c/o Endurance Technologies
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About Epoxies, Vinylesters, & Polyesters

THE RESIN FAMILIES:

Epoxies
Vinylesters
Polyesters

Epoxies, polyesters and vinylesters represent two resin families. Epoxies belong to a family of resins which are epoxy functional, which means they can be cured with amine curing agents at room temperatures to form excellent adhesives and composite resins. Polyesters and vinylesters belong to another family of resins containing an unsaturated polyester or hybridized vinylester backbone which is catalyzed with a peroxide (normally Conap and MEKP) to condense into a cross-linked solid resin.

RESINS AND ADHESIVES

Resins (liquid plastics, i.e. epoxies, polyesters and vinylesters) are commonly used in many applications when wetting out fiber reinforcing in order to saturate the fibers and form an FRP (fiber reinforced plastic) part. Whether the part utilizes fiberglass fibers, carbon fiber, Kevlar aramid, or wood fibers adhesions to and wetting of the fibers is a critical step in the production of a quality part.

EPOXIES

Epoxies represent some of the most versatile resins available to the composite manufacturer. Generally, in all categories of work, the builder/repairer will realize the greatest degree of bond strength, waterproofing and toughness with well formulated epoxies. New generation MAS Epoxies have curing systems which are phenol free (representing a safe step forward for all resin users). Atmospheric moisture is of little concern, as blush-free MAS systems allow builders and repairers to laminate and bond with little or no surface preparation between applications as long as mix ratios are followed and mixing is adequate. Shrinkage of MAS epoxies is below .03% eliminating prerelease. In the case where a part, originally manufactured utilizing polyester or vinylester, has yielded to strain and cracked, a well-reinforced epoxy repair will tenaciously hold to the substrate with 2000 psi strrength (vinylester: 500 psi). Many high strain repair areas and lightweight parts must flex and strain without micro fracturing. MAS resins have the ability to flex with the fibers while maintaining permanence and adhesion. Whether a part or repair is made of wood, carbon, Kevlar, fiberglass, core material or hybrids of the above, MAS Epoxies will wet and permanently stick to the composite. Just a quick note: one composite manufacturer recently eliminated a peroxide cured and extremely pricey custom-formulated aerospace adhesive (fancy packaging and all) with a standard MAS product. The benefits included reduced price, increased strength, and elimination of shrink problems from the bond line. When MAS Epoxies are used for a chemical resistant barrier (barrier coating) the finished coating system has excellent resistance to water uptake (below .5%) and the user can be confident that subsequent finishes will stick to the new epoxy and the epoxy will stick to the surface. New generation MAS epoxies feature many of the advantages of low viscosity and accurately tailored gel and cure times. Permanent repairs and the highest quality custom aerospace construction have been enjoying the advantages of epoxies since the sixties. MAS brings these advantages to the builder and repairer at room temperatures, and we're gearing up for more surprises in the 21st century.

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VINYLESTER

Vinylesters represent a resin development step in the right direction. While still utilizing a polyester resin type of cross-linking (i.e. peroxide cured). These hybrid resins are toughened with epoxy molecules within the backbone. Shrinkage is less of a concern with vinylesters and prerelease of the part from the mold is reduced. The toughening effect of the resin modifications makes for a better resistance to micro fracturing and some of the secondary functionality of the backbone assists in adhesion to substrates. Vinylesters are capable of forming secondary bonds around 500 PSI (MAS Epoxies 2000 PSI). Resistance of vinylester resin to moisture is good and some commercial barrier coatings have been marketed utilizing this resin family. The down side of the vinylesters include sensitivity to mixing, handling, high VOC's (in the form of styrene), atmospheric moisture and temperature sensitivity (sometimes it just will not cure). Good tough vinylester is also quite pricey when compared to polyesters, in fact the dollars per pound approach that of epoxies. Vinylesters definitely represent an improvement over polyesters when considering standard peroxide curing, however adhesion to dissimilar and already cured substrates is still far below perfect and many vinylester hulls suffer similar massive delamination of the hull skins from core and bulkhead substrates. Additionally since almost all barrier-coating applications are after market it is essential that the coating system have maximal bonding strength to the original substrate. Vinylester resins only show good fiber adhesion to standard glass fiber, standard low adhesions to more exotic fibers (Kevlar/carbon fiber) and wood.

Open surface curing of both vinylesters and polyesters requires a surfacing agent. Subsequent applications require careful surface preparation if reasonable adhesion is to be achieved.

POLYESTER

Polyesters are one of the least expensive resins available to the FRP boat builder utilizing female tooling in the form of a mold. Polyester has the advantage of being extremely inexpensive when compared with other thermoset resins i.e. vinylesters and epoxies. If the upside is cheap pricing, the down side includes poor adhesions, high water absorption, high shrinkage, and high VOC's. Polyester resins are only compatible with fiberglass fibers. Polyester is best suited for applications insensitive to weight and do not require high adhesion or fracture toughness. For instance if a simple inexpensive solid fiberglass part must be fabricated in open tooling in one operation and requires no secondary bonding. If shape accuracy is not critical, resistance to water is of no concern, and ventilation of the workspace is excellent, then polyester's a great candidate. Polyesters historically exhibit poor performance in the areas of adhesion and elongation, rendering the finished part prone to micro cracking and secondary bond failures. These parameters become more important when we consider adhering dissimilar materials within the same part or welding any materials that are not the usual fiberglass strand substrate. Finished polyester hulls are still suffering from osmotic blistering when untreated by an epoxy barrier coating against water. Boat yards are filled with hull and superstructures suffering from massive areas of core disbonding or delamination resulting from an adhesive mismatch with the industry at large (i.e. depending on polyester as an adhesive).