

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 fibreglass use a polyester resin as the plastic system. Nearly all fibreglass boats are made from polyester based fibreglass, 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 fibreglass and the relative ease with which water can diffuse through polyester resin. Refer to our Osmosis Information Sheet.
- It is a poor adhesive which makes it an unwise 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.
- It is Dangerous Goods and can be quite volatile for those not careful in mixing and using immediately.

Increasingly Vinylester resin is being used. There are some boat parts and even the occasional whole boat made out of Vinylester reinforced resin. Many yards use vinylester 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 nowhere near 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.

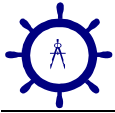
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Bote Cote Epoxies, Fillers, **Pour-on-Gloss** Decoupage Coating, **COP-R-BOTE** Epoxy Antifouling, **AQUACOTE** Polyurethane Coatings, **PURBOND** Waterproof Single Pack Glue, **TREDGRIP** Rubberised non-slip Paint, Glass & Carbon **Reinforcing Fabrics**, **FERONITE** Rust converter and Primer, Marine, Proof & Aircraft **Plywoods**, **NIDAPLAST** Composites, **S/S & Bronze** Fasteners
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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 must be used. This is due to the use of liquid styrene to thin it out (not good to breathe).
- 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, Bote Cote Marine Epoxy resin offers much greater capability.
- Epoxy resin will bond dissimilar or already cured materials thereby making 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 than Polyester or Vinylester and this reduces the cost and weight of repair when compared to polyester / vinylester as less product is required to beef up the area.

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 as the binder used to hold the mat together is compatible with epoxy. Woven or knitted cloth must be used in repairs which provide a stronger structure than chopped strand mat.

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.

All 4 & 5 to 1 ratio epoxies carry a risk of allergic sensitization due to the use of TETA in the hardener. The 2:1 ratio Bote Cote is a modern formulation where the hardener is partially catalyzed eliminating many of the risks associated with using Epoxy resins (refer to the “Why Bote Cote Information Sheet at www.BoatCraftNSW.com.au for additional advantages the Bote Cote has over other Epoxies in the marketplace). It is not a dangerous good and has no particular transport or storage risks.

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