Polypropylene

# *Pro-fax* and *Moplen* Polypropylene Chemical Resistance

basell Polyolefins

**Contents**

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## About Basell

Basell develops, produces and markets polypropylene, polyethylene, advanced polyolefin materials and polyolefin catalysts and also develops and licenses polyolefin processes.

Formed in October 2000, Basell is owned equally by BASF and Shell. Basell and its joint ventures serve customers in more than 120 countries with materials produced in 18 countries. The company's network of joint ventures expand Basell's technology and market base and enable the company to follow key customers as they expand and globalize their operations.

With research and development centers in Europe, North America and the Asia-Pacific region, Basell is continuing and expanding a technological heritage that dates back to the start of the polyolefins industry. The company is committed to continuously extending the property profile of its polyolefins portfolio and to developing with its customers a shared agenda for bringing new products to market as quickly as possible.

Basell is committed to strong Health, Safety and Environmental (HSE) performance. The company's products are used in countless consumer and industrial goods from food and drink packaging to car components, and from household products to underground piping.

Basell's corporate centre is located in Hoofddorp, The Netherlands, near Amsterdam. The company has regional offices in Brussels, Belgium; Mainz, Germany; Wilmington, Delaware, USA; Sao Paulo, Brazil and Hong Kong, as well as sales offices in the major markets around the world.

## *Pro-fax* and *Moplen* chemical resistance

*Pro-fax* and *Moplen* polypropylene resins, like most polyolefins, are 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 publication, which is updated at intervals.

The chemical resistance data presented here is based on ASTM D543. Unstressed specimens of *Pro-fax* resin, 3 in. long by 0.025 in. (76.2 mm x 0.635 mm) thick, in the shape of dumbbells were used. Results are reported after 1-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.

*Pro-fax* and *Moplen* polypropylene resins have 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℃ (140℉), the weight increase is less than 0.5% for a similar period. According to ASTM D570, 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.

*Pro-fax* and *Moplen* polypropylene resins are appreciably affected by chlorosulfonic acid and oleum at room temperature, 98% sulfuric acid, 30% hydrochloric acid, and 30% hydrogen peroxide at 100℃ (212℉). They are also affected by 98% sulfuric acid at 60℃ (140℉) 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 *Pro-fax* and *Moplen* resins over a period of 6 months at temperatures up to 120℃ (248℉).

The permeation resistance of *Pro-fax* and *Moplen* polypropylene resins to organic chemicals depends on the rate and extent to which absorption occurs. This, in turn, affects the suitability of the resin to serve in a particular environment. When the resin 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 in determining the extent of absorption by polypropylene. Absorption becomes greater as temperatures are increased and polarity of the medium is decreased. Polypropylene copolymers swell more than homopolymers, indicating greater absorption. Such nonpolar liquids as benzene, carbon tetrachloride, and petroleum ether have a higher absorption rate with 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.

*Pro-fax* and *Moplen* polypropylene resins have excellent resistance to environmental stress-cracking. When they are tested according to ASTM D1693 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 *Pro-fax* and *Moplen* polypropylene resins 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 of *Pro-fax* polypropylene resin according to the following code:

Note: The user is advised to make his or her own tests to determine the suitability of polypropylene in the particular environment.

**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 or her 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 or her 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. % | Temp., °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_2$0) | 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 | – |

| Environment | Conc. % | Temp., °C 20 | 60 | 100 |
|---|---|---|---|---|
| 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 | (a) | C | – | – |
| Butyl acetate | 100 | C | C | – |
| Butyl alcohol | 100 | A | A | – |
| Calcium carbonate | Satd. | A | A | – |
| Calcium chlorate | Satd. | A | A | – |
| Calcium chloride | 50 | A | A | – |
| Calcium hydroxide | | A | A | – |
| Calcium hypochlorite bleach | 20[a] | 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 | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| 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)] | A | – | – |
| Chromic acid | 50[(a)] | A | A | – |
| Chromic acid | 10[(a)] | 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 (80℃) | – |
| Ethyl chloride | 100 | C | C | – |
| Ethylene dichloride | 100 | B | – | – |
| Ethylene glycol | | A | A | – |
| Ethylene oxide | 100 | B (10℃) | – | – |
| Ethyl ether | 100 | B | – | – |
| Fatty acids ($C_6$) | 100 | A | A | – |
| Ferric chloride | Satd. | A | A | – |
| Ferric nitrate | Satd. | A | A | – |
| Ferric sulfate | Satd. | A | A | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| Ferrous chloride | Satd. | A | A | – |
| Ferrous sulfate | Satd. | A | A | – |
| Fluorosilicic 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 | A | – |
| Hydrochloric acid | 30[(a)] | A | B | D |
| Hydrochloric acid | 20 | A | A (80℃) | – |
| Hydrochloric acid | 10 | A | A (80℃) | B |
| Hydrochloric acid | 2 | A | A | A |
| 50-50 $HCl-HNO_3$ | (a) | B | D (80℃) | – |
| Hydrofluoric acid | 40 | A | – | – |
| Hydrofluoric acid | 60[(a)] | A | A (40℃) | – |
| 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 | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| 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 | – |
| 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[a] | C | D | – |
| Nitric acid | 60 | A | D (80℃) | – |
| Nitric acid | 10 | A | A | A |
| 50-50 $HNO_3$-HCl | (a) | B | D (80℃) | – |
| 50-50 $HNO_3$-$H_2SO_4$ | (a) | C | D (80℃) | – |
| 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℃) | 100 | C | C | – |
| Phenol | 100 | A | A | – |
| Phosphoric acid | 95 | A | A | – |
| Plating solutions, brass | | A | A | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| 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 | 1 | 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 | – |
| 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℃) | – |
| Sodium chlorite | 5 | A (80℃) | A | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| Sodium chlorite | 10 | A (80℃) | A | – |
| Sodium chlorite | 20 | A (80℃) | A | – |
| Sodium cyanide | Satd. | A | A | – |
| Sodium dichromate | Satd. | A | A | – |
| Sodium ferricyanide | Satd. | A | A | – |
| Sodium ferrocyanicle | 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℃) | – |
| Sulfates of [ Calcium and magnesium | Satd. | A | A | – |
| Sulfates of [ potassium and sodium | | A | A | – |
| Sulfur | | A | A | – |
| Sulfuric acid | 98[(a)] | C | – | D |
| Sulfuric acid | 60 | A | B (80℃) | – |
| Sulfuric acid | 50 | A | B | – |
| Sulfuric acid | 10 | A | A | A |
| 50-50 $H_2SO_4/HNO_3$ | (a) | C | D (80℃) | – |
| 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 | A | A (80℃) | – |

| Environment | Conc. % | Temp., ℃ 20 | 60 | 100 |
|---|---|---|---|---|
| Turpentine | 100 | C | C | C |
| Urea | | A | A | – |
| Urine | | A | A | – |
| Water (distilled, soft, hard and vapor) | | A | A | A |
| Wet chlorine gas | | – | D (70℃) | – |
| Whiskey | | A | A | A |
| White Paraffin | 100 | A | B (80℃) | – |
| 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 | – |

(a) May produce cracking in material under stress

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