 <p>POLYPROCESSING COMPANY Providing Solutions Through Innovation</p>	Technical Bulletin	Crosslinked Polyethylene with OR-1000™ System The #1 System for Oxidizing Chemical Environments
	Date: June 2005 Rev. A	

Crosslinked Polyethylene with OR-1000™ System The #1 System for Oxidizing Chemical Environments

Poly Processing Company and other polyethylene tank manufacturers, as well as major polyethylene resin manufacturers have published many documents over the past several years discussing the benefits of certain rotational molding resins in acidic and alkaline chemical environments. The majority of these documents support the use of crosslinked polyethylene over linear polyethylene in acidic and basic chemical environments. These articles speak to the longevity of crosslinked polyethylene rotationally molded tanks, the safety of having polymer chains that are chemically bonded, and the leveraged investment of knowing that crosslinked polyethylene chemical storage tanks have been utilized for the last 35 years.

In 2001, one of the largest resin manufacturers in North America published a fairly extensive study which showed that their linear polyethylene in a lab environment performed as well as, if not better than crosslinked polyethylene, in acidic and alkaline chemical applications. This study, coupled with marketing efforts by linear polyethylene tank manufacturers who do not rotationally mold crosslinked polyethylene tanks in the course of their normal business, has given rise to some industry confusion and misunderstanding about what is the best resin system for storing oxidizing chemicals. We will summarize the facts about rotationally molded polyethylene storage tanks and the value of an engineered antioxidant resin system coupled with the long-term performance of crosslinked polyethylene.

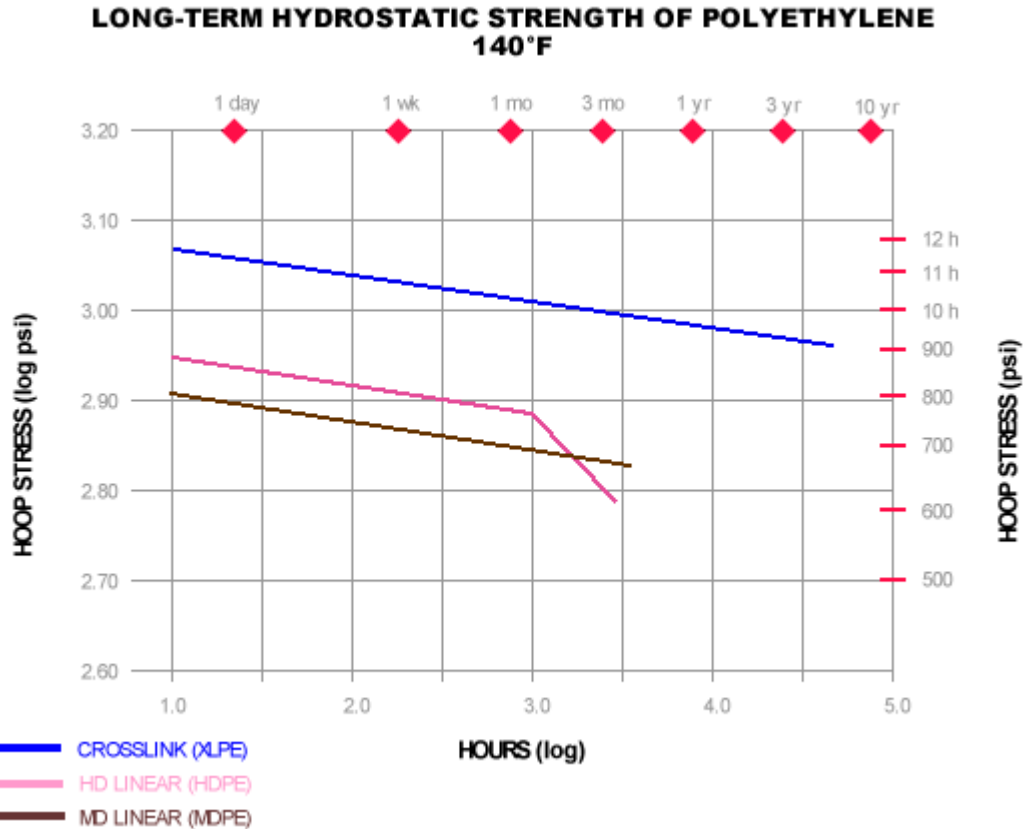
We would first like to discuss the lab study performed by the linear resin manufacturer. The study compared crosslinked polyethylene with linear polyethylene in sulphuric acid and sodium hypochlorite environments. The sulphuric acid was concentrated approximately 93%-97%, and the Sodium Hypochlorite was around 14% concentration. The lab study describes how the crosslinked polyethylene and linear polyethylene were submersed in the chemicals and then tested using ARM Impact testing as well as Environmental Stress Crack Resistivity (ESCR) testing. The study concluded that the linear materials in a chemical resistivity mode held up as well as crosslinked materials in a lab environment. In addition, Higher ESCR properties are found in lower density materials like LLDPE or LDPE as compared to HDPE resins. It doesn't mean you want to use a tank made only from the lower density resins. ESCR shows how well the material performs in a pre-notched condition in the presence of certain chemicals.

The lab study performed by the resin manufacturer did not cover or discuss the long-term properties of these materials in harsh, environmental conditions. Over time, sodium hypochlorite and sulphuric acid create an oxidative environment, which remove hydrogen molecules from the polymer chains creating embrittlement. This phenomenon is inherent to all types of polyethylene, since they are hydrocarbon based molecules. Storing acids and bases in actual everyday environments presents a completely different set of parameters and stresses that have little to do with the lab environment.

Poly Processing Company has been aware of this relationship between ESCR and Chemical resistance for many years and has been an industry leader in creating engineered resin systems which give the end user the ability to have excellent oxidation and chemical resistivity without sacrificing long term performance and toughness. These engineered resin systems deliver peace of mind, a margin of safety, and leveraged investment to the end user.

Another critical factor to consider when storing acids and bases in actual everyday environments is the Long Term Hydrostatic Strength (LTHS) of the polyethylene. LTHS properties are one of the keys to providing the continued strength necessary for tanks during its service life. This property is especially important in field applications where tanks can see elevated temperatures approaching

140°F. LTHS tests are conducted at both ambient temperature (73°F) and at elevated temperature (140°F) since actual field conditions are typically in this range.
Figure 1.




Source: Chevron Phillips Company, Plastics Technical Center

The rapid deterioration in properties is indicated by a “knee” in the curve of hoop strength versus time as illustrated in Figure 1 above. Even high performance HDPE will develop a LTHS knee at around 1000 hours (log 3), and some MDPE products will have a knee in less than 10,000 hours (log 5). This type of performance substantially reduces the expected long-term performance at elevated temperatures. Crosslinked polyethylene has been tested to 50,000 hours at 140°F and shows no signs of a knee.

There is still the need to surround the oxidation resistant material with a robust resin system that will give you longer useful tank life, superior impact resistance, and greater tensile strength for a safer product. That is why crosslinked polyethylene is still the material of choice for industrial and municipal chemical applications.

Poly Processing Company has been the leader in rotationally molded crosslinked polyethylene storage tanks for 35 years. We work with the leading universities in the country to develop engineered resin systems that will perform above and beyond any standard “off the shelf” polyethylene in harsh, oxidizing environments. One of the systems we developed is the OR-1000™ system. This system uses the best linear resin for chemical resistivity combined with four (4) times the antioxidant power and a crosslink outer wall for maximum long-term performance and durability.

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Poly Processing Company developed the OR-1000™ oxidation resistance system in 1995. This lower density linear material serves to increase the service life of crosslinked polyethylene tanks in oxidizing chemical service (Sodium Hypochlorite, Sulphuric Acid, Hydrochloric Acid, and Nitric Acid). To develop the outstanding long-term physical properties of crosslinked polyethylene, the amount of antioxidant compounded into the material has to be limited. Although crosslinked polyethylene has superior properties to any other rotational molding grade polyethylene, the tank's useful service life will be reduced without the OR-1000™ system. In order to utilize the superior properties of crosslinked polyethylene, the OR-1000™ system was developed to greatly improve the service life in harsh oxidizing chemical environments. This material is a medium density linear based resin with a large amount of antioxidant added to it for the best oxidizing resistance system in the industry. The OR-1000™ system has been engineered to prevent de-lamination during the useful life of the tank.

To compare the effect of oxidizing chemicals on the OR-1000™ system and crosslinked polyethylene, 1/8" thick tensile bars of both OR-1000™ and crosslinked polyethylene were submerged in a manufacturer's storage tank. This tank handled a highly oxidizing chemical, 17% Sodium Hypochlorite, and was emptied and filled at least once a day. Every 30 days, samples were pulled and tensile and percent elongation was determined as well as ESCR tests. Oxidization or reduction in physical properties is indicated by reduced in elongation. After six months of testing, the elongation of the crosslinked polyethylene tensile bars had decreased 26% while OR-1000™ elongation had no change. This is due to the added antioxidant in the OR-1000™ system as well as the fact that the linear material used in the testing was a lower density material than the crosslinked material.

Crosslinked polyethylene provides superior environmental stress cracking resistance (ESCR) or sometimes generally referred to as resistance to slow crack growth (SCG) in almost all chemical applications. Two tests which clearly show this difference are the bent strip ESCR (ASTM D1693) with 10% Igepal where crosslink polyethylene does not fail in over 1000 hours compared to typical values for LMDPE of <400 hours. Another test which shows the slow crack growth difference with no surfactant (in air) is the polyethylene notch test (PENT) described in ASTM F 1473 and crosslink polyethylene again does not fail in over 1000 hours and LMDPE grades fail in <100 hours. Even though linear polyethylene grades with improved ESCR have become available over the past 10 to 15 years, they still do not match crosslinked polyethylene in SCG performance. Slow crack growth resistance as was shown earlier in this paper is an important property that can affect the long-term performance of tanks.

The best of both worlds is having the OR-1000™ system for the long-term oxidative resistivity characteristics (as discussed in the resin manufacturer's lab study), with the robustness of crosslinked polyethylene for the long-term durability and long useful life that is expected of industrial grade chemical storage tanks. This is why so many chemical manufacturers and distributors choose Poly Processing Company for engineered chemical storage solutions.

Crosslinked polyethylene tanks with the OR-1000™ system varying in sizes from 500 gallons to 14,950 gallons have been in true industrial and municipal use for over 10 years with excellent results. Poly Processing Company backs every crosslinked polyethylene tank with the OR-1000™ system with a 5 year full warranty on all suitable applications including sodium hypochlorite and hydrochloric acid, sulfuric acid 80%-98% carries a full 3 year warranty

Store your harsh oxidizing chemicals with the confidence and peace of mind that you deserve. Specify Poly Processing Company's crosslinked polyethylene tanks with the OR-1000™ system for longevity, safety, and leveraged investment. Please consult your distributor or Poly Processing Company at 1-866-590-6845 for your specific requirements.