DRIVE Marine Services

Fibreglass Reinforced Plastics (FRP) Explained

When we use the term fibreglass we mean plastic reinforced with fibres of glass commonly known as Glass Reinforced Plastic (GRP) or FRP. The fibres come in many different constructions (e.g. chopped strand, woven, knitted etc) and weights (amount of glass per square metre). The plastic can be many types but there are 3 types which are most commonly used when fibreglassing, being Epoxy, Vinylester & Polyester.

Most things which we describe as fiberglass use a polyester resin as the plastic system. Nearly all fiberglass boats are made from polyester based fiberglass, unless it is high performance when Epoxy is used and usually with carbon-fibre to reduce weight. Polyester is used as it is:

- Cheap and readily available,
- withstands ultraviolet light well and weathers slowly, but over a number of years, the surface does degrade and become chalky,
- Most people know how to use it, although two to one mix Epoxies, such as Bote Cote, are easier to mix and use.

Polyester Resin has a number of disadvantages:

- The most significant in the marine application is osmosis, which nearly every permanently immersed boat, manufactured using polyester, will eventually suffer from. These are blisters which form due to small defects within the fiberglass and the relative ease with which water can diffuse through polyester resin. Refer to the Osmosis brochure.
- It is a poor adhesive which makes it a poor choice for repairs as the repair stands a strong chance of delaminating or in layman's terms, coming off.
- It is also heavy as quite a thick lay-up must be used to achieve the desired strength and is best suited to building things that are not weight sensitive.
- Polyester resin is only compatible with fibreglass fibres. It will not adhere to Carbon or Kevlar fibres.
- Polyesters historically exhibit poor performance in the areas of adhesion and elongation, rendering the finished part prone to micro cracking and secondary bond failures.

Increasingly we are seeing Vinylester resin used. There are some boat parts and even the occasional whole boat made out of Vinylester reinforced resin. Many yards use vinyl ester for repair work on polyester boats. Vinylester is actually based on an epoxy with polyester molecules incorporated into it to enable it to react just like conventional polyester. Unfortunately these polyester molecules bring with them polyesters problems as well. The advantages of Vinylester are:

- It is a distinct improvement over polyester but it is considerably more expensive.
- It shares with polyester the advantage of being reasonably resistant to UV light and it is fairly weather resistant.
- It is better at preventing moisture diffusing through it than polyester, but no where as good as un-modified epoxy.
- It is a better adhesive than polyester, but again it is no where near as good as un-modified epoxy.
- It is probably the best room temperature curing resin to use in high temperature applications.

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There are distinct disadvantages to using Vinylester as well:

- Both polyester and Vinylester are highly flammable. Being "Dangerous Goods" therefore storage and transport present significant problems and may invalidate the users insurance.
- Significant amounts of Volatile Organic Compounds (VOC) are emitted whilst it is being used and breathing protection may be necessary. This is due to the use of liquid styrene to thin it out (not good to breath).
- Sometimes it won't cure if the atmospheric conditions are not right due to its sensitivity to atmospheric moisture and temperature.
- It also has difficulty in bonding dissimilar and already-cured materials.
- It is not unusual for repair patches on Vinylester resin fibreglass to delaminate or peel off and many Vinylester hulls suffer delamination of the hull skins from core and bulkhead substrates.
- As Vinylester resin ages, it becomes a different resin (due to it's continual curing as it ages) so new Vinylester resin sometimes resists bonding to older Vinylester, or will bond and then later peel off.
- Vinylester resins bond very well to fibreglass, but offer a poor bond to Kevlar and carbon fibre due to the nature of those two more exotic fibres.
- Due to the touchy nature of Vinylester resin, careful surface preparation is necessary if reasonable adhesion is desired for any repair work.
- Vinylester is fairly brittle compared to Epoxy and is prone to cracking where high point loads maybe applied or when used in areas where flexing occurs.

Epoxy is known in the marine industry for its incredible toughness and bonding strength. It is the best product to use when fibreglassing for the following reasons:

- It is extremely effective as a moisture barrier therefore reducing the risk of Osmosis.
- It is also a superb adhesive. It sticks to other materials with 2,000-p.s.i. vs. only 500-p.s.i. for Vinylester resins and even less for polyesters.
- In areas that must be able to flex and strain with the fibres without micro-fracturing, epoxy resins offer much greater capability.
- Epoxy resin will bond dissimilar or already cured materials which makes repairs that are very reliable and strong.
- Epoxy offers excellent results in repair-ability when it is used to bond two different materials together.
- Epoxy is considerably stronger

The above factors make epoxy the resin of choice for repairs and for over coating a boats hull to help resist osmosis. Epoxy does degrade in strong ultraviolet light and it in turn must be protected with a UV resisting paint (most pigmented paints and of course Aquacote). Epoxy cannot be used with chopped strand mat due to the binder used to hold the mat together not being compatible with epoxy. Woven or knitted cloth must be used in repairs which provide a stronger structure than chopped strand.

Fairing powders (Bote Cote Sanding Filler) and epoxy are available to make a bog which can be sanded to fair the repair to a smooth surface. There are also filler powders available which can be mixed to make a structural adhesive and structural filler for "filleting" applications.

Epoxy carries a small risk of allergic sensitization (2:1 ratios such as Bote Cote are much safer than 4 & 5:1 ratios), which provided adequate hygiene and good air circulation is employed does not present hazard to most people. It is not a dangerous good and has no particular transport or storage risks.

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