Durability of Heathcote Industrial Plastics Constrained Layer Dampers (CLD's)

Summary

This bulletin addresses the long-term durability of Heathcote Industrial Plastics Constrained Layer Dampers (CLD's) and their ability to perform in certain types of demanding environments. This will be addressed from a variety of view-points including chemical composition, resistance to harsh environments, independent tests for product durability, and certain applications where CLD products have demonstrated excellent ability to perform in demanding applications. Test results on moisture resistance, UL durability, accelerated weathering, outdoor weathering, thermal cycling and fatigue resistance will be discussed.

Composition

The polymer used in CLD's is a highly chemically bonded acrylate. The long-term ageing resistance lies in the polymer comprised in CLD's. The chemical bonds which make up the polymer chains consist of carbon-carbon single bonds which are highly resistance to energy in the form of heat or ultraviolet light as well as chemical attack. In less durable polymers or adhesives, such conditions could lead to cleaving of the polymer backbone and thus a weakening of mechanical properties. In the case of acrylic high performance polymers, however, additional crosslinking is chemically favoured over chain scission (cleavage). This means that rather than undergoing a process of decomposition, the acrylate materials will tend to build modulus very slightly over extended exposures. This translates to a stronger, long lasting bond.

Durability Testing

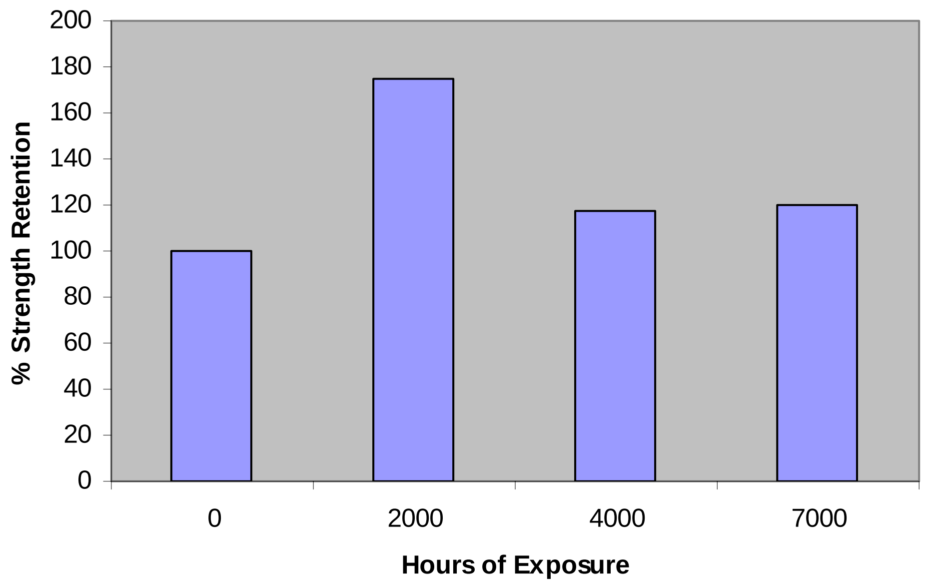
Temperature Exposure

Because of the demanding and diverse applications users have for CLD’s durability has always been a key interest in the performance of these products. One of the first issues for polymers is retention of tack and adhesion after exposure to elevated temperatures. The CLD Polymer in 0.25mm thickness yielded 92% retention of peel adhesion after the roll was aged for more than 5 years at 65°C. The initial tack and liner release properties were still excellent. The difference in peel values suggests that a roll of this polymer is relatively unaffected by long-term exposure to elevated temperatures. Bonds made with CLD’s can tolerate periodic, short-term exposures to temperatures up to 260°C.

Accelerated Weathering

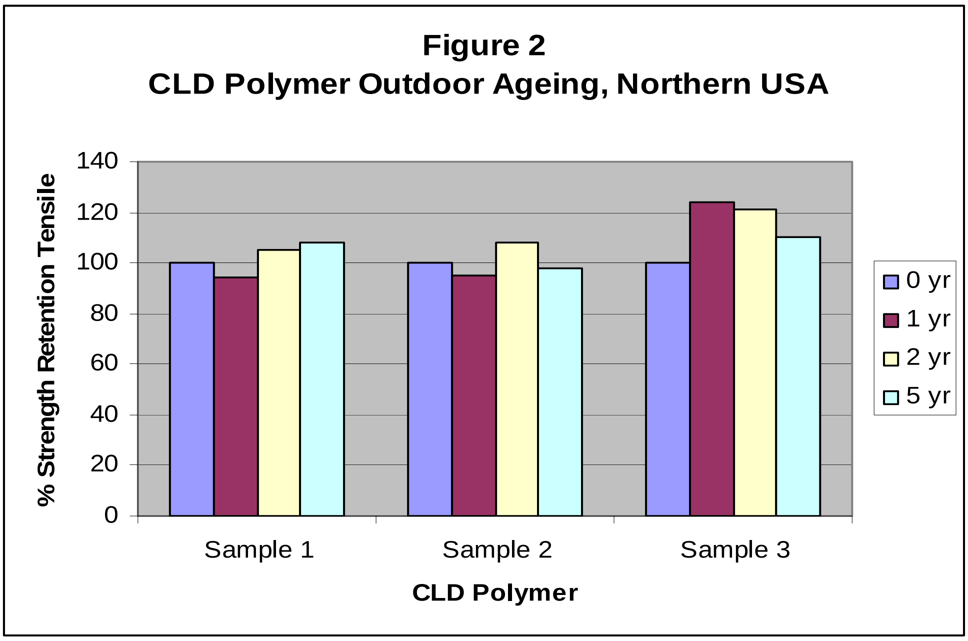
Certain other accelerated ageing tests have been conducted in weatherometers which subject a bond to heat, humidity and concentrated ultraviolet light exposure. These tests were performed in dynamic shear by making a stainless steel overlap bond with 1mm polymer and then subjecting the samples to cycling heat, humidity and carbon and arc lamp exposure. Small samples provided an increased amount of edge exposure to UV radiation. Figure 1 indicates that the bond strength does not deteriorate below its original performance level even after exposure of 7000 hours in the weatherometer under these tests.

Figure 1. Weatherometer Testing



Outdoor Weathering

Outdoor weathering decks in Arizona, Florida and other locations around the world are also used to collect data on the long-term performance of the CLD Polymer. These tests typically demonstrate about 100% bond strength retention in certain thicknesses after 2 to 5 years ageing cycles in the hot, humid climate of Florida, the hot, dry and very sunny climate of Arizona and the cold to hot extremes of northern USA on bonds to aluminium, glass, PVC and painted metal. Figure 2 shows the constant performance of 3 sample CLD products after 5 years of outdoor ageing in the northern USA. Similar results have been obtained in 5 year tests conducted in Japan.



Moisture and Solvent Resistance

Adhesion tests have been performed on 1mm CLD Polymer bonds of aluminium to aluminium which were subjected to over 8 years of submersion in 5% salt water and ordinary tap water. After testing, bright clean aluminium surfaces were observed underneath the adhesive bond. A combination of adhesive and cohesive failure modes were observed when the bond was broken which indicated very high performance levels. Long-term exposure to high humidity or water submersion can have the effect of making a polymer more resilient and tolerant of high elongation. A subsequent lowering in peak force is also measured after many days of exposure, usually on the order of 40%. This effect is typical as it parallels the increase in resilience and is the same trend often seen with structural silicone materials which are also recognised for their durability. Drying of the CLD polymer bond, which occurs in a normal environmental cycle, will show that this effect is reversible and that the bond will return to the original dry strength. After splashes or incidental contact with solvents such as fuels, alcohols, adhesive removers like MEK, and even weak acids or bases, no affect is measured on the bond performance. Only after continuous submersion in harsh fuels or solvents is softening of the Polymer experienced. Note: While CLD polymer products may withstand occasional contact with these types of chemicals, continuous exposure is not recommended.

Clarity

Since the introduction of the clear CLD Polymers, the additional issue of long-term clarity and appearance consistency is commonly asked. Tests have been run for 3000 hours in an accelerated weathering machine which exposes bonds to high temperatures and intense ultraviolet (UV) light. To measure clarity, 3mm float glass plates were bonded together with 1mm CLD polymer. The percent transmittance was monitored periodically during the exposure cycle, beginning at 88.2% and finishing at 87.3%. After this long, harsh exposure, only a 1% change in transmittance was observed. In high humidity environments, however, the 1mm and 0.5mm polymers may take on a hazy appearance due to slight absorption of water molecules. Because the same acrylic polymers are used throughout the CLD Tape family, these results suggest inherent stability of the whole family.

UL Listing and Durability Testing

CLD polymers have UL 746C listings which involve stringent qualification tests and periodic monitoring by Underwriter's Laboratories. Qualification for this listing requires high-strength retention after extended exposure to high temperatures, humidity, cold, and cyclic conditions. The table below shows various thickness CLD Polymers with the UL 746C listing, and substrate combinations, as well as the maximum listed temperature for each combination.

CLD Polymers

UL746C Listings - File MH 17478

Category QOQW2 Component - Polymeric Adhesive Systems, Electrical Equipment

Polymer Thickness	Substrates	Temp. Rating
0.4, 0.65, 1 mm	Aluminium, Stainless Steel, Galvanised Steel, Enamelled Steel, Glass/Epoxy, Ceramic	110°C
	PBT	90°C
	Polycarbonate, ABS, UPVC	75°C
0.05, 0.13 0.25mm	Stainless Steel, Glass/Epoxy, Enamelled Steel, Ceramic, Phenolic, Nickel Plated Steel	110°C
	ABS, Polycarbonate, Aluminium, Galvanised Steel	90°C
	UPVC	75°C