NOTICE TO USERS

This Material Safety Data Sheet (MSDS) contains information necessary for the health and safety training and personal protection of the users of Makrolon polycarbonate resin. This publication must be read by plant safety personnel and explained to those workers who directly handle any Makrolon polycarbonate resin.

This booklet generally applies to all grades of Makrolon polycarbonate resin although physical property data for different product grades and colors may vary. It is important that the package labels, process brochures and product information bulletins for the particular Makrolon polycarbonate resin product being handled and processed be consulted. For assistance in the handling and processing of Makrolon polycarbonate resin, contact Mobay's Plastics and Rubber Division technical personnel.

The information in this document relates only to Makrolon polycarbonate resin. It is not intended to address the suitability of Makrolon polycarbonate resin for any specific end-use applications nor any precautions associated with use of finished products.

USER RESPONSIBILITY

Makrolon polycarbonate resins are not hazardous when handled and used properly. However, it is impossible to predict all situations and conditions which may exist in the workplaces where Makrolon polycarbonate resin is processed and used. Therefore, it is the user's responsibility to provide a safe workplace as well as to examine all stages of operations where precautions (in addition to those outlined in this publication) are required.

THE PROCESSING OF MAKROLON POLYCARBONATE RESIN SHOULD BE CARRIED OUT UNDER THE SUPERVISION OF QUALIFIED PERSONS.

TABLE OF CONTENTS

MANUFACTURER IDENTIFICATION

Mobay Corporation
Plastics and Rubber Division
Mobay Road
Pittsburgh, PA 15205-9741

EMERGENCY TELEPHONE NUMBERS

Transportation Emergency Telephone Numbers

CHEMTREC: 800-424-9300
District of Columbia: 202-483-7616

Non-Transportation Emergency Telephone Number

412-923-1800

PRODUCT IDENTIFICATION

The family of Makrolon polycarbonate resins includes both Bisphenol A (BPA) polycarbonate homopolymer and specialty copolymers based on BPA and other co-monomers. The copolymers may be manufactured as speciality resin grades or as components in polymer blends. Depending on which grade is selected, the resin may be either solid pellet or granular powder in form.

Base Resin (Homopolymer)

Chemical Family	Polycarbonate
Chemical Names	Bisphenol A Polycarbonate Poly (Bisphenol A Carbonate)
Chemical Composition	Carbon / Hydrogen / Oxygen
Molecular Weight	M_w 20,000 to 40,000 M_n 8,000 to 15,000

Chemical Name (as product of constituent monomers)*:

Carbonic acid, polymer with 4,4'-(1-methylethylidene) bis [phenol]
Empirical formula: $(CH_2O_3 \cdot C_{15}H_{16}O_2)_X$; CAS No.: 26087-45-0

Carbonic dichloride, polymer with 4,4'-(1-methylethylidene) bis [phenol]
Empirical formula: $(C_{15}H_{16}O_2 \cdot CCl_2O)_X$; CAS No.: 25971-63-5

Specialty Resins (Copolymers)

Common Name: Bisphenol A / Tetrabromobisphenol A Copolycarbonate

Chemical Name (as product of constituent monomers)*:

Carbonic dichloride, polymer with 4,4' - (1-methylethylidene) bis (2,6-dibromophenol) and 4,4'-(1-methylethylidene) bis [phenol]

Empirical formula: $(CCl_2O \cdot C_{15}H_{12}Br_4O_2)_X$; CAS No.: 32844-27-2

As listed in the EPA TSCA Inventory of Chemical Substances

Additives
Additives are incorporated to accentuate the physical and chemical properties of the base resin. These additives include, among other specific components, the following generic classes of compounds. Most commercial and developmental (designated Makrolon polycarbonate Resin DP1-XXXX) products contain one or more types of additives.

TYPE OF ADDITIVE	FUNCTION	GENERIC IDENTITY	TYPICAL LEVELS	MAKROLON RESIN DESIGNATION
Thermal Stabilizers	Inhibit thermal decomposition and discoloration	Organic phosphites Organic phosphonites Alkyl epoxides	Less than 0.10%	All products
Ultraviolet Light Stabilizers	Extend outdoor weathering life	Substituted benzotriazoles and benzophenones	Less than 0.6%	All grade numbers ending in 3 or 7.
Impact Modifiers	Extend impact strength	Elastomers Polyethylene	Less than 8%	All four-digit grade numbers beginning with 7.
Reinforcing Agents	Provide rigidity and stability	Glass fibers	5 - 30%	All four-digit grade numbers beginning with 8 or 9. All three-digit grade numbers beginning with SF.
Flame Retardants	Improve ignition resistance	Polytetraflouro-ethylene, Organic salts, Inorganic salts	Less than 1%	All four-digit grade numbers beginning with 6 or 9 All SF grades.
Mold Release Agents	Enhance processing	Aliphatic esters Polyalkyl esters	Less than 0.7%	All four-digit grade numbers ending with 5, 7, or 58 and Rx-2548
Blowing Agents	Foam molding	Tetrazoles Hydrazocarboxylates	5 - 15%	All SFC grades.
Colorants	Impart color	Dyes and Pigments (See Colorants below)	Less than 0.01% Trans-parents. Less than 3% Opaques	All four-digit color numbers and SM Series following the grade number.

Makrolon 6280, E-316, 1143 and HMS series polycarbonate products utilize specialty resins, BPA/+TBBPA copolymers and polyfunctional cresols, to impart flame retardance and melt stability.

Colorants
Commercially available dyes and pigments based on titanium dioxide, carbon black, phthalocyanines, cadmium (insoluble sulfide and sulfoselenides), lead salts, chromium (III), silica (powder) and other organic and inorganic compounds are used to formulate Makrolon polycarbonate resins. In the resin form (pellets or granular powder), these colorants and/or additives are encapsulated in the polymer resin matrix. Because they are encapsulated or bound in the resin matrix, they are not expected to create any unusual hazards when handled and processed according to good manufacturing and industrial hygiene practices and the guidelines provided in this publication (see Human Health Data and Regulatory and Industry Standards sections).

PHYSICAL PROPERTIES*

- Appearance and Odor: Makrolon polycarbonate resin is an amorphous solid supplied in the form of cylindrical pellets, averaging 2.5 mm in diameter and 3.2 mm in length or in a granular powder form for selected resin grades. It has very little or no odor.

• Specific Gravity:	1.1 - 1.4
• Bulk Density (Unreinforced):	
Pellets	38 - 42 lb/in³
• Resin Solubility:	
Water (H_2O)	Insoluble
Methylene Chloride ($MeCl_2$)	Approx. 20% by wt.
Tetrahydrofuran (THF)	Approx. 15% by wt.
• Ignition Temperature (ASTM D 1929-Setchkin Method):	
Flash Ignition	840°F (449°C)
Self Ignition	1070°F (632°C)
• Thermal Decomposition (Thermal Gravimetric Analysis in Air):	
Initial (Onset)	788°F (420°C)
50% wt. Loss	896°F (480°C)
• Temperature (Other):	
Glass Transition, Tg (amorphous)	284-302°F (140-150°C)
Vicat Softening, ASTM D 1525	306-315°F (152-157°C)
Injection Molding, Typical Range	550-650°F (288-343°C)
• Color Availability:	
Natural	Transparent, translucent and opaque depending on grade
Clear Tints	In various grades
Saturated Colors	Transparent to opaque
• Odor:	
Processing	Mild and not offensive to most individuals
• Other:	
Vapor Pressure	Not applicable
Vapor Density	
Boiling Point	
Evaporation Rate	

Values shown are representative for general-purpose grades based on material tested. Data can vary among samples. They are approximate and thus should not be interpreted as manufacturing specifications.

REGULATORY AND INDUSTRY STANDARDS

Toxic Substances Control Act (TSCA)
Commercial coded (J-coded) and Developmental (JA/JB-coded) Makrolon polycarbonate resin and all other chemical substances incorporated into the resin (additives, fillers, colorants, and other polymeric substances) are included in the TSCA INVENTORY OF CHEMICAL SUBSTANCES compiled by the U.S. Environmental Protection Agency.

Non-commercial (non-coded) Makrolon polycarbonate resin and other chemical substances incorporated into the resin (additives, fillers, colorants, and other polymeric substances) may not be included in the TSCA inventory and may be subject to TSCA section 5 (h)(3) limitations for research and development use only.

Occupational Safety and Health Act — Hazard Communication Standard (OSHA-HCS)
Makrolon polycarbonate resin has been reviewed against the criteria of the OSHA-Hazard Communication Standard 29 CFR 1910.1200. The products in their commercial form are not hazardous under the criteria of the federal OSHA-HCS. However, thermal processing and decomposition fumes from the products may be hazardous (see Human Health Data section).

All ingredients, colorants and additives used in the preparation of Makrolon polycarbonate resins have been reviewed against the NTP, IARC and OSHA lists for carcinogens. With the exception of certain cadmium compounds, none of the ingredients, colorants or additives are contained on these lists. Some Makrolon polycarbonate resin grades contain cadmium in the form of insoluble sulfides and sulfoselenides which are chemically stable pigments. Cadmium and certain cadmium compounds have been listed as suspected carcinogens on the NTP list and IARC Group 2B list. In those Makrolon polycarbonate resins which are formulated with cadmium based pigments, the cadmium compounds are encapsulated in the polymer resin matrix. Since they are confined to the matrix, no exposures are anticipated when handled and processed according to good manufacturing and industrial hygiene practices and the guidelines provided in this MSDS.

Exposure Limits
Makrolon polycarbonate resin pellets, granular powder or dust are not included in the OSHA Permissible Exposure Limit (PEL) or ACGIH Threshold Limit Value (TLV) tables. However, both OSHA and ACGIH have established exposure limits for Inert or Nuisance Dusts and Fibrous Glass Dusts as follows.

OSHA PEL:	15 mg/m³ total dust
	5 mg/m³ respirable dust
ACGIH TLV (1987 - 88):	10 mg/m³ total dust
Glass-Fiber-Reinforced Grades	10 mg/m³ fibrous glass dust

Food and Drug Administration (FDA)
Specific grades of Makrolon polycarbonate resin comply with FDA regulation 21 CFR 177.1580 (Polycarbonate resins).

National Sanitation Foundation (NSF)
Several Makrolon polycarbonate resins are listed by NSF for Standard 51 "Plastic Materials and Components Used in Food Equipment".

United States Pharmacopeia (USP)
Numerous Makrolon polycarbonate resins have passed USP XXI Class VI testing and several non-USP tests.

Underwriters Laboratories Inc. (UL)
Various Makrolon polycarbonate resins have been tested and classified by UL for their flammability and other characteristics. Specific details on these UL classifications can be found on UL "yellow cards".

Additional Information
Your Mobay representative can provide additional information on the above as well as other regulatory and industry standards relating to your particular needs.

REACTIVITY, FIRE AND EXPLOSION DATA

Reactivity
Makrolon polycarbonate resin is a stable organic thermoplastic solid resin. Hazardous polymerization will not occur.

Flammability
Makrolon polycarbonate resin can burn if a large amount of energy sufficient to break the polymer into segments is present. Ordinarily, a constant outside flame source is needed to begin and continue combustion. Fire prevention methods similar to those employed with wood and other combustibles are recommended. National Fire Protection Association (NFPA) ratings are: Health-0, Flammability-1, Reactivity-0.

Extinguishing Media
Water, Water Fog, Dry Chemical, Foam, Carbon Dioxide (CO_2). Water is the best extinguishing medium. CO_2 is not generally recommended because its lack of cooling capacity may permit re-ignition.

Firefighting
Full emergency equipment with self-contained breathing apparatus should be worn by firefighters. During a fire, irritating and toxic gases and aerosols may be generated by thermal decomposition and combustion (see Decomposition Products section).

Decomposition Products
The products of combustion are carbon monoxide (CO), carbon dioxide (CO_2), bisphenol A, methane, diphenyl carbonate and phenol derivatives. Some flame-retardant grades will also evolve trace quantities of bromine compounds during combustion.

Explosion
Because of their size, Makrolon polycarbonate resin pellets are not explosion hazards. However, dust control devices must be used in regrinding, sawing and other "post"molding operations and should be periodically checked for proper maintenance. Sources of static build-up and all other ignition sources should be removed. Regular cleaning practices and good ventilation can prevent build-up of potentially explosive concentrations of dust. For additional guidelines, see NFPA 654 "Standard for the Prevention of Dust Explosions in the Plastics Industry".

Makrolon polycarbonate resin in granular-powder form failed to explode in the following laboratory explosivity screening tests:

1) Electric Spark Ignition: flame extended less than 2 inches.
2) Oven Ignition: no evidence of flame.

Nevertheless, since dry organic powder may form explosive mixtures with air given the right conditions, it is considered prudent to do the following:

1) Vent storage bins, conveyors, and dust collectors, etc.,
2) Ground handling equipment, and
3) Keep flame, sparks, and heat away from dusty areas.

ANIMAL TOXICITY

Oral
Polycarbonate resin has a very low oral toxicity. It has been administered orally in a single dose of 6 g/kg to rats with no mortalities.

Skin Irritation
When polycarbonate resin (powder) was placed on the skin (intact and abraded) of a rabbit (24 hr. exposure), only slight (minimal) irritation resulted.

Eye Irritation
When polycarbonate resin (powder) was placed in the eye of a rabbit, mild irritation occurred which was consistent with abrasive action of the powder.

Fume Inhalation

A "Toxic Evaluation of Thermoplastics Resins At and Above Processing Temperatures" was performed and published.* The study was designed to evaluate the sensory irritating potency of the fumes generated by a variety of thermoplastic resins, polycarbonate resin being one, at a temperature range of melt processing (injection molding, thermoforming, etc.) and at higher temperatures which may occur on occasion due to malfunction of the equipment. Also acute lethality associated with exposures to these fumes was evaluated.

The results of this study indicate that, depending on the nature of the polymers, the smoke emitted at various temperatures has a wide difference in their sensory irritation properties.

All polycarbonates (Makrolon resin series) under normal processing temperatures (280-340°C) released very little smoke. This smoke had low irritation properties. Even at temperatures above normal operations (400°C) the RD_{50}** values indicated that the fumes released were of low irritation potency. However, above this temperature, decomposition occurred rapidly and release of carbon monoxide (CO) occurred resulting in acute lethality.

*Toxicity evaluation of thermoplastic resins at and above processing temperature, G.K. Sangha, M. Matlikk and Y. Alarie, Department of Industrial Environmental Health Sciences, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, Pennsylvania, 15213, AIHA Journal (42), July 1981.

**RD_{50} reflects the sample weight of material that caused a 50% decrease respiratory rate.

HUMAN HEALTH DATA

Primary Route(s) of Exposure

Eye contact with fines or processing fumes, skin contact with processing fumes, inhalation of processing fumes.

Effects and Symptoms of Overexposure

Makrolon polycarbonate resin is a non-reactive solid polymer in pellet or granular powder form and is not considered a hazardous material during normal storage, processing or use.

Exposure to Makrolon polycarbonate resin primarily comes by contact with the pellet or granular material to the skin and/or eyes or by inhalation of the gases and fumes evolved during the thermal processing of this material. Certain individuals may experience irritation of the eyes with symptoms of swelling, tearing, and itching; irritation of the skin with symptoms of reddening, swelling and a rash; and/or irritation of the respiratory tract with symptoms of coughing and a choking sensation (see Animal Toxicity — Fume Inhalation and Medical Conditions Aggravated by Exposure sections).

Note: At recommended processing conditions, water, carbon dioxide (CO_2), diphenylcarbonate, monochlorobenzene and phenol are the primary fume constituents evolved. These constituents are not expected to be present at concentrations which would present an adverse health effect. However, at temperatures above normal processing temperatures, carbon monoxide (CO) and other decomposition products are released (see Reactivity, Fire and Explosion Data — Decomposition Products and Animal Toxicity — Fume Inhalation sections).

Mechanical irritation (i.e., scratches/abrasion) to the eyes or skin may occur due to exposure to fines or processing fumes. The eyes may become red, feel scratchy and may tear. If it is a glass-fiber-reinforced grade of resin, the skin may feel itchy.

No chronic effects are known as a result of exposure to Makrolon resin.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Certain sensitive individuals and individuals with respiratory impairments may be affected by exposure to specific components in the processing fumes. Such potential effects would primarily be related to the principal exposure routes and result in irritation of eyes, nose, throat or skin (see Emergency and First Aid Procedures section).

EMERGENCY AND FIRST AID PROCEDURES

Individuals with specific sensitivities may exhibit eye, nose, throat or dermal irritation upon overexposure to processing fumes.

Eye Irritation
Flush eyes with plenty of lukewarm water. See a physician if irritation persists.

Skin Irritation
Wash affected areas with soap and water. See a physician if irritation persists.

Respiratory Irritation
Remove to fresh air. See a physician if any breathing difficulty persists.

Note: Severe thermal burns can result from contact with molten resin. Emergency medical attention should be obtained immediately.

EMPLOYEE PROTECTION RECOMMENDATIONS

Eye Protection
Safety glasses with side shields.

Skin Protection
None required in normal handling of the pellets or granular powder. When handling the hot resin (extrudate, air shots or parts) substantial well-insulated gloves are to be worn to prevent thermal burns.

Respiratory Protection
None required in normal handling of pellets. In handling of a resin powder or a resin that may be reinforced with fiber glass, it may be necessary to wear a NIOSH/MSHA-approved dust respirator if the airborne dust concentration is near or exceeds the nuisance dust exposure limits (see Regulatory and Industry Standards — Exposure Limits section).

Ventilation
Thermal processing equipment should be ventilated to control gases and fumes given off when the resin is heated to extrusion or injection molding temperatures.

For most operations, a continuous supply of fresh air to the general workplace area along with the continuous removal of processing fume contaminated air through a local exhaust ventilation system will be adequate. However, the ventilation requirements must be determined on an individual basis for each workplace.

Note: Removal of the flammable processing fume deposits from exhaust hoods, ductwork and other surfaces should be done periodically. Protective clothing to be worn during the cleaning operations should include at a minimum, a face shield, safety glasses and rubber gloves.

Other: Safety showers and eye wash stations should be located so they are easily accessible when needed. Education and training in the safe use, handling and processing of the resin is important.

Each workplace needs to be evaluated individually. Its specific conditions and hazards may require precautions beyond good industrial hygiene practices and those specified in this material safety data sheet.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Remove mechanically by sweeping, shoveling or vacuuming the resin and place into container for reuse or disposal. Do not reuse if contaminated. Use caution when walking in areas where Makrolon polycarbonate resin (pellets or powder/granules) has been spilled due to slipping hazard.

CERCLA (SUPERFUND) REPORTABLE QUANTITY: Not applicable

WASTE DISPOSAL METHOD: Material may be incinerated or landfilled in compliance with federal, state and local environmental control regulations.

RCRA STATUS: Makrolon polycarbonate resin, pellets, powder granules, regrind, molded parts, extrusion purge (goobers), etc., do not meet the RCRA criteria for a hazardous waste.

SPECIAL PRECAUTIONS AND STORAGE DATA

Packaging
Makrolon polycarbonate resin is packaged in standard unit weights.

Packaging Material	Unit Weight	Configuration
Multi-wall Bag	50 lb.	40 bags/pallet
Plastic Bag	60 lb.	40 bags/pallet
Corrugated Cardboard	1,000 lb.	1 gaylord/pallet

Bulk shipments are available in truck load and railcar quantities. The bulk density range of Makrolon polycarbonate resin is 38-42 lbs/ft^3.

Storage
Makrolon polycarbonate resin will not degrade during storage. While heating and/or cooling is not required, the resin should be stored indoors to protect it from rain or excessive moisture. At extended temperatures above 200°F, the pellets can become softened and may stick in clumps upon cooling. Pallets should not be stacked more than three (3) high. Periodically check storage for vertical stability and/or container damage or fatigue.

Store resin in clean, dry environment in sealed containers. Avoid storing flammable materials in the resin storage area. If the resin is a food-grade resin, it should not be stored with or near any toxic liquid or solid that may adulterate the resin. Makrolon polycarbonate resin must be dried before processing. Drying instructions for desiccant dryers are contained on the labels.

SHIPPING DATA

The shipping data for Makrolon polycarbonate resin is listed below. As indicated in this information, these products are not classified as hazardous materials.

D.O.T. SHIPPING NAME	None
TECHNICAL SHIPPING NAME	Bisphenol A Polycarbonate
D.O.T. HAZARD CLASS	Non-Regulated
UN/NA NO	None
PRODUCT RQ	None
D.O.T. LABELS	None
D.O.T. PLACARDS	None
FRT. CLASS BULK	Plastic Materials, Pellets
FRT. CLASS PKG	Plastic Materials, O/T Exp., Pellets
PRODUCT LABEL	*

*The labels for the containers used in the packaging of Makrolon polycarbonate resins contain the product name, product code, color number for the resin, lot number, name and address of manufacturer and the Chemtrec emergency phone number.

APPROVALS

This Material Safety Data Sheet (MSDS) has been approved by the Product Safety Manager responsible for the Plastics and Rubber Division. If there are any questions pertaining to the information contained in this document or the need for additional information that may not be contained here, please contact your Mobay representative.

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A Bayer USA INC. COMPANY

Bayer MOBAY

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