PEXIDAN® Moisture-Cure Crosslinked Polyethylene

What is Crosslinked Polyethylene?

To understand what crosslinked polyethylene is it is useful to know a few general concepts about polymers. The chemical structure of a polymer is a series of molecular "chains" of various lengths and may even have a branched geometry. These chains are usually "tangled" up in each other to some extent depending upon the temperature and applied stress. When the polymer is heated towards its melting point these chains become more flexible, moving and slipping from the entanglement of each other. This disentanglement allows a polymer to flow during processing such as extrusion or injection molding.

A *thermoplastic* polymer is one that can be melted repeatedly through the process of disentanglement of the polymer chains. A *thermoset* polymer is one that cannot be re-melted once it has been 'cured' because the entanglement of the polymer chains remains at elevated temperature. In the context of the above discussion a thermoset polymer is one that has an infinite molecular weight and the structure is that of a 'network'. Chemical bonds are formed between the polymer chains that effectively reduce the mobility by locking the entangled chains to one another, which in turn prevents the material from flowing. This is a rather simplified explanation but it serves the purpose of this document. With this in mind, crosslinked polyethylene is a thermoset that is produced by creating a polyethylene of infinite molecular weight through molecular bonds across individual polymer chains.

Why is Crosslinking of Polyethylene Desirable?

Crosslinking polyethylene improves many of the physical and chemical properties of the polymer as compared to the thermoplastic version, with the most significant improvement being the polymer's performance at elevated temperatures.

Properties such as tensile strength, elongation, permanent set and deformation are improved at temperatures where a thermoplastic polyethylene would melt and flow. This makes crosslink polyethylene suitable for applications such as wire insulation, hot water pressure pipe and shrink tubing to name a few.

Other properties that are improved by crosslinking are stress-crack, abrasion and chemical resistance, and elevated temperature performance is achieved without sacrificing the low temperature performance. Crosslinking simply expands the service temperature range of the thermoplastic polyethylene.

So what is PEXIDAN® 'Moisture-Cure' Polyethylene?

Crosslinking can be achieved by several processes, all involving the alteration of the base polymer by chemical or physical means. The moisture-cure method has several variations on the basic silane chemistry, a chemistry that sees everyday use in RTV 'bathtub' silicone.

In the PEXIDAN® moisture-cure polyethylene process, a copolymer of (poly)ethylene and vinyl silane is carefully created by SACO AEI in an initial phase of production. Upon processing by the manufacturer, the PEXIDAN® copolymer is allowed to undergo a reaction with water, in the presence of a PEXIDAN® catalyst, to form linkages between the silane branches of individual polymer chains. This linking of chains results in much larger molecules being formed that effectively give the polymer infinite molecular weight, and with it, the properties and benefits described above.

The PEXIDAN® moisture-cure process has great advantages for manufacturers. Polyethylene that is crosslinked with the PEXIDAN® technology can be easily processed on common thermoplastic equipment and then cured off-line by exposing the product to moisture. The cure rate is dependent upon moisture level, temperature, wall thickness and the specific characteristics of the polymer system. The curing can be accelerated by use of a low-pressure steam environment or hot water immersion, but in many cases it is possible to crosslink under 'ambient' conditions.

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