Chemical Resistance

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Chemical "resistance" and "compatibility" are synonymous terms used in relation to the ability of a plastic to function in different environments. In regards to polyethylene chemical storage tanks, chemical resistance encompasses the total effect a product would have on a tank. The factors that make up the overall compatibility of a chemical to a rotomolded tank are (1) chemical attack, (2) absorption or permeation, and (3) solubility and stress crack resistance.

Chemical Attack

By definition, chemical attack involves an actual chemical reaction with the plastic. This can be a breaking of molecular chains and/or an addition of chemical groups to the molecule. For example, in the case of an oxidation reaction with polyethylene, both occur with the addition of carbonyl groups. This causes and eventual loss of properties to the point that a tank would not be serviceable.

Polyethylene in general is one of the most inert plastics available. Very few chemicals react with polyethylene and with those that do, the rate is relatively slow. The ultra high molecular weight characteristics of high density crosslinked polyethylene resins after crosslinking makes these particular polyethylenes even more resistant than other grades.

Permeation

This involves the physical absorption of the chemical into the polyethylene. If this is a volatile chemical, then an actual loss of the product can occur as the chemical vaporizes from the outer wall of the tank. The amount of absorption is generally limited to 3 to 7 percent by weight of the polyethylene. Also, the loss of volatile products is relatively small. For example, a 25-gallon tank with a 50-mil wall will only lose between 5 and 6 grams of gasoline per day due to permeation. The thicker the wall, the lower the rate of loss.

The absorption of a product into the wall of a tank will cause more property changes. The tensile strength is reduced approximately 15 to 20 percent and stiffness approximately 20 percent. Normally, this does not affect the utility of a tank or prohibit the application. The property losses due to permeation are offset by increasing the design wall thickness of the tank.

Elevated Temperature

The effects of elevated temperature (100° F or greater) on polyethylene tank are predictable and expected. Polyethylene, which is a flexible material, becomes even more flexible when heated. It will, therefore, bulge more at an elevated temperature than at room temperature.

By looking at the design hoop stress values for various temperatures, one can see the effects of increased temperature services. The values remain relatively constant up to 100° F, after which they begin to decrease.

100° F	600 psi	130° F	450 psi
110° F	550 psi	140° F	400 psi
120° F	500 psi	150° F	300 psi

A rise in temperature of 50° F (100° F to 150° F) reduces the design hoop stress value from 600 psi to 300 psi and doubles the required wall thickness. It follows that simply increasing the service rating of a tank from 1.35 S.G. to 1.65 S.G., or even to 1.90 S.G. is not necessarily sufficient. The proper wall thickness must be calculated for the temperature of service.

The maximum temperature rating for crosslinked polyethylene material is 150° F. Above that temperature the thermal stabilizers in the plastic are more rapidly consumed. Continued use will cause embrittlement and a reduction in the useful life of the part. Temperature services from 100° F to 150° F are acceptable applications, however, thicker tank walls are required to maintain a safe design. Consult the factory when application such as these arise.

Table I

The following chemicals do not attach or permeate high density crosslinkable polyethylene resins up to 100° F. Each application should be considered individually. All concentrations apply except where noted.

Acetic Acid
Aluminum Salts
Alum
Ammonium Hydroxide
Ammonium Salts
Amyl Alcohol
Antimony Salts
Arsenic Acid
Barium Hydroxide
Benzene Sulfonic Acid
Bismuth Salts
Boric Acid
Bromic Acid
Butanediol
Butyl Alcohol
Calcium Hydroxide
Calcium Salts
Chromic Acid<50%
Citric Acid
Copper Salts
Detergents
Diazo Salts
Diethyl Carbonate
Diethanol Amine
Diethylene Glycol
Diglycolic Acid
Dimethylamine
Dimethyl Formamide
Ethyl Alcohol
Ethylene Glycol
Ferric Salts
Ferrous Salts
Fluoboric Acid
Fluosilicic Acid
Formic Acid
Gallic Acid
Gluconic Acid
Hexanol
Hydrazone<35%
Hydrozine Hydrochloride
Hydriodic Acid
Hydrobromic Acid
Hydrochloric Acid
Hydrofluoric Acid
Hydrofluorosilicic Acid
Hydrogen Peroxide<52%
Hydrogen Phosphide
Hydroquinone
Hypochorous Acid
Iodine Solutions
Lactic Acid
Latex
Lead Acetate
Magnesium Salts
Mercuric Salts
Mercurous Salts
Mercury
Methyl Alcohol
Methylsulfuric Acid
Michel Salts
Nicotinic Acid
Nitric Acid<50%
Oxalic Acid
Perchloric Acid
Phenol<10%
Potassium Hydroxide
Potassium Salts
Phosphoric Acid
Photographic Solutions
Propyl Alcohol
Propylene Glycol
Sea Water
Selenic Acid
Sewage
Silicic Acid
Silver Salts
Soap Solutions
Sodium Ferricyanide
Sodium Ferrocyanide
Sodium Hydroxide
[1]Sodium Hypochlorite<9%
Sodium Salts
Sodium Sulfonates
Stanic Salts
Stannous Salts
Starch Solutions
Stearic Acid
[1]Sulfuric Acid <80%
Sulfurous Acid
Sugar Solution
    Glucose
    Lactose
    Sucrose, etc.
Tannic Acid
Tanning Extracts
Tartaric Acid
Titinium Acid
Toluene Sulfonic Acid
Triethanolamine
Urea
Vinegar
Wetting Agents
Zinc Salts

[1]Concentrations above stated percentage require special considerations, contact factory for guidelines concerning these applications.

Table II

The following oils and organic chemicals do not attack HDXLPE resins. They will be absorbed into the wall of the tank; however, there should be no loss of chemical. Because of this absorption, no chemical other than the original should be stored in the tank as long as contamination may result as the absorbed oil is leached out. Storage at temperatures up to 100° F are possible provided the effects of the absorption on the properties of the tank are not prohibitive.

Fatty Acids	**Mineral Oils**	**Animal Fats**	**Vegetable Oil**
Butyric	Lube	Lard	Corn
Lauric	Transformer	Fish Oil	Coconut
Linoleic	Hydraulic	Musk Oil	Cottonseed
Oleic		Whale Oil	Olive
Palmitic			Peanut
Stearic			

Table III

The following organic chemicals do not attack high density crosslinkable polyethylene resins. They will be absorbed into the wall of tank and a permeation loss will occur. Because of this permeation and the effect it has on the physical properties of the tank, it is generally not recommended that these chemicals be storage at room temperatures above 100° F. However, their use largely depends on such factors as size of tank, its location, toxicity of the chemical, and applicable codes such as NFPA, OSHA, etc.

Anitine
Benzene
Carbon Tetrachloride
Chlorabenzene
Cychohexanol
Cycolohexnone
Dibutylphthalate
Diesel Fuel
Dimethylamine
Ethyl Butyrate
Ethylene Chlorohydin
Fuel Oil
Fufural
Aliphatic Hydrocarbons (hexane, octane, hexene, octene, etc.)
Jet Fuel
Gasoline
Nitrobenzene
Octyl Cresol
Propylene Dichloride
Toluene
Xylene