Borders Model Boat Club

www.bordersmodelboatclub.yolasite.com.

About Adhesives

How Adhesives Work

There are two types used by modellers, Bonding types, where a layer of "sticky stuff" is applied between the surfaces, eg PVA adhesives, and welding types, eg "Plasweld", where a layer of solvent is applied, causing the surfaces to dissolve and merge. The latter type is used in plastic kits or "Plasticard" construction.

The strength bonding types of adhesive is determined by two factors:

a) the strength of the adhesive itself.

b) the adhesion between the adhesive and each of the surfaces being bonded.

This can be of two types, "mechanical bonding", where the strength is obtained by mechanical interlocking or "keying" between the surface and the glue, or "specific adhesion" where the strength relies on molecular attraction. It is this which enables perfectly smooth non-porous surfaces to be bonded.

Mechanical Bonding

At first sight, to get a strong joint it would appear that rough surfaces are best, but this is not always the case. The surface porosity must be taken into consideration. Surface preparation is very important.

Timber

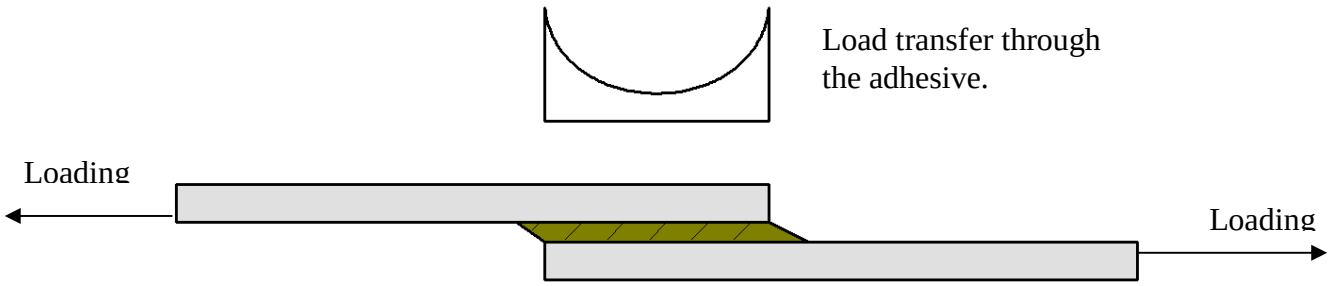
Timber has "grain". It is made up from a lot of cellulose tubes, which have outer shiny, slippery surfaces. To get a good bond, the adhesive must penetrate the tubes in order to get sufficient keying. Timber surfaces must be sanded before gluing in order to make sure that broken and flattened ends of the tubes are removed so that the adhesive can penetrate. This is particularly important when gluing plywood as the manufacturing process bonds the layers together using heat and pressure, which causes the tubes on the surface to be crushed.

Metals

Except for sintered components, metals have a non porous surface, and specific adhesion is the main bonding process. To maximise this, the surfaces must be chemically clean and free of corrosion. In best practice, a cleaning process, degreasing, etching with phosphoric acid, followed by neutralising the surface with a mild alkaline solution might be used. Some mechanical adhesion can be obtained by polishing with fine wet and dry paper, used wet. It is better to have a lot of microscopic scratches than a few deep scores. In any case, it is important to give the parts a thorough cleaning, ending with degreasing with acetone, followed by an alkaline wipe (very dilute ammonia, unless copper alloys are involved). (Some adhesives will not set correctly in an acid environment. This is why "Super Glue" sometimes fails to set)

Load transfer in a Joint

Something which is often overlooked is the manner in which the load is transferred across the joint, which engineers refer to as diffusion.



Owing to something engineers call “compatibility”, most of the load is transferred at the ends of the joint. This is why joints sometimes peel back. So particular care must be taken at the edges to make sure there are no cracks or voids in the bonding. In extreme cases, where high strength is essential, it helps if the ends can be tapered off.

Types of Adhesive

PVA (Polyvinyl Acetate)

PVA glues are suitable for making timber joints, but under sustained heavy loading, joints can exhibit some creep. It is only toxic if you eat it.

“White Glue”, (or “Carpenters Glue”) has significant flexibility, and while this can reduce the joint stiffness slightly, it reduces the diffusion effects. It also has a certain amount of filling capability, handling small irregularities in the surfaces being bonded. The recent forms of this adhesive claim to be water resistant when fully cured. The adhesive is oil resistant, but is damaged by temperatures above 70°C or below freezing. (White glue must be stored in temperatures above freezing, so should not be stored in a garden shed.) The drawback to this type of adhesive is that when cured, it forms a surface to which other adhesives cannot bond, so repairs can be difficult.

When making a glued joint with PVA adhesives, the parts are best clamped together under moderate, but not excessive pressure while the glue sets. PVA adhesives are water based, so surplus adhesive can be removed with a damp cloth, and any that gets on your hands can be washed off.

The cured adhesive can be softened by applying heat, enabling some adjustments after a glued joint has set

The different brands have slightly different properties. Some brands can be sanded, others (eg Evostick W) are more rubbery, and tear rather than sand to a smooth surface.

When making a joint, it should be placed under pressure until dry, with the surplus glue being removed with a moist cloth before it sets.

Polyurethane

Polyurethane adhesives are sometimes confused with PVA adhesives, but there are importand differences. It is recommended that you should wear gloves while using them as it is difficult to get it off your hands. (It can be removed with brush cleaner or white spirit, but if done often can cause dermatitus.)

The adhesive cures in the presence of water, so surfaces to be bonded should be moist (not wet). Wipe the surfaces with a damp cloth before applying the adhesive.

Any surplus can be wiped off with a rag moistened with white spirit.

Once cured , joints made with Polyurethane adhesives will be waterproof.

Because setting is triggered by moisture, the shelf life of an opened bottle of bottle of polyurethane glue may only be about a year.

While there appears to be little to choose strengthwise between lap joints made with PVA and Polyurethane adhesives, it is said that Polyurethane adhesives are better for making end grain joints. This is because the Polyurethane adhesive expands as it sets, enabling it to grip onto porous wood end grain, whereas PVA adhesives shrink.

Epoxy

Epoxy adhesives are suitable for bonding timber, metals and fabrics. Users should be aware that the chemicals used in these adhesives are toxic, particularly in the hardeners, and so the makers instructions and Health and Safety advice should be followed.

There is a vast range of different varieties of epoxy, with different elastic, viscoelastic and temperature range properties. They have high filling capability, but in general, they are less suited to making timber to timber joints as they tend to have less flexibility. The joints formed are waterproof, and most will withstand temperatures up to 80°C. They tend to become rubbery above 90°C unless they are "filled" with fibres or metal dust. They are two-part products, where the "resin" and "hardener" must be mixed in the proportions quoted by the manufacturer. (This is often 1:1, but is not always so)

The types of epoxy adhesive which modellers will encounter fall into two types, hot or cold cure.

The difference is that the cold cure types never completely set, and exhibit significant viscoelastic or creep properties, that is to say the joints move if left under load. However they make perfectly satisfactory low loading joints. They have the advantage that the joint can be undone by heating, or by using solvents.

The hot cure types need a curing temperature of about 90°C to achieve maximum strength. When correctly cured, they become clear, glasslike and rigid, and make joints capable of withstanding higher loadings.

If required, the adhesive can be thinned with cellulose thinners to get a thinner glue line.

When making a joint, it should be placed under light pressure until dry, with the surplus glue being removed with a cloth moistened with acetone or cellulose thinners before it sets. Over clamping can reduce the efficiency of the bond.

Note that Epoxy adhesives can trigger long-term sensitivity (allergies) from overexposure.

Cyano-Acrilate

(Super Glues)This type of adhesive appeared in the mid 1950's, and has since developed into many different types. The joints made are rigid and brittle, are not waterproof, and sometimes deteriorate with age (This is not always the case).

The adhesive is supplied as a clear liquid (of various viscosities). It sets very rapidly in an alkaline environment when heat and pressure are applied. Activators, or "Kickers" are available to ensure the adhesive sets. Some users advise putting the adhesive on one surface, a very thin (Apply then mop with a tissue) layer of "kicker" on the other, before bring the parts together. This makes an instant joint, often with a puff of smoke. Alternatively, "kicker" is supplied in an aerosol can, so that the joint can be sprayed after assembly.

Some chemicals used in timber seasoning, or as preservatives can slow down or stop the curing process. In such cases, the activator is essential.

Cyano-Acrilate adhesives have a limited shelf life, which can be lengthened by refrigerated storage.

Special Cyano-Acrilate "De-Bonders" or "Glue Removers" are available to undo joints.

The adhesive is sold in various states of viscosity:

Low -	will penetrate cracks by capillary attraction
medium	general purpose joints
High	(Gel) used for vertical surfaces, or overhead. Tends to cure more slowly, and has some gap filling capability. Tends to form stronger joints than the thinner varieties.

Rubber Based Adhesives

There are two forms of rubber based adhesives that are used by modellers, solvent based, and water based.

The solvent based types are solutions of raw rubber in an organic solvent. They may be modified by adding resins to increase the strength of the joint, and add some filling capacity.

The water based types are based on natural or synthetic latex, with minute particles suspended in water, forming a creamy consistency. This type of adhesive is often used to attach Obeche veneer to expanded polystyrene cores, for example in making wings for model aircraft.

Both types are commonly supplied as "contact adhesives", where the two surfaces are each coated with the solution, and then brought together to form an instant bond. The joint has a considerable immediate strength, which will increase further as the solvents dry out.

These types will stick almost anything, provided that the solvent does not attack the materials in question, but can exhibit significant creep when subjected to prolonged loading.