

Makrolon[®] SF800 Z and SF805

- Polycarbonate (PC)
- Structural foam grades
- Injection molding

Short description

Makrolon[®] SF800 Z:

EMEA/LA region; MVR (300 °C/1.2 kg) 8.5 cm³/10 min; structural foam; 5 % glass fiber reinforced; milled fiber; chlorine- and bromine-free flame retardancy; medium viscosity; easy release; injection molding; available in natural (opaque) and opaque colors; in combination with an appropriate blowing agent for the production of structural foam moldings

Makrolon[®] SF805:

EMEA/LA region; MVR (300 °C/1.2 kg) 7.5 cm³/10 min; structural foam; 5 % glass fiber reinforced; chlorine- and bromine-free flame retardancy; high viscosity; easy release; injection molding; available in natural (opaque) and opaque colors; in combination with an appropriate blowing agent for the production of structural foam moldings

Characterization

Makrolon[®] SF800 Z and SF805 are medium-viscosity polycarbonates based on bisphenol A, reinforced with approximately 5 % by weight glass fiber.

These Makrolon[®] grades contain mold release agents and chlorine- and bromine-free flame retardants that are effective in very small amounts.

A mixture of Makrolon[®] SF800 Z or SF805 with a suitable blowing agent yields large-volume, foamed parts.

Makrolon[®] SF800 Z and SF805 can be processed with standard commercial blowing agents that are suitable for foaming polycarbonates.

Attention should be paid to the recommended metering quantities and, where appropriate, to the drying instructions provided by the individual manufacturers.

Delivery form

Granules packed in 25-kg polyethylene sacks, big bags, octatainers with a polyethylene inliner or in bulk.

All Makrolon[®] batches are homogenized after production.

Makrolon[®] SF800 Z und SF805 are only available in their natural color (opaque) and opaque color shades.

The production plants for Makrolon[®] have been certified to DIN ISO by the appropriate quality organizations.

The certificates can be found on the INTERNET at <http://www.bayermaterialscience.com> (Customer Services / Certificates).

Registered customers can access Safety Data Sheet on the Internet (bayerone.bayer.com). It can also be sent on request.

The Safety Data Sheet includes data on labeling, transport and storage, as well as information on handling, product safety and toxicological and ecological profiles.

Applications

When combined with a suitable blowing agent, Makrolon[®] SF800 Z and SF805 can be used for the production of large-volume foamed parts (e.g. housings for automatic telling machines, housing sections for industrial printers).

When it comes to producing large molded parts with pronounced changes in wall thickness, the injection molding of solid plastics comes up against its limits.

An alternative here is structural foam molding using Makrolon[®] SF800 Z and SF805.



Compared with injection molding using solid plastics, the advantages of structural foam molded parts in Makrolon® SF800 Z and SF805 are their reduced warpage and shrinkage, high dimensional stability, avoidance of sink marks and a wider processing window.

Properties (see also table)

The properties of cellular and non-cellular materials are listed in the accompanying table.

The data given here for cellular materials are intended as guide values for the 900 to 1000 kg/m³ density range.

Makrolon® SF800 Z and SF805 exhibit outstanding flame retardance in the foamed state.

In UL 94 tests,

Makrolon® SF800 Z achieves fire ratings of V-0/3.0 mm and 5VA/5.0 mm (minimum density 0.73 g/cm³), while Makrolon® SF805 is rated V-0/3.0 mm and 5VA/6.0 mm (minimum density 0.75 g/cm³).

The properties of the foamed parts depend to a large extent on their density (pore volume), pore structure and the formation of the skin zone.

These characteristics are decisively influenced by the processing parameters.

Processing

Pre-treatment / drying¹⁾

Makrolon® SF800 Z and SF805 must be dried before processing. No more than 0.02 % residual moisture may be present in the granules for injection molding. Moisture in the melt leads to surface defects and a more marked reduction in molecular weight.

Makrolon® should be dried in suitable dryers at 120 °C.

The drying time for moist granules is largely a function of the nature and type of the drying unit and can take between 2 and 12 hours depending on the drying capacity. Drying times of 2 to 4 hours are sufficient in modern high-speed dryers.

The physical mixing of the individual components takes place immediately after drying in an automatic mixer on the hopper of the injection molding machine.

Small amounts of material can be mixed by hand in a suitable mixing drum.

Injection molding

Injection molding of solid plastics: ¹⁾

Makrolon® SF800 Z und SF805 can be processed on all modern injection molding machines. Shut-off nozzles are suitable given sufficient, uniform heating. At high melt temperatures, melt can flow out of open nozzles.

The melt temperatures generally employed during processing are between 310 and 330 °C.

It should be possible for the molds to be heated intensively and uniformly, and the mold temperature should be at least 80 °C; 100 - 130 °C is required to ensure parts with a low inherent stress and a good surface. No demolding problems are encountered at temperature up to 130 °C.

Structural foam molding with blowing agents:

These are illustrated by the following example:

Injection molding machine:

Low-pressure structural injection molding

Barrel temperatures:

Extruder: 260 / 270 / 280 / 290 / 300 / 310 °C

Deflector: 310 °C

Transfer barrel: 310 / 310 / 310 °C

Back pressure: (hydraulic): 10 - 15 bar

Screw speed: up to max. 0.3 m/sec

Injection time: as short as possible

Conventional injection molding machines with shut-off nozzles and suitable non-return valves can also be used.

High injection speeds will ensure an optimum foam structure.

Small quantities of decomposition product may be given off when processing under the recommended conditions. To preclude any risk to the health and well-being of the machine operatives, tolerance limits for the work environment must be ensured by the provision of efficient exhaust ventilation and fresh air

at the workplace in accordance with the Safety Data Sheet.

In order to prevent more marked partial decomposition of the polymer and the release of volatile decomposition products, the prescribed processing temperatures should not be substantially exceeded.

1) Details on this can be found in the following Technical Information Sheets:

"Determining the dryness of Makrolon[®] by the TVI test"

"Processing data for the injection molder"

"The injection molding of high-quality molded parts"

Fig. 1: Melt viscosity as a function of shear rate (Makrolon[®] SF800 Z)



Typical Values

Property	Test Condition	Unit	Standard	Makrolon® SF800 Z	SF805
Rheological properties					
C Melt volume-flow rate	300 °C; 1.2 kg	cm ³ /10 min	ISO 1133	8.5	7.5
C Molding shrinkage, parallel	60x60x2; 500 bar	%	ISO 294-4	0.7	0.7
C Molding shrinkage, normal	60x60x2; 500 bar	%	ISO 294-4	0.55	0.55
C Melt mass-flow rate	300 °C; 1.2 kg	g/10 min	ISO 1133	9.0	8.0
Mechanical properties (23 °C/50 % r. h.)					
C Tensile modulus	1 mm/min	MPa	ISO 527-1,-2	2700	2900
Yield stress	5 mm/min	MPa	ISO 527-1,-2	60	62
Yield strain	5 mm/min	%	ISO 527-1,-2	4.8	4.7
C Stress at break	5 mm/min	MPa	ISO 527-1,-2	50	60
C Strain at break	5 mm/min	%	ISO 527-1,-2	55	20
Flexural modulus	2 mm/min	MPa	ISO 178	2700	2900
Flexural strength	2 mm/min	MPa	ISO 178	90	100
Flexural strain at flexural strength	2 mm/min	%	ISO 178	6.2	6.0
Flexural stress at 3.5 % strain	2 mm/min	MPa	ISO 178	75	85
C Charpy impact strength	23 °C	kJ/m ²	ISO 179-1eU	220C(N)	190C
Charpy impact strength	-20 °C	kJ/m ²	ISO 179-1eU		160C
C Charpy impact strength	-30 °C	kJ/m ²	ISO 179-1eU	210C	140C
Charpy impact strength	-60 °C	kJ/m ²	ISO 179-1eU	170C	90C
Charpy notched impact strength	23 °C; 3 mm	kJ/m ²	ISO 7391/b.o. ISO 179-1eA	20C	15C
Izod notched impact strength	23 °C; 3 mm	kJ/m ²	ISO 7391/b.o. ISO 180-A	20C	15C
C Puncture maximum force	23 °C	N	ISO 6603-2	4400	4300
C Puncture maximum force	-30 °C	N	ISO 6603-2	5100	4900
C Puncture energy	23 °C	J	ISO 6603-2	35	30
C Puncture energy	-30 °C	J	ISO 6603-2	30	25
Ball indentation hardness		N/mm ²	ISO 2039-1	120	119
Tensile modulus	1 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 527-1,-2	1700	1800
Stress at break	5 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 527-1,-2	30	35
Strain at break	5 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	%	b.o. ISO 527-1,-2	6.0	6.0
Flexural modulus	2 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 178	1700	1800
Flexural strength	2 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 178	50	55
Flexural strain at flexural strength	2 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 178	5.0	5.0
Flexural stress at 3.5 % strain	2 mm/min; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	MPa	b.o. ISO 178	50	55
Charpy impact strength	23 °C; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	kJ/m ²	b.o. ISO 179-1eU	50C	25C
Charpy impact strength	-20 °C; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	kJ/m ²	b.o. ISO 179-1eU	50C	25C
Ball indentation hardness	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	N/mm ²	b.o. ISO 2039-1	50	50



Typical Values

Property	Test Condition	Unit	Standard	Makrolon®	
				SF800 Z	SF805
Thermal properties					
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1,-2	128	130
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1,-2	138	140
C Vicat softening temperature	50 N; 50 °C/h	°C	ISO 306	142	143
C Coefficient of linear thermal expansion, parallel	23 to 55 °C	10 ⁻⁴ /K	ISO 11359-1,-2	0.55	0.55
C Coefficient of linear thermal expansion, transverse	23 to 55 °C	10 ⁻⁴ /K	ISO 11359-1,-2	0.65	0.7
C Burning behavior UL 94	3.0 mm	Class	UL 94	V-0 (GY)	V-0 (GY)
Burning behavior UL 94	5.0 mm	Class	UL 94	V-0 (GY)	
Burning behavior UL 94	6.0 mm	Class	UL 94		V-0 (GY)
Burning behavior UL 94-5V	5.0 mm	Class	UL 94	5VA (GY)	
Burning behavior UL 94-5V	6.0 mm	Class	UL 94		5VA (GY)
C Oxygen index	Method A	%	ISO 4589-2	32	32
Thermal conductivity	23 °C	W/(m·K)	ISO 8302	0.22	0.22
Resistance to heat (ball pressure test)		°C	IEC 60695-10-2	136	136
Relative temperature index (Tensile strength)	3.0 mm	°C	UL 746B	80	80
Relative temperature index (Tensile impact strength)	3.0 mm	°C	UL 746B	80	80
Relative temperature index (Electric strength)	3.0 mm	°C	UL 746B	80	80
Glow wire test (GWFI)	1.0 mm	°C	IEC 60695-2-12	850	850
Glow wire test (GWFI)	1.5 mm	°C	IEC 60695-2-12	960	960
Glow wire test (GWFI)	3.0 mm	°C	IEC 60695-2-12	960	960
Glow wire test (GWFI)	4.0 mm	°C	IEC 60695-2-12	960	960
Glow wire test (GWIT)	0.8 mm	°C	IEC 60695-2-13	900	825
Glow wire test (GWIT)	1.5 mm	°C	IEC 60695-2-13	900	825
Glow wire test (GWIT)	3.0 mm	°C	IEC 60695-2-13	900	825
Temperature of deflection under load	1.80 MPa; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	°C	b.o. ISO 75-1,-2	123	125
Temperature of deflection under load	0.45 MPa; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	°C	b.o. ISO 75-1,-2	131	133
Vicat softening temperature	50 N; 50 °C/h; Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	°C	b.o. ISO 306	132	132
Burning behavior UL 94	Foamed 5.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Class	UL 94	V-0 (GY)	
Burning behavior UL 94	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Class	UL 94		V-0 (GY)
Burning behavior UL 94-5V	Foamed 5.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Class	UL 94	5VA (GY)	
Burning behavior UL 94-5V	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Class	UL 94		5VA (GY)
Electrical properties (23 °C/50 % r. h.)					
C Relative permittivity	100 Hz	-	IEC 60250	3.1	3.1
C Relative permittivity	1 MHz	-	IEC 60250	3.0	3.0
C Dissipation factor	100 Hz	10 ⁻⁴	IEC 60250	8	8
C Dissipation factor	1 MHz	10 ⁻⁴	IEC 60250	90	90
C Volume resistivity		Ohm·m	IEC 60093	1E14	1E14
C Surface resistivity		Ohm	IEC 60093	1E16	1E16
C Electrical strength	1 mm	kV/mm	IEC 60243-1	32	34
C Comparative tracking index CTI	Solution A	Rating	IEC 60112	200	175
Comparative tracking index CTI M	Solution B	Rating	IEC 60112	125M	125M
Volume resistivity	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Ohm·m	b.o. IEC 60093	1E14	
Surface resistivity	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	Ohm	b.o. IEC 60093	1E16	
Electrical strength	Foamed 6.0 mm; density in the foamed state 900-1000 kg/m ³ [^]	kV/mm	b.o. IEC 60243-1	> 8.0	



Typical Values

Property	Test Condition	Unit	Standard	Makrolon®	
				SF800 Z	SF805
Other properties (23 °C)					
C Water absorption (saturation value)	Water at 23 °C	%	ISO 62	0.30	0.30
C Water absorption (equilibrium value)	23 °C; 50 % r. h.	%	ISO 62	0.10	0.10
C Density		kg/m ³	ISO 1183-1	1230	1230
Glass fiber content	Method A	%	b.o. ISO 3451-1	5	5
Bulk density	Pellets	kg/m ³	ISO 60	650	650
Processing conditions for test specimens					
C Injection molding-Melt temperature		°C	ISO 294	300	300
C Injection molding-Mold temperature		°C	ISO 294	110	110
C Injection molding-Injection velocity		mm/s	ISO 294	200	200

C These property characteristics are taken from the CAMPUS plastics data bank and are based on the international catalogue of basic data for plastics according to ISO 10350.

Impact properties: N = non-break, P = partial break, C = complete break

colored fields = UL recognition





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Unless specified to the contrary, the values given have been established on standardized test specimens at room temperature. The figures should be regarded as guide values only and not as binding minimum values. Please note that, under certain conditions, the properties can be affected to a considerable extent by the design of the mold/die, the processing conditions and coloring.

Under the recommended processing conditions small quantities of decomposition product may be given off during processing. To preclude any risk to the health and well-being of the machine operatives, tolerance limits for the work environment must be ensured by the provision of efficient exhaust ventilation and fresh air at the workplace in accordance with the Safety Data Sheet. In order to prevent the partial decomposition of the polymer and the generation of volatile decomposition products, the prescribed processing temperatures should not be substantially exceeded.

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