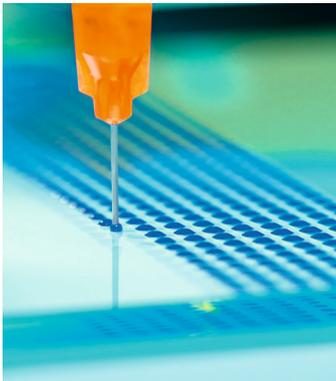


- **SCOPE:** As joining and sealing applications become more and more complex, the demand for adhesives with multiple curing mechanisms is significantly increasing. This article provides an overview of the different dual curing adhesives manufactured by Delo, their hybrid chemistries, curing methods and typical applications.

Delo has developed an extensive portfolio of dual-curing adhesives based on dissimilar chemistries, which offer significant advantages over more “traditional” adhesives, without sacrificing reliability, bond strength, or ease-of-use. Uses include industrial displays, automotive camera modules, electric motors, and even simple applications such as thread-locking.



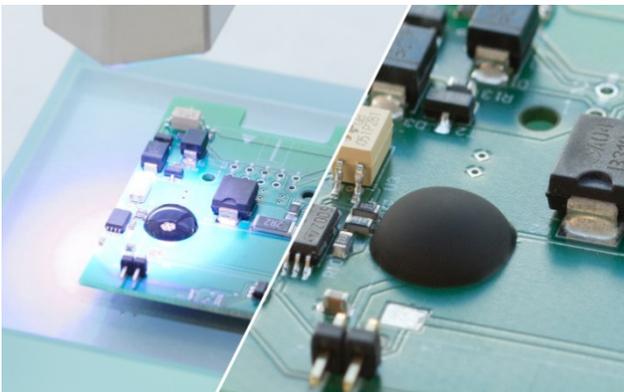
When bonding components together, it is essential that the whole volume of the adhesive is fully cured, as uncured adhesive in the finished assembly may cause corrosion, or, in the case of optical products, interfere with the light path. For light curing adhesives (Ultra Violet & Visible Light), achieving full cure can be a problem due to shadow areas that the light can't reach. Heat-cured adhesives do not suffer from this problem, but some components can be sensitive to temperatures even as low as 90 – 100C. Two-part cold-cured adhesives such as epoxies and polyurethanes can overcome this issue, but the user then must suffer from the long curing times that these adhesives require, thereby increasing cycle times and reducing throughput.

### **Diverse Curing Mechanisms – What's Available?**

Dual-curing adhesives overcome these issues in different ways, depending on the chemistry of the adhesive. Currently, hybrid light + heat curing adhesives appear to be the preferred solution, but other chemistries such as light + humidity and light + anaerobic adhesives are gaining in popularity.

### **Light + Heat Cured Adhesives:**

These are based on two diverse chemistries, epoxy and acrylate. Epoxies tend to be hard once cured, offering increased resistance to chemical and temperature stresses due to the tight cross-linking of the polymer that occurs during cure. Acrylates are usually softer adhesives, enabling quicker curing and greater flexibility of the cured adhesive.



Using a combination of heat and light to cure these adhesives offers the user a very fast fixation by snap-curing the photoinitiator in the adhesive. Subsequent heat curing ensures that there is no uncured adhesive in any shadow zones that might exist in the assembly. This fast fixation also allows increased accuracy for the user – this is especially useful for companies that have invested heavily in high-accuracy placement machines, only to see that investment wasted due to movement of the parts being bonded during the heat-cure stage.

This heat-cured stage generally involves heating the parts up to around 100C after the light cure process. However, for temperature-sensitive materials such as some plastics, modified epoxy adhesives are available that will cure at 60C, combining defined processes and short cycle times, despite the low curing temperature of the adhesive. These are especially useful in applications such as automotive camera modules, or where the end product is subjected to chemical influences that would otherwise harm an acrylate adhesive. These dual-curing epoxies also exhibit very low outgassing (some are NASA-qualified) and low yellowing, making them ideal for applications with demanding optical requirements, such as LED assembly.

Dual-curing acrylates offer similar advantages to dual-curing epoxies, namely very fast fixing and full cure after subsequent heat curing, but these adhesives also exhibit excellent impact resistance and tension-equalising properties due to their flexible nature. These are ideally suitable for applications such as the assembly of rotary encoders, where optional fluorescing and colouring can be added to aid visual inspection.

Light + heat cured adhesives also offer increased flexibility in the manufacturing process. While heat-curing is mandatory for a small number of these adhesives, the majority offer independent curing mechanisms, allowing curing either by light, or by heat, or by a combination of the two.



#### **Light + Humidity Cured Adhesives:**

Light + humidity cured adhesives also enable a fast fixation by light, but the secondary curing mechanism in this instance is humidity, so there is no requirement for additional curing equipment. The majority of the assembly should be capable of being cured by light, to achieve optimum bond strength, but for applications such as mobile phone displays, where only the black border prevents light getting to the adhesive, then humidity curing at a rate of 2mm / day is the ideal secondary curing mechanism, enabling immediate handling after the initial light-cure process.



These are also single-part adhesives, and are free of isocyanates (no Health & Safety issues) and silicones (no impediment to subsequent adhesive bonding), unlike some acrylates. They are highly flexible, optically clear adhesives offering excellent climatic resistance, whilst also providing excellent bond strength on surfaces such as glass, PMMA, metal pins and most plastics.

#### **Light + Anaerobic Cured Adhesives:**

Anaerobic adhesives cure in the presence of metal and the absence of oxygen, but in a lot of cases, the adhesive at the edge of the joint is exposed to air, which results in a small amount of uncured adhesive, possibly at either end of the bond. By using the photoinitiator in the adhesive to snap cure the edges of the joint, a 100% cure of the adhesive then becomes possible. For example, Hall Effect sensors are used in automotive applications when position or speed need to be monitored. These sensors are sometimes located directly on the wheel rim or even on the wheel hub.

From there, they provide accurate information on how frequently the wheel is rotating. Using light + anaerobic dual-curing adhesives for these applications is especially appropriate because they assure a rapid fixation and a secure final curing, even in shadow zones.



These adhesives are also highly resistant to media such as oil, gas and braking fluid, and they also meet JEDEC requirements for salt spray, reflow, vibration and drop tests.

These adhesives also offer an extended temperature resistance of -60 to +180C, making them suitable for applications such as e-motors where a lot of heat is generated. Because they also exhibit excellent adhesion to most metals and plastics, with very high impact resistance, they are used for the assembly of slot magnets and temperature sensors.

### **Conclusions**

Dual-curing adhesives provide increased flexibility in the manufacturing process, giving end users more freedom when designing the manufacturing flow. They eliminate the unwanted possibility of uncured adhesive in the end product, and offer maximum placement accuracy when building complex assemblies on expensive equipment.

For further information on DELO adhesives:

<https://www.inseto.co.uk/adhesives.php>