Bayer MaterialScience

MAKROLON® 2805 and 2858

Product Information

Polycarbonate Resins

2805 General-Purpose Grade
2858 General-Purpose, FDA-Quality Grade

Description

Makrolon 2805 and 2858 polycarbonate resins are linear, medium-viscosity, high-performance thermoplastics produced in pellet form for processing primarily by injection molding. The resins are available in natural, clear tints, and transparent, translucent, and opaque colors.

Makrolon 2805 and 2858 resins contain an internal mold release additive. In addition, Makrolon 2858 resin complies with FDA food-contact regulations 21 CFR 177.1580 (Polycarbonate Resins) and may be used in contact with all food types. Most colors may be used for all thermal food-contact applications. However, some colors are limited by Conditions of Use B, 21 CFR 175.300 and 176.170 and may not be used when the food is sterilized in the food-contact article under autoclaving conditions. Please contact your Bayer Corporation representative with complete details when food contact is involved.

Makrolon 2858 resin, in natural 000000 and clear tints 550042 and 550115, is also listed under NSF standard 51 for use in food equipment. Please consult your Bayer Corporation representative for more information about food equipment applications.

Applications

Makrolon 2805 and 2858 polycarbonate resins have an excellent balance of engineering properties, including outstanding impact strength and ductility, a large service temperature range, excellent electrical properties, and dimensional stability. These general purpose grades are used in the automotive industry, building and construction, business equipment, consumer products, electronics and telecommunications, lighting, packaging, optical devices, optical lenses, and photographic equipment. As with any product, use of Makrolon 2805 and 2858 resins in a given application must be tested (including but not limited to field testing) in advance by the user to determine suitability.

Medical Applications

Makrolon 2858 polycarbonate resin is used in a variety of medical devices.

Biocompatibility: Certain color formulations of Makrolon 2858 resin, such as clear tint 550115, meet the requirements of the FDA-modified ISO 10993, Part 1 "Biological Evaluation of Medical Devices" tests with human tissue contact time of 30 days or less. Only products that meet these requirements may be considered candidates for applications requiring biocompatibility.

Regrind must not be used in medical applications requiring biocompatibility.

Manufacturer's Responsibility: It is the responsibility of the medical device, biological product or pharmaceutical manufacturer ("Manufacturer") to determine the suitability of all component parts and raw materials, including Makrolon 2858 resin, used in its final product in order to ensure safety and compliance with FDA requirements. This determination must include, as applicable, testing for suitability as an implant device and suitability as to contact with and/or storage of human tissue and liquids including, without limitation, medication, blood or other bodily fluids. Under no circumstances may Makrolon 2858 resin be used in any cosmetic, reconstructive or reproductive implant applications. Nor may Makrolon 2858 resin be used in any other bodily implant applications or any applications involving contact with or storage of human tissue, blood, or other bodily fluids for greater than 30 days, based on FDA-modified ISO 10993, Part 1 "Biological Evaluation of Medical Devices" tests.

The suitability of a Bayer product in a given end-use environment is dependent upon various conditions including, without limitation, chemical compatibility, temperature, part design, sterilization method, residual stresses, and external loads. It is the responsibility of the Manufacturer to evaluate its final product under actual end-use requirements and to adequately advise and warn purchasers and users thereof.

Single-use medical devices made from a Bayer product are not suitable for multiple uses. If the medical device is designed for multiple uses, it is the responsibility of the Manufacturer to determine the appropriate number of permissible uses by evaluating the device under actual sterilization and end-use conditions and to adequately advise and warn purchasers and users thereof.

Sterilization: Parts molded from Makrolon 2858 resin are sterilizable using radiation, ethylene oxide, or steam autoclaving. When sterilizing with steam, germicides and detergents must be rinsed thoroughly from polycarbonate parts prior to autoclaving. Failure to thoroughly remove germicides and detergents from the part prior to autoclaving may cause accelerated degradation of the polycarbonate.

Steam sterilization temperatures for parts made of Makrolon polycarbonate must not exceed 250º F (121ºC) to avoid part deformation. Please note that permanent immersion of polycarbonate parts in water above 140ºF (60ºC) or in steam causes loss of material properties and must be avoided. Furthermore, condensed steam should not be allowed to accumulate, as this may cause damage to parts. Polycarbonate parts should also be protected from damage by substances such as alkaline corrosion inhibitors, which are frequently added to boiler feed water.

The sterilization method and the number of sterilization cycles a medical device made from Makrolon 2858 resin can withstand will vary depending upon type/grade of product, part design, processing parameters, sterilization temperature, and chemical environment. Therefore, the Manufacturer must evaluate each device to determine the sterilization method and the number of permissible sterilization cycles appropriate for actual end-use requirements and must adequately advise and warn purchasers and users thereof.

Drying

All polycarbonate resins are hygroscopic and must be thoroughly dried prior to processing. A desiccant dehumidifying hopper dryer is recommended. To achieve a moisture content of less than 0.02%, hopper inlet air temperature should be 250°F (121°C) and inlet air dew point should be -20°F (-29°C) or lower. The hopper capacity should be sufficient to provide a minimum residence time of 4 hours. Additional information on drying procedures is available in the Bayer brochure *General Drying Guide.*

Processing

Makrolon 2805 and 2858 polycarbonate resins may be easily processed on commercially available equipment suitable for injection molding of polycarbonate. Processing parameters are listed in the "Typical Injection Molding Conditions" table. Actual processing conditions will depend on machine size, mold design, material residence time, shot size, etc.

Typical Injection Molding Conditions

Barrel Temperatures:	
Rear	500°–540°F (260°–282°C)
Middle	530°–570°F (277°–299°C)
Front	555°–595°F (291°–313°C)
Nozzle	535°–595°F (279°–313°C)
Melt Temperature	560°–590°F (293°–310°C)
Mold Temperature	150°–220°F (66°–104°C)
Injection Pressure	10,000–20,000 psi
Hold Pressure	50–70% of Injection Pressure
Back Pressure	50–100 psi
Screw Speed	50–75 rpm
Injection Speed	Moderate to Fast
Cushion	1/8–1/4 in
Clamp	3–5 ton/in^2

Additional information on processing may be obtained by consulting the Bayer publication *Makrolon Polycarbonate — A Processing Guide for Injection Molding* and by contacting a Bayer Corporation technical service representative.

Regrind Information

Where end-use requirements permit, up to 20% Makrolon resin regrind may be used with virgin material, provided that the material is kept free of contamination and is properly dried (see section on Drying). Any regrind used must be generated from properly molded parts, sprues, and/or runners. All regrind used must be clean, uncontaminated, and thoroughly blended with virgin resin prior to drying and processing. Under no circumstances should degraded, discolored, or contaminated material be used for regrind. Materials of this type should be properly discarded.

Improperly mixed and/or dried regrind may diminish the desired properties of Makrolon resin. It is critical that you test finished parts produced with any amount of regrind to ensure that your end-use performance requirements are fully met. Regulatory or testing organizations (e.g., UL) may have specific requirements limiting the allowable amount of regrind. Because third party regrind generally does not have a traceable heat history or offer any assurance that proper temperatures, conditions, and/or materials were used in processing, extreme caution must be exercised in buying and using regrind from third parties.

The use of regrind material should be avoided entirely in those applications where resin properties equivalent to virgin material are required, including but not limited to color quality, impact strength, resin purity, and/or load-bearing performance.

Please see back cover for additional information ...

Typical Properties* for Natural Resin	ASTM Test Method (Other)	Makrolon® 2805/2858 Resins U.S. Conventional	SI Metric
General			
Specific Gravity	D 792	1.20	
Density	D 792	0.043 lb/in³	1.20 g/cm³
Specific Volume	D 792	23.1 in³/lb	0.83 cm³/g
Mold Shrinkage	D 955	0.006–0.008 in/in	0.006–0.008 mm/mm
Water Absorption, Immersion at 73°F (23°C):	D 570		
24 Hours		0.12%	
Equilibrium		0.30%	
Melt Flow Rate[a] at 300°C/1.2-kg Load	D 1238	10 g/10 min	
Optical			
Transmittance at 0.125-in (3.2-mm) Thickness	D 1003	88%	
Haze at 0.125-in (3.2-mm) Thickness	D 1003	<0.8%	
Refractive Index	D 542	1.586	
Mechanical[b]			
Tensile Stress at Yield	D 638	9,400 lb/in²	65 MPa
Tensile Stress at Break	D 638	10,200 lb/in²	70 MPa
Tensile Elongation at Yield	D 638	6%	
Tensile Elongation at Break	D 638	115%	
Tensile Modulus (1 mm/min)	D 638	350,000 lb/in²	2.4 GPa
Flexural Stress at 5% Strain	D 790	12,500 lb/in²	86 MPa
Flexural Modulus	D 790	340,000 lb/in²	2.4 GPa
Compressive Stress at Yield	D 695	11,000 lb/in²	76 MPa
Impact Strength, Notched Izod:	D 256		
73°F (23°C)			
0.125-in (3.2-mm) Thickness		17 ft·lb/in	908 J/m
Tensile Impact Strength, "S" Specimen:	D 1822		
0.125-in (3.2-mm) Thickness		275 ft·lb/in²	575 kJ/m²
Rockwell Hardness:	D 785		
M Scale		75	
R Scale		120	
Thermal			
Deflection Temperature, Unannealed:	D 648		
0.250-in (6.4-mm) Thickness			
264-psi (1.82-MPa) Load		268°F	131°C
66-psi (0.46-MPa) Load		280°F	138°C
Coefficient of Linear Thermal Expansion	D 696	3.34 E-05 in/in/°F	6.0 E-05 mm/mm/°C
Thermal Conductivity	C 177	1.39 Btu·in/(h·ft²·°F)	0.20 W/(m·K)
Specific Heat	D 2766	0.28 Btu/(lb·°F)	1,172 J/(kg·K)
Relative Temperature Index:	(UL746B)		
0.059-in (1.5-mm) Thickness			
Electrical		125°C	
Mechanical with Impact		115°C	
Mechanical without Impact		125°C	
Vicat Softening Temperature, 50N; 50K/h	D 1525	291°F	144°C
Flammability**			
Oxygen Index	D 2863	28%	
UL94 Flame Class:	(UL94)		
1.5-mm (0.059-in) Thickness		V-2 Rating	
2.5-mm (0.098-in) Thickness		HB Rating	
6.0-mm (0.236-in) Thickness		HB Rating	
Electrical			
Volume Resistivity (Tinfoil Electrodes)	D 257	1.0 E+16 ohm·cm	
Surface Resistivity	D 257	1.0 E+16 ohm	
Dielectric Strength (Short Time Under Oil at 1-mm [0.04-in] and 73°F [23°C])	D 149	810 V/mil	32 kV/mm
Dielectric Constant (Tinfoil Electrodes): 60 Hz	D 150	3.0	
1 MHz		2.9	
Dissipation Factor (Tinfoil Electrodes): 60 Hz	D 150	0.0009	
1 MHz		0.01	
Arc Resistance: Stainless Steel Electrodes	D 495	11 s	
Tungsten Electrodes		120 s	

General Characteristics of Polycarbonate

Hydrolytic Stability. Parts molded from polycarbonate absorb only 0.15 to 0.19% water at room temperature and 50% relative humidity. Dimensional stability and mechanical properties remain virtually unaffected. Even with immersion in water, dimensional changes measure only about 0.5%. Although frequent, intermittent contact with hot water does not harm polycarbonate, continuous exposure to humidity or water at high temperatures (>140°F/60°C) is not recommended due to hydrolytic degradation, which reduces impact strength and tensile properties.

Gas Permeability. Steam permeability, measured on 100-µm thick film, is 15 $g/m^2 \cdot 24$ h (0.97 $g/100\ in^2 \cdot 24$ h). Significant permeability also exists for other gases, such as hydrogen, carbon dioxide, sulfur dioxide, helium, ethylene oxide, and oxygen.

Chemical Resistance. Polycarbonate is resistant to mineral acids (even in high concentrations), a large number of organic acids, many oxidizing and reducing agents, neutral and acidic saline solutions, some greases and oils, saturated aliphatic and cycloaliphatic hydrocarbons, and most alcohols. It is important to note that polycarbonate is degraded by alkaline solutions, ammonia gas and its solutions, and amines. Polycarbonate dissolves in a number of organic solvents, such as halogenated hydrocarbons and some aromatic hydrocarbons. Other organic compounds cause polycarbonate to swell or stress-crack, e.g., acetone and methyl ethyl ketone. Since chemical resistance to various media is dependent on variables, such as concentration, time, temperature, part design, and residual stresses, the above information should serve only as a guideline. It is imperative that production parts be evaluated under actual application conditions prior to commercial use.

Regulatory Compliance Information

Some of the end uses of the products described in this bulletin must comply with applicable regulations, such as FDA, NSF, USDA, and CPSC. If you have any questions on the regulatory status of these products, contact your Bayer MaterialScience representative or Bayer's Regulatory Affairs Manager in Pittsburgh, Pa.

Health and Safety Information

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the Makrolon resins described in this bulletin. Before working with these products, you must read and become familiar with the available information on their hazards, proper use, and handling. This cannot be overemphasized. Information is available in several forms, e.g., material safety data sheets and product labels. Consult your Bayer MaterialScience representative or contact Bayer's Product Safety and Regulatory Affairs Department in Pittsburgh, Pa.

Note: The information contained in this bulletin is current as of June 2002. Please contact Bayer MaterialScience to determine whether this publication has been revised.

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