Fachverlag für die Polymerindustrie

Huntsman provides advice for designing adhesive bonding applications

Huntsman Advanced Materials is offering free advice to designers and design engineers looking to achieve the best performance from adhesive bonding, focused on the importance of designing components for bonding as a recommended alternative to simply taking a design made for mechanical fastening.

Almost every industrial item produced is composed of components which need to be assembled. In many application areas, industrial adhesives have superseded mechanical joining as the assembly technique of choice with their ability to provide outstanding lap shear strength, reduced corrosion, less finishing operations, reduced assembly costs, improved product performance, durability and greater design freedom, says **Huntsman.**

High performance adhesives harden through a chemical reaction and have a strong affinity to joint surfaces. However, in order to maximise these inherent advantages, joints need to be designed and pretreated in accordance with the adhesive selected and the application performance requirements. As general guidelines for optimising bonding performance, customers are advised to consider three essential factors; pre- and post-application treatment and the loading conditions that bonded joints are subject to.

Pre- and post-application treatment

Methods of application of the adhesive and the assembly of the components should always be taken into account at the design stage. In order to get the best performance from an adhesive bond, it is important to design the component for bonding rather than simply taking a design made for mechanical fastening. Together with the practical curing conditions, these determine the choice of adhesive type to be used.

To make a successful bond, the adhesive must wet the surfaces to be assembled, fill the gap between the two surfaces and then fully cure. The best joints are achieved when the surfaces are absolutely clean and have good affinity to the adhesive. Poor surface conditions usually result in relatively low strength and reduced durability. The bonding process requires a uniform and consistent surface preparation involving the removal of all foreign contaminants from the surfaces. A particular surface treatment may also be needed to improve the affinity for the adhesive.

For many applications, good and sufficient durability is obtained with easily achievable levels of surface control (or pretreatment), bond line thickness and adherence to an appropriate curing schedule. With two-component adhesives, the resin and hardener components must be thoroughly measured and mixed in the correct ratio. A precise amount of mixed adhesive should be placed and spread onto the bonded area – both steps can be performed using automated processes.

Where highly viscous or thixotropic components are used, metering units may be fed by special drum pumps. Similarly, for single component epoxy adhesives, hand or air operated application equipment can help to ensure a reproducible and reliable quality bond.

The hardening, or curing of reactive adhesives requires time. By applying heat, curing times can be shortened. Furthermore, whilst strong bonds can be achieved after 2 to 24 hours at room temperature curing for many two-part adhesives, exposing the adhesive bond to higher curing temperatures, even a few degrees above room temperature, usually increases bond strength.

Jigs or other fixtures should be used to prevent bonded surfaces moving during the curing process and only light pressure should be applied as evenly as possible over the whole bond area. Excessive pressure leaves the joint starved of adhesive.

Loading conditions

Bonded assemblies may be subject to tensile, compressive, shear or peel stresses, or a combination thereof. Adhesives are more resilient under shear, compression and tension stresses, performing less effectively under peel and cleavage loading. A bonded joint needs to be designed so that the loading stresses will be directed along the lines of the adhesive's greatest strengths.

[image_0_right]

As shown in **figure 1,** a bonded joint can be loaded in five basic ways. Cleavage and peel loading are the most severe as they concentrate applied force into a single line of high stress. As bonded structures are subject to a combination of forces, they need to be designed in such a way as to avoid cleavage and peel stresses in order to achieve optimal strength.

[image_1]

The basic types of bonded joints are shown in **figure 2.** In practical application, a combination of two or more basic types may be used (the relative dimensions and areas of bonded joint surfaces may vary from those shown in the diagrams). Tapering of the ends of lap joints or scarf joints serves to distribute stress more uniformly and reduce stress concentration.

Huntsman’s new adhesive guides on Adhesives technology and Surface preparation and pretreatments are available for free download at **www.huntsman.com/advanced_materials** or via Slideshare at the following address: **www.slideshare.net/HuntsmanAdMatEU/adhesives-technology-user-guide**

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