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

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Poly Processing Company (PPC) has been the leader in rotationally molded crosslinked polyethylene (PE) storage tanks for 40+ years. PPC work with 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 developed is the OR-1000™ system. This system uses linear PE resin for chemical resistance combined with four (4) times the antioxidant power and a crosslinked polyethylene (XLPE) outer shell for maximum long-term performance and durability. This bulletin sets forth data supporting the nature of the bonding of these two resins.

Using XLPE and OR-1000™ linear PE as "bricks", PolyProcessing Company provides the "mortar"- a proprietary processing technology developed to bring the components together in an optimal configuration. The end result is a tank consisting not only of integral XLPE and OR-1000™ portions, but also with a very consistent interface between the components, as shown in Figure 1.

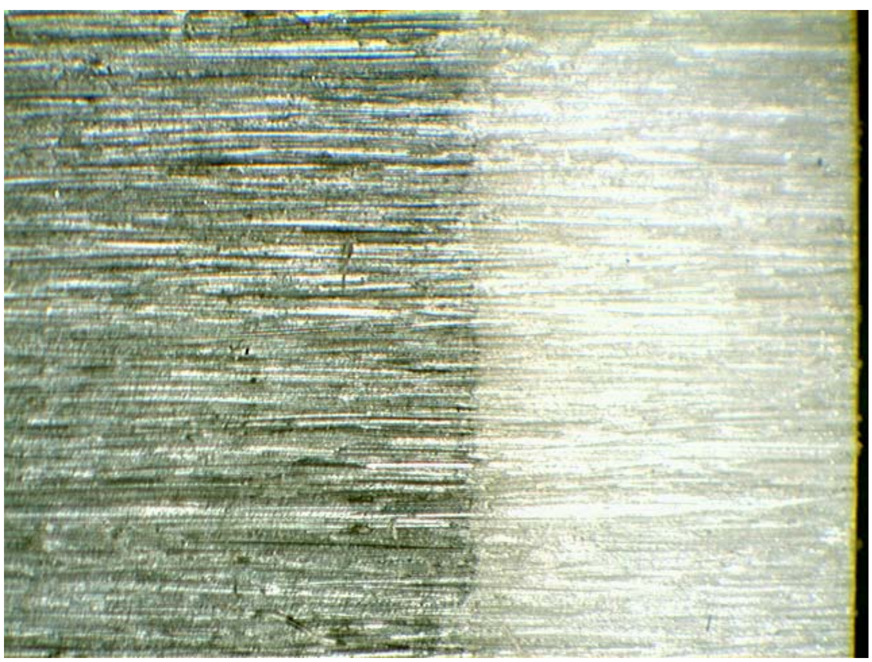

Figure 1: Photomicrograph showing interface between XLPE (left) and OR-1000™ (right). Micrograph depicts a black XLPE tank for improved contrast.

Figure 1 is a photomicrograph of a commercially produced tank consisting of an XLPE and an OR-1000™ linear PE. The tank depicted uses black XLPE in order to better depict the XLPE/ OR-1000™ interface. PolyProcessing Company routinely manufactures black tanks for use in outdoor environments to further protect the tanks against degradation from the ultraviolet (UV) portion of sunlight [1]. It is notable from Figure 1 that the bond between the XLPE and OR-1000™ is very consistent in appearance. In fact, the two layers have commingled at the interface.

The strength of this XLPE/OR-1000™ bond can be demonstrated by applying a variation on ASTM D1876, the standard test method for peel resistance of adhesives (T-peel test). In this test, primarily applied to flexible systems such as films to determine the peel resistance of adhesive bonds, a T-type specimen is clamped in the test grips of a tension-testing machine. A load (force) of constant head speed is applied and the load as a function of distance peeled (% strain) is recorded. Thus the peel resistance over a specified length of the bond line after the initial peak load can be determined.

In order to apply the peel resistance test to specimens taken from OR-1000™ tanks, a clamping device was mounted to a sliding fixture, which was in turn mounted to a tension-testing machine. The specimen was partially separated at the XLPE/OR-1000™ bond. The OR-1000™ portion was then clamped in the jaw of the tension-testing machine and the XLPE portion was clamped in the movable fixture. When the test started, the sliding fixture kept the test specimen at a 90^{o} angle, focusing the force on the XLPE/ OR-1000™ bond.

Test specimens taken from a tank with an XLPE/OR-1000™ bond equivalent to that shown in Figure 1. The test was repeated ten times with essentially the same results as depicted in Figure 2 and documented in Table 3. As shown in Figure 2, the failure mechanism of all specimens was tensile failure of the OR-1000™ portion of the specimen. **This indicates that the bond between the XLPE and OR-1000™ is mechanically stronger than the OR-1000™ itself.** The standard deviations between individual breaking loads, elongation to break values, and maximum loads are also shown in Table 3. This data indicates that there is a 99% confidence level that the breaking load of the OR-1000™ is between about 14 and 15 lbs and thus the strength of the bond is at least 14.5 lbs. on average.

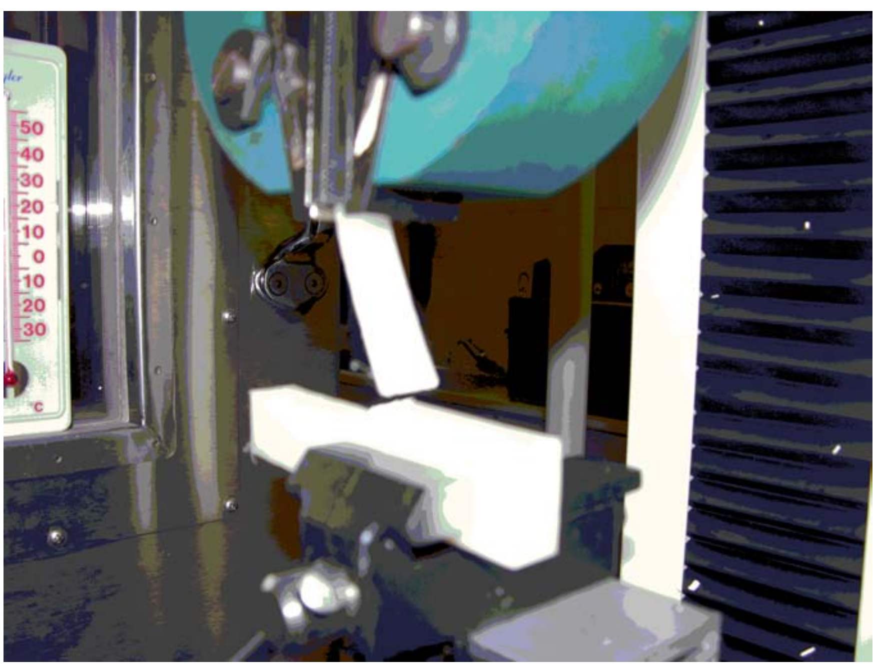

***Figure2: Sliding clamping fixture gripping lined tank specimen after peel test-
note the OR-1000™ portion failed prior to de-lamination of the XLPE/ OR-1000™ bond.***

Table 3: Results of Peel/De-lamination Testing of OR-1000™ Tank Specimens [2]

Specimen #	Max. Load (lb-f)	Break Load (lb-f)	Elongation at Break (%)	Failure Mechanism
1	22.1	14.4	42.2	Tensile Failure-OR-1000™
2	22.5	15.5	42.9	Tensile Failure-OR-1000™
3	20.2	13.6	38.8	Tensile Failure-OR-1000™
4	21.6	14.4	39.5	Tensile Failure-OR-1000™
5	22.3	14.9	41.1	Tensile Failure-OR-1000™
6	20.9	13.8	41.8	Tensile Failure-OR-1000™
7	22.0	14.8	40.3	Tensile Failure-OR-1000™
8	21.1	14.1	42.7	Tensile Failure-OR-1000™
9	20.7	13.9	41.6	Tensile Failure-OR-1000™
10	21.9	15.1	40.9	Tensile Failure-OR-1000™
Average	**21.6**	**14.5**	**41.2**	
SD	**0.765**	**0.617**	**1.34**	

The data and results set forth in this technical bulletin demonstrate that PolyProcessing Company's cross linked polyethylene tanks with the OR-1000™ system are the best choice for containing strong oxidizing chemicals in outdoor environments. The end product is a unified containment system with not only the long-term oxidative resistance but also the robustness of crosslinked polyethylene for the long-term durability and long useful life that is expected of industrial grade chemical storage tanks. Crosslinked polyethylene tanks with the OR-1000™ system varying in sizes from 55 gallons to 14,950 gallons have been in true industrial and municipal use for over 10 years with excellent results.

References

1. H. F. Mark. Encyclopedia of Polymers Science and Technology – 3rd Ed. Vol 12. John Wiley & Sons Inc. 2004
2. All peel/de-lamination testing was carried out at The Plastics Manufacturing Center, Pennsylvania College of Technology, Williamsport, Pa. 17701.