

Cyanoacrylate Adhesives Introduction

Cyanoacrylate adhesives became well known after their commercial introduction in the early 1970s in the consumer market. These unique products were initially referred to as “superglue”.

These adhesives are solvent-free, one-part products that cure instantly on contact with mated surfaces through a reaction with surface moisture. No other adhesive bonds so rapidly so easily to such a variety of substrates as does a cyanoacrylate.

Cyanoacrylate adhesives have high strength, excellent adhesion, especially to rubber and plastics. Early generations of cyanoacrylate adhesives had significant performance limitations. Poor shock or impact resistance (brittleness); and poor gap filling abilities. Since they were essentially thermoplastic in nature, cyanoacrylate adhesives exhibited poor thermal and chemical resistance.

Newer formulations, however, have greatly improved the performance properties of these “instant” adhesives. Rubber toughened cyanoacrylates show the best performance in water and humid environments. New thermally resistant formulations offer continuous service at temperatures as high as 120°C. Products have been developed with higher peel strength and for flexibilizing the bond line. Surface insensitive cyanoacrylates offer the most rapid fixture times of all the cyanoacrylates.

Recently light curing cyanoacrylate adhesives have been developed that offer the rapid light cure properties of a thermosetting acrylic adhesive coupled with the ease and speed of a secondary cyanoacrylate cure, allowing them to cure in shadowed areas. A major benefit that light curing cyanoacrylate adhesives offer is that open liquid adhesive can be cured to a tack free surface in less than 3 seconds through exposure to a low intensity light. This prevents blooming and stress cracking of plastics and greater gap thickness can be cured.

Curing Mechanism

When confined in a thin film between two surfaces, cyanoacrylate adhesives cure rapidly at room temperature to form rigid thermoplastics with excellent adhesion to most substrates. Cyanoacrylates typically reach handling strength within one minute at room temperature and achieve full strength in 24 hours.

Cyanoacrylate adhesives undergo anionic polymerization in the presence of a weak base, such as water, and are stabilized through the addition of a weak acid. An essential function of the stabilizer is to prevent polymerization in the container, which is usually made of polyethylene.

When the adhesive contacts a slightly alkaline surface, trace amounts of adsorbed water or hydroxide ions (OH-) that are present on the substrate’s surface neutralize the acidic stabilizer in the adhesive, resulting in rapid polymerization.

In general, ambient humidity in the air and on the bonding surface is sufficient to initiate curing within a few seconds. Therefore, parts must be joined quickly. The open time is dependent on the grade of adhesive, the ambient temperature and relative humidity, and the nature of the substrate surface (pH and amount of adsorbed water).

Optimal bonding conditions are when the ambient relative humidity is between 40% and 60%. Lower humidity slows cure, high humidity accelerates it, but could lead to lower bond strength.

To achieve the fastest cure, a very thin bond line is desirable. The cyanoacrylate adhesive need only be applied to one surface.

Without the application of a primer, acidic surfaces may delay or even prevent curing, whereas more alkaline or basic surfaces accelerate curing. Generally, the accelerator is applied to one surface while the adhesive is applied to the mating surface. Exposed liquid adhesive can be cured within seconds with activators. In those cases the activator is sprayed directly on the liquid cyanoacrylate.

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Features

- Excellent adhesion to a wide variety of substrates
- Simple cure mechanism
- Rapid strength development
- High strength possible on polyolefins and fluorocarbons using primers
- Available in USP Class VI compliant formulations
- High shear strength
- No measuring or mixing required

Limitations

- Blooming/frosting, except Chenso
- Difficult to cure fillet or exposed liquid adhesive without activator or UV-light
- Limited gap cure
- Stress cracking could occur to some plastics
- Soluble in polar solvents
- Thermal and chemical stability not as good as with certain other structural adhesives
- Unmodified formulations have low peel and impact strength
- Pungent odor associated with early formulations

CHENSO instant adhesives are available in a choice of viscosities, cure speed, gap filling capability, and substrate compatibility. High performance cyanoacrylate products offer additional properties, including toughened formulations, low odor and low blooming products, surface insensitive and thermally resistant formulations.