Polypropylene Chemical Resistance

Polypropylene, like most of the polyolefins, is highly resistant to solvents and chemicals.

The results of extensive laboratory and actual field installation tests of polypropylene's chemical resistance are reported in this data sheet.

The corrosion resistance data presented here are based on unstressed specimens of polypropylene, 3 in. long by 0.025 in. thick, in the shape of dumbbells. Results are reported after l-month immersion. As it is difficult to create actual service conditions in the laboratory, the results of many of the environments should be taken only as an indication of behavior in service.

Polypropylene has outstanding resistance to water and other inorganic environments. In most aqueous environments, its weight increase is less than 0.2% when it has been stored for 6 months at ambient temperatures. When the temperature is increased to 60°C (140° F), the weight increase is less than 0.5% for a similar period. According to ASTM D 570-63T, its 24-hr water absorption rate is 0.03%. It resists most strong mineral acids and bases, but, like the other polyolefins, it is subject to attack by oxidizing agents.

Polypropylene is appreciably affected by chiorosulfonic acid and oleum at room temperature, 98% sulfuric acid, 30% hydrochloric acid, and 30% hydrogen peroxide at 100°C (212°F). It is also affected by
98% sulfuric acid at 60°C (140°F) and fuming nitric-acid and liquid bromine at room temperatures. Under strain, failure could occur with strong oxidizing acids at temperatures lower than those mentioned. With few exceptions, however, inorganic chemicals produce little or no effect on polypropylene over a period of 6 months at temperatures up to 120°C (248°F).

The permeation resistance of polypropylene to organic chemicals depends on the rate and extent to which absorption occurs. This, in turn, will govern the suitability of the resin to serve in a particular environment. When the plastic is removed from the environment, evaporation will take place and cause it to return almost to its original dimensions. Property changes resulting from the absorption will be reversed if evaporation is complete.

Temperature and polarity of the organic medium are the foremost factors determining the extent of absorption by polypropylene. Absorption becomes greater as temperatures are increased and polarity of the medium is decreased. Copolymers swell more than homopolymers, indicating greater absorption. Such nonpolar liquids as benzene, carbon tetrachloride, and petroleum ether have a higher absorption rate by polypropylene than polar media such as ethanol and acetone. Some reduction in tensile strength and an increase in flexibility and elongation to break in tension can be expected, depending on the nature and amount of the organic medium absorbed.

Polypropylene has excellent resistance to environmental stress-cracking. When it is tested according to ASTM D I693-60T, the brittle fractures that occur with certain polyethylenes in contact with polar organic liquids, detergents, and silicone fluids are not observed. Failure of this type with polypropylene is rare. Those environments known to cause such cracking to polypropylene are 98% sulfuric acid, concentrated chromic/sulfuric acid mixtures, and concentrated hydrochloric acid/chlorine mixtures.

The useful life of polypropylene at elevated temperatures is limited by oxidative degradation. The expected life of polypropylene at any given temperature is also determined by the nature of the environment, and by the extraction of some of the antioxidant system. Any environment that tends to extract the antioxidants may lead to more rapid breakdown of the polypropylene, especially at elevated temperatures.

RATING SYSTEM

This chart rates the chemical resistance polypropylene according to the following code:

A = NEGLIGIBLE EFFECT — Should be suitable for all applications where these environmental conditions exist.

B = LIMITED ABSORPTION OR ATTACK — Should be suitable for most applications, but the user is advised to make his own tests to determine the suitability of polypropylene in the particular environment.

C = EXTENSIVE ABSORPTION AND/OR RAPID PERMEATION — Should be suitable for applications where only intermittent service is involved, or where the swelling produced has no detrimental effect on the part. The user should make his own tests to determine the suitability of polypropylene in the particular environment.

D = EXTENSIVE ATTACK — The specimen dissolves or disintegrates. Polypropylene is not recommended.

Environment	Conc., %	Temperature, °C 20	60	100
Acetic acid (glacial)	97	A	B (80°C)	—
Acetic acid	50	A	A (80°C)	—
Acetic acid	40	A	—	—
Acetic acid	10	A	A	—
Acetone	100	A	A	—
Acetophenone	100	B	B	—
Acriflavine (2% solution in H_2O)	2	A	A (80°C)	—
Acrylic emulsions		A	A	—
Aluminum chloride		A	A	—
Aluminum fluoride		A	A	—
Aluminum sulfate		A	A	—
Alums (all types)		A	A	—
Ammonia (aqueous)	30	A	—	—
Ammonia gas (dry)		A	A	—
Ammonium carbonate	Satd.	A	A	—
Ammonium chloride	Satd.	A	A	—
Ammonium fluoride	20	A	A	—
Ammonium hydroxide	10	A	A	—
Ammonium metaphosphate	Satd.	A	A	—
Ammonium nitrate	Satd.	A	A	—
Ammonium persulfate	Satd.	A	A	—
Ammonium sulfate	Satd.	A	A	—
Ammonium sulfide	Satd.	A	A	—
Ammonium thiocyanate	Satd.	A	A	—
Amyl acetate	100	B	C	—
Amyl alcohol	100	A	B	—
Amyl chloride	100	C	C	—
Aniline	100	A	A	—
Anisole	100	B	B	—
Antimony chloride		A	A	—
Aqua regia	*	B	B	—
Aviation fuel (115/145 octane)	100	B	C	—
Aviation turbine fuel	100	B	C	—
Barium carbonate	Satd.	A	A	—
Barium chloride	Satd.	A	A	—
Barium hydroxide		A	A	—
Barium sulfate	Satd.	A	A	—
Barium sulfide	Satd.	A	A	—
Beer		A	A	—
Benzene	100	B	C	C
Benzoic acid		A	A	—
Benzyl alcohol		A	A (80°C)	—
Bismuth carbonate	Satd.	A	A	—
Borax		A	A	—
Boric acid		A	A	—
Brine	Satd.	A	A	—
Bromine liquid	100	D	—	—
Bromine water	*	C	—	—
Butyl acetate	100	—	C	C
Butyl alcohol	100	A	B	—

Environment	Conc., %	Temperature, °C 20	60	100
Calcium carbonate	Satd.	A	A	—
Calcium chlorate	Satd.	A	A	—
Calcium chloride	50	A	A	—
Calcium hydroxide		A	A	—
Calcium hypochlorite bleach	20	A	B	—
Calcium nitrate		A	A	—
Calcium phosphate	50	A	—	—
Calcium sulfate		A	A	—
Calcium sulfite		A	A	—
Carbon dioxide (dry)		A	A	—
Carbon dioxide (wet)		A	A	—
Carbon disulfide	100	B	C	—
Carbon monoxide		A	A	—
Carbon tetrachloride	100	C	C	C
Carbonic acid		A	A	—
Castor oil		A	—	—
Cetyl alcohol	100	A	—	—
Chlorine (gas)	100	D	D	—
Chlorobenzene	100	C	C	—
Chloroform	100	C	D	D
Chlorosulfonic acid	100	D	D	D
Chrome alum		A	A	—
Chromic acid	80*	A	—	—
Chromic acid	50*	A	A	—
Chromic acid	10*	A	A	—
Chromic/sulfuric acid		D	D	—
Cider		A	A	—
Citric acid	10	A	A	—
Copper chloride	Satd.	A	A	—
Copper cyanide	Satd.	A	A	—
Copper fluoride	Satd.	A	A	—
Copper nitrate	Satd.	A	A	—
Copper sulfate	Satd.	A	A	—
Cottonseed oil		A	A	—
Cuprous chloride	Satd.	A	A	—
Cyclohexanol	100	A	B	—
Cyclohexanone	100	B	C	—
Decalin	100	C	C	C
Detergents	2	A	A	A
Developers (photographic)		A	A	—
Dibutyl phthalate	100	A	B	D
Dichloroethylene	100	A	—	—
Diethanolamine	100	A	A	—
Diisooctyl phthalate	100	A	A	—
Emulsifiers		A	A	—
Ethanolamine	100	A	A	—
Ethyl acetate	100	B	B	—
Ethyl alcohol	96	A	A	A (80°C)
Ethyl chloride	100	C	C	—
Ethylene dichloride	100	B	—	—
Ethylene glycol		A	A	—
Ethylene oxide	100	B (10°C)	—	—
Ethyl ether	100	B	—	—

Environment	Conc., %	Temperature, °C 20	60	100
Fatty acids (C_6)	100	A	A	—
Ferric chloride	Satd.	A	A	—
Ferric nitrate	Satd.	A	A	—
Ferric sulfate	Satd.	A	A	—
Ferrous chloride	Satd.	A	A	—
Ferrous sulfate	Satd.	A	A	—
Fluosilicic acid		A	A	—
Formaldehyde	40	A	A	—
Formic acid	100	A	—	—
Formic acid	10	A	A	—
Fructose		A	A	—
Fruit juices		A	A	—
Furfural	100	C	C	—
Gas liquor		C	—	—
Gasoline	100	B	C	C
Gearbox oil	100	A	B	—
Gelatin		A	A	—
Glucose	20	A	A	—
Glycerin	100	A	A	A
Glycol		A	A	—
Hexane	100	A	B	—
Hydrobromic acid	50*	A	A	—
Hydrochloric acid	30*	A	B	D
Hydrochloric acid	20	A	A (80°C)	—
Hydrochloric acid	10	A	A (80°C)	B
Hydrochloric acid	2	A	A	A
50-50 HCl-HNO_3	*	B	D (80°C)	—
Hydrofluoric acid	40	A	—	—
Hydrofluoric acid	60*	A	A (40°C)	—
Hydrogen chloride gas (dry)	100	A	A	—
Hydrogen peroxide	30	A	—	D
Hydrogen peroxide	10	A	B	—
Hydrogen peroxide	3	A	—	—
Hydrogen sulfide		A	A	—
Hydroquinone		A	A	—
Inks		A	A	—
Iodine tincture		A	—	—
Isooctane	100	C	C	—
Isopropyl alcohol	100	A	A	—
Ketones		A	—	—
Lactic acid	20	A	A	—
Lanolin	100	A	A	—
Lead acetate	Satd.	A	A	—
Linseed oil	100	A	A	—
Lubricating oil	100	A	B	—
Magenta dye (aqueous solution)	2	A	A Some staining	—
Magnesium carbonate	Satd.	A	A	—
Magnesium chloride	Satd.	A	A	—
Magnesium hydroxide	Satd.	A	A	—
Magnesium nitrate	Satd.	A	A	—
Magnesium sulfate	Satd.	A	A	—
Magnesium sulfite	Satd.	A	A	—
Meat juices		A	A	—
Mercuric chloride	40	A	A	—
Mercuric cyanide	Satd.	A	A	—
Mercurous nitrate	Satd.	A	A	—
Mercury	100	A	A	—

Environment	Conc., %	Temperature, °C 20	60	100
Methyl alcohol	100	A	A	—
Methylene chloride	100	A	—	—
Methyl ethyl ketone	100	A	B	—
Milk and its products		A	A	A
Mineral oil	100	A	B	—
Molasses		A	A	—
Motor oil	100	A	B	—
Naphthalene	100	A	A	A
Nickel chloride	Satd.	A	A	—
Nickel nitrate	Satd.	A	A	—
Nickel sulfate	Satd.	A	A	—
Nitric acid	Fuming	D	D	D
Nitric acid	70*	C	D	—
Nitric acid	60	A	D (80°C)	—
Nitric acid	10	A	A	A
50-50 HNO_3-HCl	*	A	D (80°C)	—
50-50 HNO_3-H_2SO_4	*	C	D (80°C)	—
Nitrobenzene	100	A	A	—
Oleic acid		A	B	—
Oleum		—	—	D
Olive oil	100	A	A	—
Oxalic acid (aqueous)	50	A	B	—
Paraffin	100	A	B	—
Paraffin wax	100	A	A	—
Petrol	100	B	C	—
Petroleum ether (boiling point 100-140°C)	100	C	C	—
Phenol	100	A	A	—
Phosphoric acid	95	A	A	—
Plating solutions, brass		A	A	—
Plating solutions, cadmium		A	A	—
Plating solutions, chromium		A	A	—
Plating solutions, copper		A	A	—
Plating solutions, gold		A	A	—
Plating solutions, indium		A	A	—
Plating solutions, lead		A	A	—
Plating solutions, nickel		A	A	—
Plating solutions, rhodium		A	A	—
Plating solutions, silver		A	A	—
Plating solutions, tin		A	A	—
Plating solutions, zinc		A	A	—
Potassium bicarbonate	Satd.	A	A	—
Potassium borate	†	A	A	—
Potassium bromate	10	A	A	—
Potassium bromide	Satd.	A	A	—
Potassium carbonate	Satd.	A	A	—
Potassium chlorate	Satd.	A	A	—
Potassium chloride	Satd.	A	A	—
Potassium chromate	40	A	A	—
Potassium cyanide	Satd.	A	A	—
Potassium dichromate	40	A	A	—
Potassium ferri-/ferrocyanide		A	A	—
Potassium fluoride		A	A	—
Potassium hydroxide	50	A	A	—
Potassium hydroxide	10	A	A	A
Potassium nitrate	Satd.	A	A	—
Potassium perborate	Satd.	A	A	—
Potassium perchlorate	10	A	A	—
Potassium permanganate	20	A	A	—
Potassium sulfate		A	A	—
Potassium sulfide		A	A	—
Potassium sulfite		A	A	—
Propyl alcohol	100	A	A	—
Pyridine	100	A	—	—
Silicone oil	100	A	A	—
Soap solution (concentrated)		A	A	—

*May produce cracking in material under stress.

Environment	Conc., %	Temperature, °C 20	60	100
Sodium acetate		A	A	—
Sodium bicarbonate	Satd.	A	A	—
Sodium bisulfate	Satd.	A	A	—
Sodium bisulfite	Satd.	A	A	—
Sodium borate		A	A	—
Sodium bromide oil solution		A	A	—
Sodium carbonate	Satd.	A	A	—
Sodium chlorate	Satd.	A	A	—
Sodium chloride	Satd.	A	A	A
Sodium chlorite	2	A	A (80°C)	—
Sodium chlorite	5	A	A (80°C)	—
Sodium chlorite	10	A	A (80°C)	—
Sodium chlorite	20	A	A (80°C)	—
Sodium cyanide	Satd.	A	A	—
Sodium dichromate	Satd.	A	A	—
Sodium ferricyanide	Satd.	A	A	—
Sodium ferrocyanide	Satd.	A	A	—
Sodium fluoride	Satd.	A	A	—
Sodium hydroxide	50	A	A	—
Sodium hydroxide	10	A	A	A
Sodium hypochlorite	20	A	B	B
Sodium nitrate		A	A	—
Sodium nitrite		A	A	—
Sodium silicate		A	A	—
Sodium sulfate	Satd.	A	A	—
Sodium sulfide	25	A	A	—
Sodium sulfite	Satd.	A	A	—
Stannic chloride	Satd.	A	A	—
Stannous chloride	Satd.	A	A	—
Starch		A	A	—
Sugars and syrups		A	A	—
Sulfamic acid		A	A (80°C)	—
Sulfates of calcium and magnesium	Satd.	A	A	—
Sulfites of potassium and sodium	Satd.	A	A	—
Sulfur		A	A	—
Sulfuric acid	98*	C	—	D

Environment	Conc., %	Temperature, °C 20	60	100
Sulfuric acid	60	A	B (80°C)	—
Sulfuric acid	50	A	B	—
Sulfuric acid	10	A	A	A
50-50 H_2SO_4/HNO_3	*	C	D (80°C)	—
Tallow		A	A	—
Tannic acid	10	A	A	—
Tartaric acid		A	A	—
Tetrahydrofuran	100	C	C	C
Tetralin	100	C	C	C
Toluene	100	C	C	—
Transformer oil	100	A	C	—
Trichloroacetic acid	10	A	A	—
Trichloroethylene	100	C	C	C
Triethanolamine	100	A	A (80°C)	—
Turpentine	100	C	C	C
Urea		A	A	—
Urine		A	A	—
Vaseline†		A	A	—
Vinegar		A	A	—
Water (distilled, soft, hard, and vapor)		A	A	A
Wet chlorine gas		—	D (70°C)	—
Whisky		A	A	A
White paraffin	100	A	B (80°C)	—
White spirit	100	B	C	—
Wines		A	A	—
Xylene	100	C	C	C
Yeast		A	A	—
Zinc chloride	Satd.	A	A	—
Zinc oxide		A	A	—
Zinc sulfate	Satd.	A	A	—

*May produce cracking in material under stress.
†Registered trademark of Chesebrough-Ponds, Inc., U.S.A.