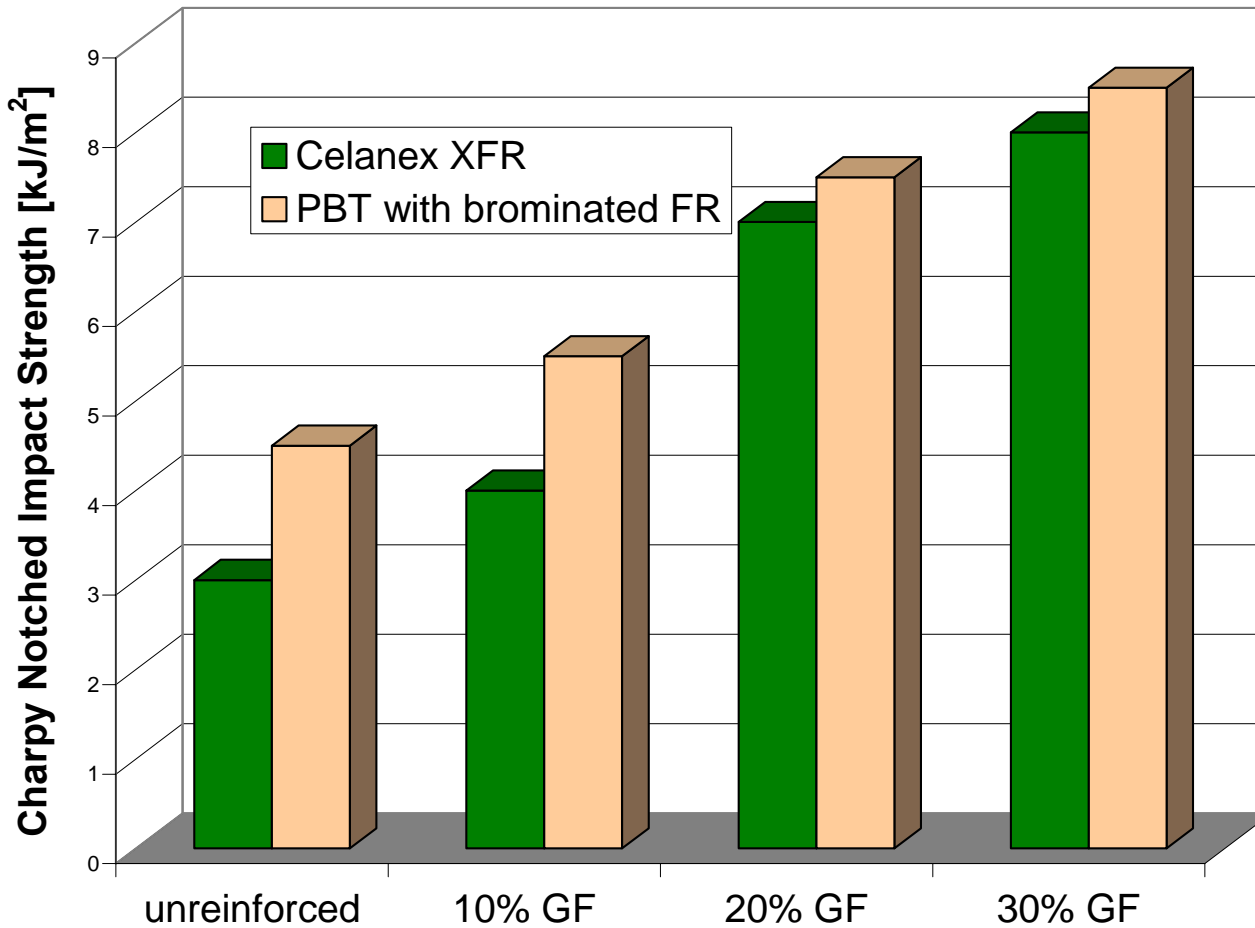


4. Celanex XFR

Tensile modulus



Charpy Notched Impact Strength



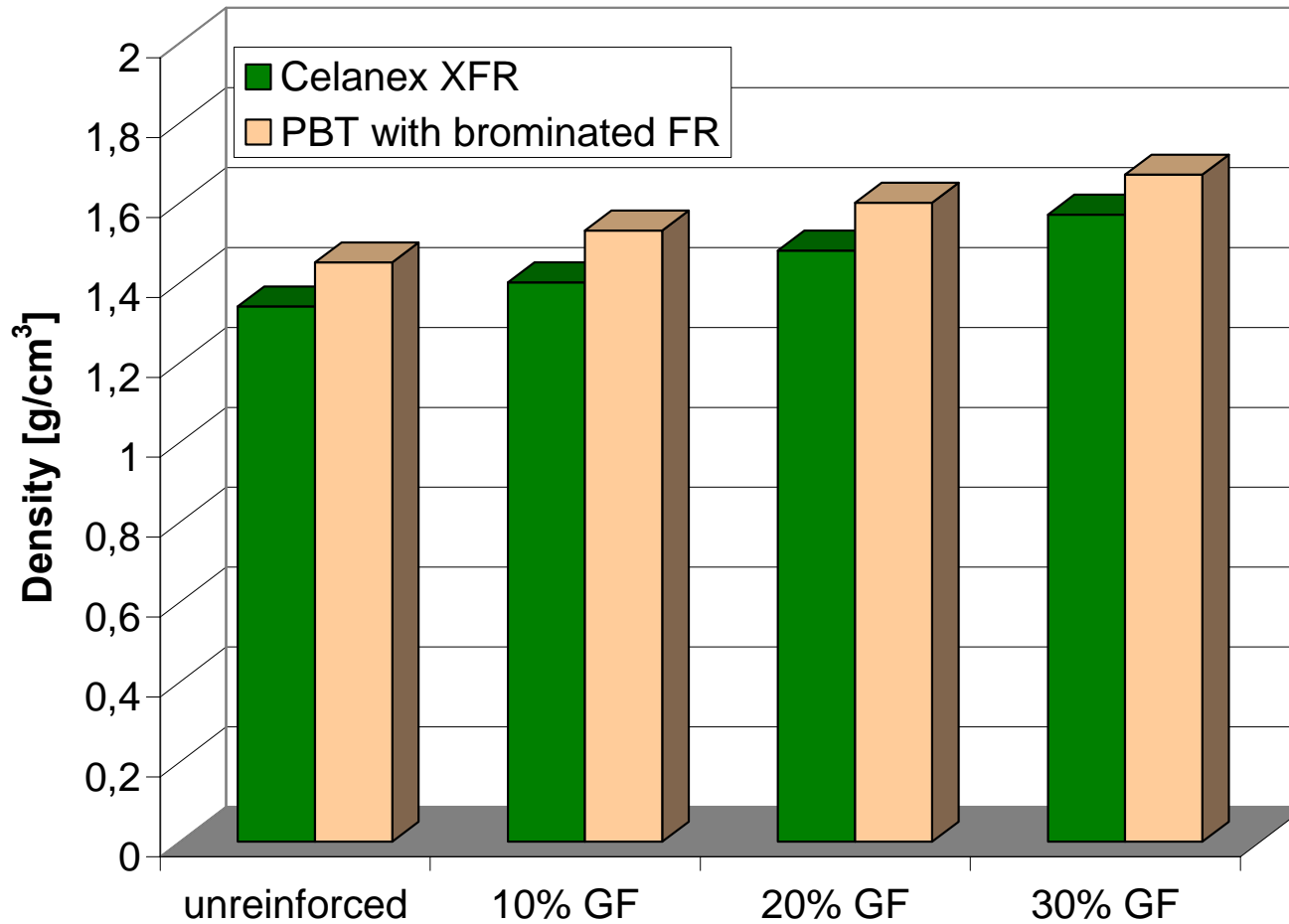
4. Celanex XFR

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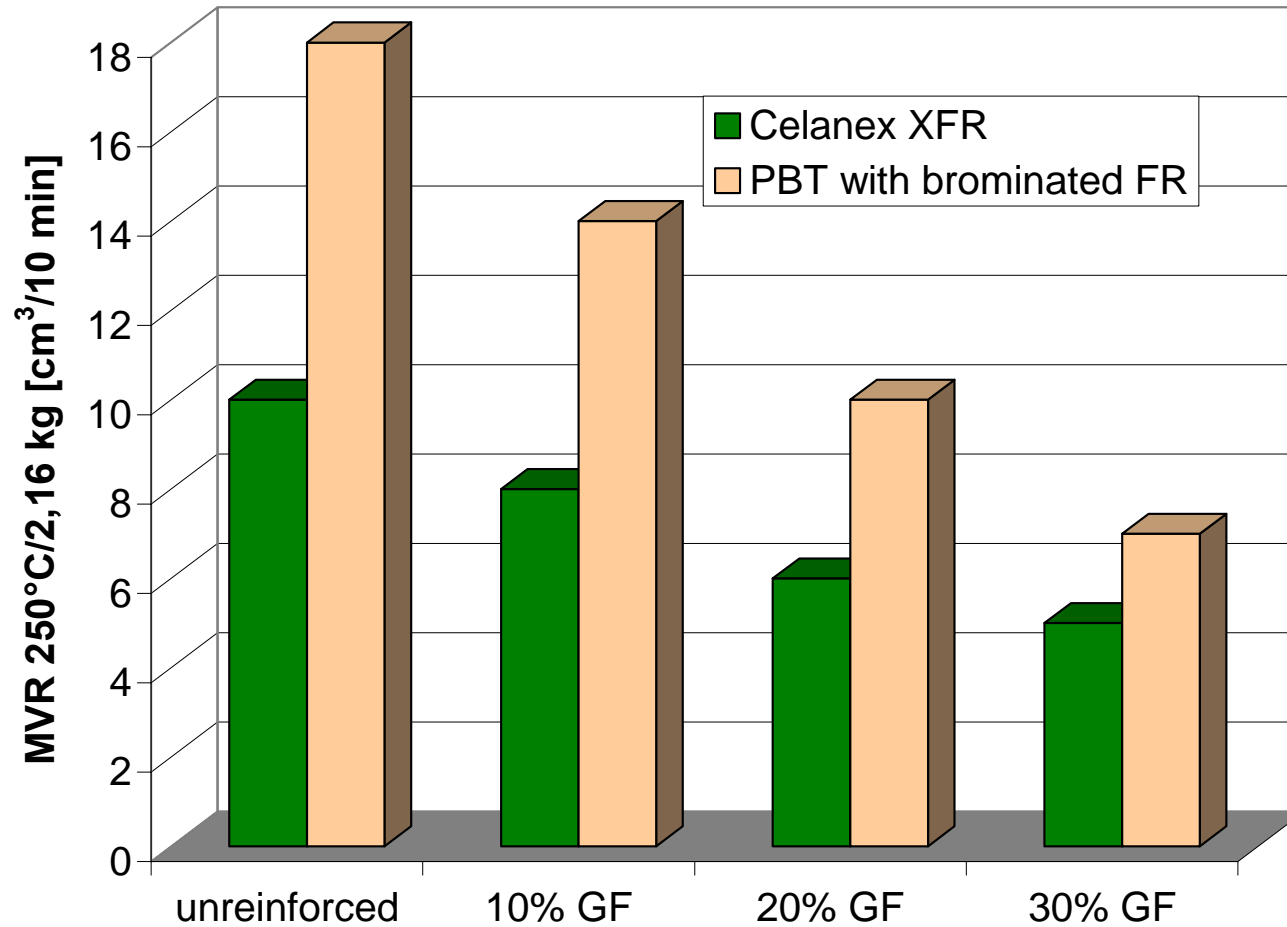
4. Celanex XFR

Density



4. Celanex XFR

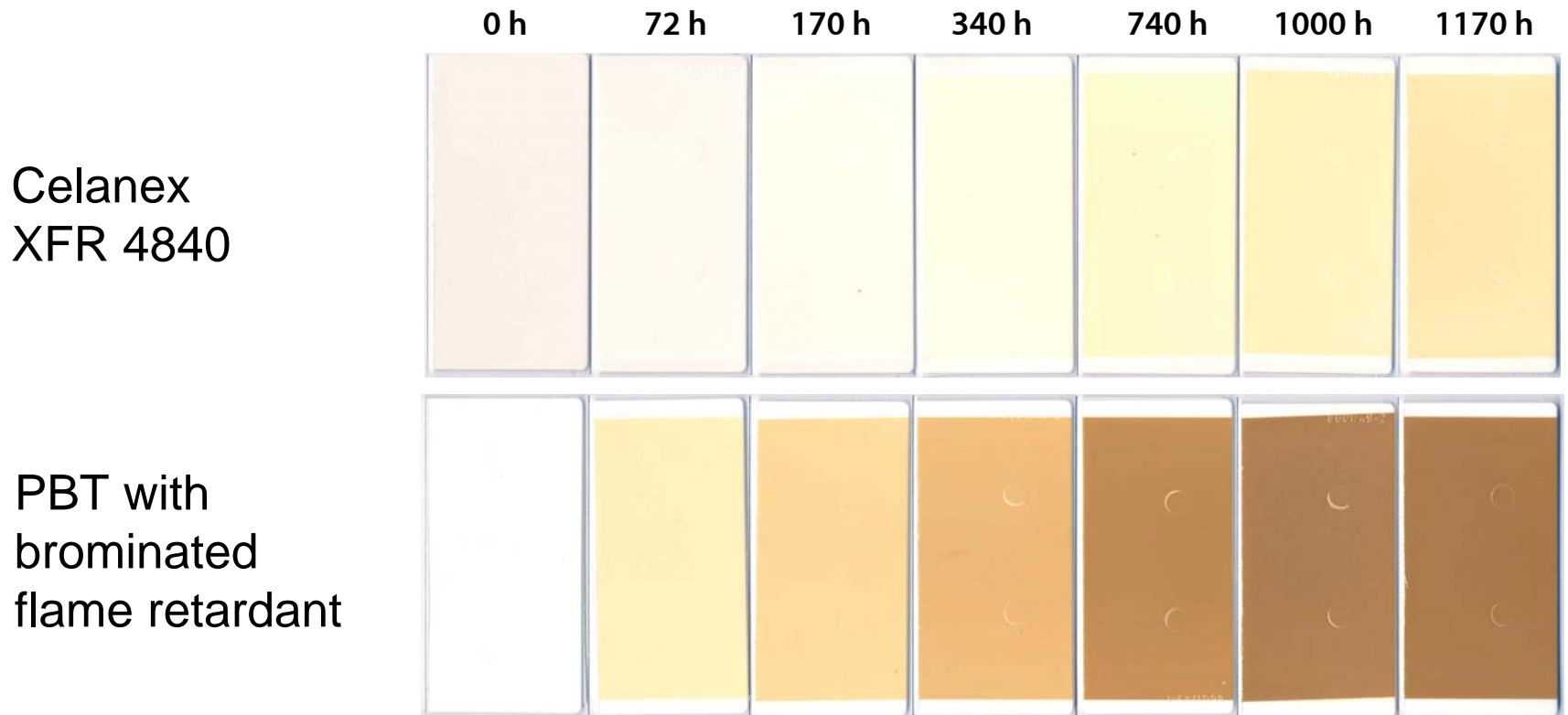
Melt volume rate



4. Celanex XFR

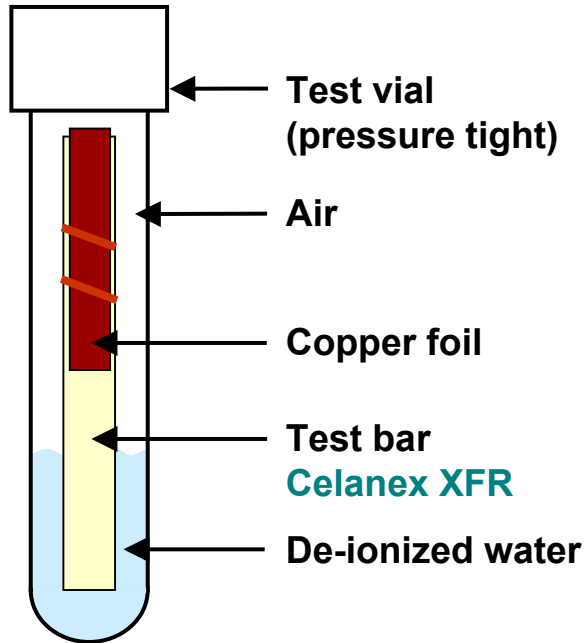
Light stability

Xenotest Beta artificial weathering test

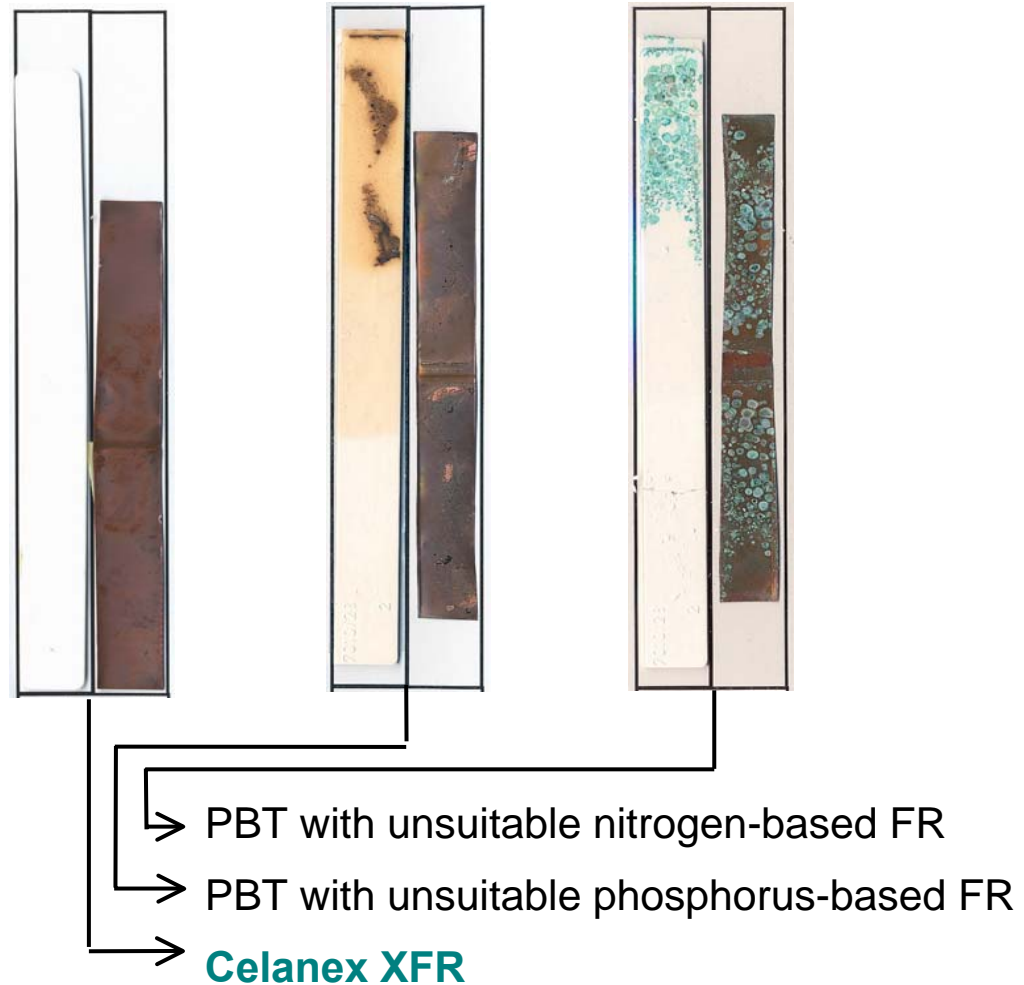


4. Celanex XFR

Copper corrosion test



*Test conditions:
Closed test vial is stored for three days at 120°C*



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5. Processing

- **Celanex XFR can be processed just like standard, flame retardant Celanex grades**

- ◆ Drying
- ◆ Melting
- ◆ Injection molding with high injection speed

- **Typical processing conditions for flame retardant PBT:**

Pre drying	
Water content	<= 0,02 %
Dry air dryer	dew point < -30°C
Drying temperature	120 - 140 °C
Drying time	2 - 4 h

Mold injection	unreinforced	GF reinforced
Cylinder temperatures	240 - 260 °C	250 - 270 °C
Melt temperature	250 - 260 °C	260 - 270 °C
Residence time in cylinder	3-5 minutes	
Tool temperature	75 - 100 °C	
Injection pressure	600 - 1000 bar	

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6. Summary

- **Existing need for halogen-free flame retardant plastics**
 - ◆ WEEE and RoHS
 - ◆ Increased environmental awareness
 - ◆ Marketing advantages by using eco labels

- **Ticona has developed a new product line of halogen-free flame retardant PBT**
 - ◆ UL94 V-0 down to 0,8 mm
 - ◆ No migration / low emission
 - ◆ High thermal stability
 - ◆ Easy processing
 - ◆ Good property profile

The Celanex[®] PBT XFR product family

Celanex **XFR** 4840

unreinforced

Celanex **XFR** 4840 GF10

10 % glass fiber reinforced

Celanex **XFR** 6840 GF20

20 % glass fiber reinforced

Celanex **XFR** 6840 GF30

30 % glass fiber reinforced

The background features a blue grid pattern with several yellow letter tiles scattered across it. The tiles are arranged to spell out 'PBT XFR'. The 'P' tile is at the top, 'B' is to its right, 'T' is at the bottom right, 'X' is on the left, 'F' is in the middle, and 'R' is to the right of 'F'.

**„Celanex[®] PBT XFR –
- Flame Retardant Halogen- and Antimony-
Free Thermoplastic Polyester –
The New Product Family of Ticona“**

**Thank you very much for your
interest and attention**

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Properties of molded parts can be influenced by a wide variety of factors including, but not limited to, material selection, additives, part design, processing conditions and environmental exposure. Any determination of the suitability of a particular material and part design for any use contemplated by the user is the sole responsibility of the user. The user must verify that the material, as subsequently processed, meets the requirements of the particular product or use. The user is encouraged to test prototypes or samples of the product under the harshest conditions to be encountered to determine the suitability of the materials.

Material data and values included in this publication are either based on testing of laboratory test specimens and represent data that fall within the normal range of properties for natural material or were extracted from various published sources. All are believed to be representative. These values alone do not represent a sufficient basis for any part design and are not intended for use in establishing maximum, minimum, or ranges of values for specification purposes. Colorants or other additives may cause significant variations in data values.

We strongly recommend that users seek and adhere to the manufacturer's current instructions for handling each material they use, and to entrust the handling of such material to adequately trained personnel only. Please call the numbers listed below for additional technical information. Call Customer Services at the number listed below for the appropriate Material Safety Data Sheets (MSDS) before attempting to process our products. Moreover, there is a need to reduce human exposure to many materials to the lowest practical limits in view of possible adverse effects. To the extent that any hazards may have been mentioned in this publication, we neither suggest nor guarantee that such hazards are the only ones that exist.

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