Guest Speaker

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Fiberglass for beginner's

WHAT IS IT?

- Fibre Reinforced Plastic or Fiberglass (F/G) is a “composite” material, normally made from two parts (a resin system and a matting system). There are two basic resin systems:
  - Vinyl-ester
  - Poly-ester
- Poly is normally a bit cheaper, vinyl is a bit more “structural”.
- IT IS VERY IMPORTANT WHEN WORKING WITH POLYMERS/FIBERGLASS THAT SAFETY IS CONSIDERED:
- Gloves / breathing mask is a “minimum”

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WHY DO WE USE IT?

- Typically, a F/G panel is approx. 1/3 the weight of a steel panel.
- Costs – F/G is inexpensive relative to steel panels (particularly if wheel arches have to be “formed”)
- Ease of replacement – all race cars get bumps / crashes – F/G can be easier to replace than a steel panel.
- Change of Shape – it is difficult to make a front or rear spoiler from steel or aluminium – F/G fits the bill perfectly for these applications.
- Ease of maintenance – if the mould is very good, the surface finish on the “product” can be of high quality – this makes preparation for paint easier. F/G also doesn’t rust like a steel panel – however, one should be aware of the slow degradation that occurs to composites from exposure to sun light.
- Ease of fitment – bonnets / bootlids need to be easily removable for routine servicing – pins / dzus clips make removal quick and easy compared to steel panels.

RESIN SYSTEMS

Resins are used to bind a structural filler material, and have different properties. Polyester's are formed by the reaction between polyols (glycol or ethylene glycol) with dibasic acids (opthalic acid or maleic acid).

- These are mixed with hardeners or, catalysts, which changes the molecular structure, thus as the compound cures it generates heat in the process. Methyl ethyl ketone peroxide (MKEP) is a 'hardening' agent.
- THIS STUFF IS DANGEROUS – USE CAUTION AND PPE.
- Vinyl ester resins are produced by the reaction ('esterification') between an epoxy resin and an unsaturated monocarboxylic acid. Essentially they comprise a base of polyester resin strengthened with epoxy molecules in the backbone of the molecular chain. Vinyl esters also use peroxides (e.g. MEKP) for hardening.
- Both resins are susceptible to 'chalking' - UV breakdown at the surface - unless an additive is incorporated in the mix.
- Hardener ratio – Typically this is 1 – 1.5% by weight, so 500Ml of resin requires 5-7 cc's of MKEP. More catalyst speeds up the cure time, at the expense of additional heat. Slow and cool is better to reduce distortion.

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POLYESTER

- Cost is relatively cheap.
- Methyl ethyl ketone peroxide ('MEKP') is 'hardening' agent.
- Strength is “modest”, more layers required in high load areas.
- Tolerant of less than ideal mixing ratios.
- Tend to get some shrinkage of product (4-6% is typical).
- Adheres reasonably well to itself, so repairs are straightforward (grind out, then fill-in).
- Does not “bond” particularly well to other materials.
- Both resins are susceptible to UV damage.

VINYL-ESTER

- About 30-50%+ more expensive.
- Vinyl esters are more tolerant of stretching than polyesters (less shattering from impact), and less likely to show stress cracking.
- Vinyl ester is much more resistant to water penetration - (good for boats!)
- Vinyl esters shrink less on curing (circa 2%).
- Stronger - the cross bonding of vinyl esters is superior to that of polyesters. This means that vinyl esters bond to core materials much more effectively than polyesters and delamination is less of an issue.
- Vinyl esters are less sensitive to ambient conditions (temperature and humidity) than are polyesters.

The Laminate Systems (aka cloth / chopped strand mat)

- The “strength” of any F/G product comes from the Laminate material.
- CSM is the most common (and cheapest) but requires “multiple layers” to achieve acceptable strength. F/G Cloth can be used to “reinforce” edges, and provide additional strength in higher stress areas. Cloth comes in many many different configurations (uni-directional / angled / tapes/ rowving etc) and weights.
- Strength of a part can be changed by using fibre's arranged at angles (uni-directional, bi-directional).
- For Polyester – strength requires greater section, or the use of “stiffening ribs or spars” (balsawood).

http://www.compositesworld.com/articles/getting-to-the-core-of-composite-laminates

- Both types of resin can be used with “core materials” – which MUST be compatible with that resin (polystyrene dissolves in polyester)
- Vinyl esters can be used with more exotic fibres (such as Kevlar, carbon fibre).

STEP 1 – Making a Mould

- To lay-up a product, we need a “shell” or mould which is an exact female replica of the shape we are trying to make.
- Surface finish (polished “hard” paint is best)
- Release agent
- Gel-coat
- Laminate with resin system, a typical small mould will have 5-8 “layers”. A large mould (bonnet) may have 8+ layers, and also “stiffening ridges” to minimise distortion.

Note – frame to support and hold in place, returns require multiple pieces (so you can remove product), stiffening ribs, and a nice thick heavy mould that shouldn't distort with use and time. There would be 100's of hours in this!

Source – Performance forums !

Remember – the mould is the most important part!

WHY?

1. It determines the quality of the product.
2. This means that any “buck” used to make a mould must be in excellent condition.
3. It can be used multiple times.
4. The better the mould, the less time it then takes to prepare a product for use on a car.

MAKING A QUALITY MOULD IS 90% OF THE BATTLE – GET THIS RIGHT AND THE REST IS EASY. TAKE CARE OF YOUR MOULDS (storage / accidental damage / distortion)

Preparing the Mould

1. A polished surface finish is best
2. All surface imperfections should be removed, minor holes can be filled with plasticine.
3. A mould release agent must be used (wax, buffed with a polishing cloth, 2-3 times on a new mould)
4. A Liquid Coverall mould release is then applied over the wax.
5. Use as a thin and even coat as possible (no runs). This is allowed to dry completely.
6. Try to ensure no dust/grit gets onto the mould surface – as any defects in your mould release layer will be the surface finish you will see in the mould and the parts.
7. After you mould the part the mould release must be removed from the mould and the part with water and a paper towel and reapplied before the next moulding operation.
8. Now you are ready to apply a “gel-coat” layer – this is basically a harder form of the resin system. 2 thin coats is normally sufficient.

Laying-Up

1. Work out how much cloth/matt is required, cut to shape if necessary
2. Mix your resin with hardener
3. Apply thin coat to the mould, lay in cloth, then “wet-out” all of that layer.
4. Corners can be tricky – tear the CSM, and use small pieces to go around the curve.
5. Multiple layers can be done in one go – remembering that heat is given off during curing.

Two matching wood “patterns”, painted with two-pack, and then buffed.

Two simple F/G moulds taken from the “bucks” – note the air blow-hole

(and streaks from release agent!)

Two halves joined together, with trim switches and momentary buttons, installed in a race car – Nice Job!

Fiberglassing – is a truly unpleasant job!

- The resin sticks like poo to a blanket, and the fibres are bloody itchy.
- The fumes are not nice ! And can make you light headed.
- Wear protective throw-away gloves and a face mask is highly advisable
- Use newspaper on the floor (and be prepared to “chip away” drops of hard resin upon completion)
- Use cheap paint pots (most have graduations on the side so that % hardener is easy to measure).
- DIY is most likely to be done with a brush, large panels its better to use a roller to “wet-out” the mat.
- Have plenty of acetone to clean-up (brushes can be cleaned ……just)
- The “pro’s” use special spray guns and “chopper guns” which greatly speed up the process.

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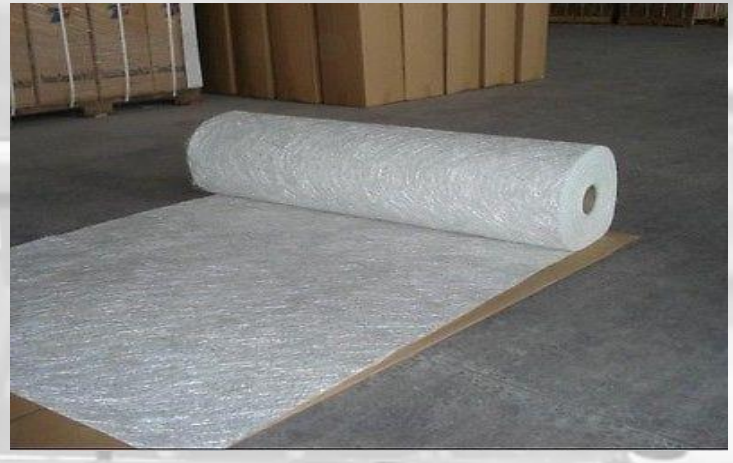

Resin & Topcoat Weight / Litres

1L of Resin = 1.1Kilo

1L of Topcoat = 1.1Kilo

Weight of CSM
(Chopped Strand Mat)

300g mat = 3.3m^2 per kilo

450g mat = 2.2m^2 per kilo

600g mat = 1.6m^2 per kilo

900g mat = 1.1m^2 per kilo

ADVANCED BITS

- Epoxy's – potentially much greater strength, much greater “accuracy required”. Can be made “pretty” with carbon fibre.
- Moulds must be “perfect”, you can cheat via sanding out with 1200-1600 and then clear-coating.
- High strength parts can be made via “vacuum bagging” and post-cure heating.
- Cost – 2-3 times !
- Have plenty of acetone to clean-up!!!!!!!!!!!!!!!!.
- Quite often – it is cost effective to get a specialist to make a mould, and products for you!
- If in doubt – ask a professional.
- 95% of applications do not require - If in doubt – ask a professional.


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Special thank you to
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