Fibreglass Explained

Answers to frequently asked questions *June 04*

ARMATEC

What is Fibreglass?

Fibreglass is a composite material system consisting of fibre reinforcement, plastic resin and additives, combined and processed to meet specific functional performance and manufacturing criteria for a finished product or part. By selecting the right combination of resin and fibres, the designer can create a product or part that meets the most demanding of product specifications.

What is FRP?

FRP is short for Fibre Reinforced Plastic and is the most widely used abbreviation for fibreglass. Sometimes FRP is used to mean Fibre Reinforced Polyester, the most commonly used plastic resin. Sometimes GRP is used and is the abbreviation for Glass Reinforced Plastic, this being the most common reinforcement used. The terms are all interchangeable.

What are the Main Benefits of FRP?

FRP composites should be considered when the finished products require high strength, light weight, dimensional stability, corrosion resistance and design flexibility. One key aspect of FRP is that the reinforcing fibres can be concentrated where the stresses are highest, and in lower stress areas the laminates can be reduced to minimise costs.

What Resins are Used?

The most common resin systems used are polyesters, epoxies and vinyl esters. For industrial applications the main resins that ARMATEC uses are isophthalic (lowest cost), bisphenol (higher temperature), vinyl esters (superior chemical resistance combined with a good degree of flexibility) and epoxies (specific chemical resistance). There are other special resins such as chlorendic, furane and phenolic for special service conditions. The choice of resin system should be done in conjunction with ARMATEC and will be based on service conditions, project requirements and history in previous applications.

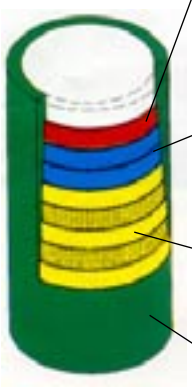
What Reinforcements are Used?

The most common reinforcement used by far is glass with others such as aramids (Kevlar) and carbon only used for specific less common applications. The glass reinforcement is used in the form of chopped strand mat, woven roving (bidirectional and uidirectional), continuous roving, continuous strand mat, and knitted structural fabrics. The choice of reinforcement form is usually left to ARMATEC to achieve the required properties of the FRP laminate. The main reinforcements that ARMATEC uses are chopped strand mat in conjunction with woven roving to achieve a good balance of strength, stiffness, and resistance to chemical penetration. As standard ARMATEC incorporates a surface veil into all FRP laminate surfaces to achieve a reinforced resin rich surface.

Why Use Contact Moulded Products?

Contact moulding, also called hand layup, is the most common method of making a FRP laminate and involves laying down layers of reinforcement, saturating with resin and consolidating with rollers. The process is often done by hand and is often partly mechanised. The process is ideal for low volume work and one off fabrications requiring high strength. Contact moulding produces parts with higher resin to glass ratios around 30% and this gives the parts higher chemical resistance. The figure below shows a pipe made by the contact moulded method.

Cross Section of Pipe



Inner Surface. The interior surface 0.25mm - 0.5mm, is a smooth resin rich laminate reinforced with surface veil. Providing optimum corrosion-resistance and a minimal friction factor when combined with the best resin for the specific chemical conditions.

Next Interior Layer. Pipe in all diameters are built with an additional chemical resistant liner at least 2.5mm in thickness in the form of chopped strand mat which critically limits chemical permeation.

Remaining Thickness. Subsequent reinforcing layers of woven roving and chopped strand mat are used to build the pipe to the desired wall thickness.

Exterior Surface. The final layer provides protection against weathering, fumes, spillage and ultraviolet attack. This gives the pipe a longer life and reduces maintenance expenses.

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What Standards are Applicable?

AS 2634-1983 for "Chemical Plant Equipment Made from Glass-Fibre Reinforced Plastics (GRP) Based on Thermosetting Resins" is the most applicable standard that is easy to use and is relevant for industrial FRP fabarications. This standard contains extensive tables of the minimum required properties for FRP laminates and tables of minimum wall thicknesses for various products such as pipes, tanks, ducts etc. There is good information on quality assurance. This standard has been updated. The earlier version is still widely referenced and used by manufacturers, designers and specifiers alike. There are many additional NZ, Australian, British and USA Standards for specific items such as tanks, underground buried pipes etc for specific applications.

What is the Strength of Fibreglass?

With the huge variety of resins and reinforcements used there is no single answer to this question. However AS2634-1983 specifies that to comply with this standard a typical 6mm FRP laminate made by the contact moulded process must have a minimum tensile strength of 78 MPa, and a minimum flexural strength of 127 MPa. This provides a good base measurement and laminate samples or cut outs can easily be checked by a materials laboratory to ensure they comply.

What Safety Design Factors are Used?

Typical design factors used vary from 3 to 12 depending on the loads and frequency. For example with a continuous load such as in a pipe under pressure the usual design safety factor used is 10. For a once only load such as an earthquake load, the design safety factor may be reduced to 3 depending on the application. Thus it is up to the client, ARMATEC and the permitting body to agree of the design safety factor used.

Why Such a High Design Safety Factor?

FRP is a form of plastic and so is subject to creep when under constant load. Typically the ultimate tensile strength of fibreglass under constant load will reduce by about 50% over the first 2 years and then stabilise. When the ultimate tensile stress is reached, a FRP laminate will fail quickly and dramatically, so it is important to design well away from this point. Further many applications of FRP involve handling hazardous chemicals so it is prudent design to use conservative safety factors.

Protecting FRP from UV Radiation?

Degradation of FRP laminates by UV radiation is usually slow, but can and will ultimately result in the exposure of fibres and weakening of the laminate. It is common practice to use pigmented finishing coats on the exterior surfaces of FRP to provide UV protection just like a very thick sun screen. The pigmentation is generally not used throughout the laminate as it obscures the consolidation process and can lead to laminates with air bubbles, and this weakens the laminate.

How do I get Fire Resistance?

Varying degrees of fire resistance and resistance to flame spread are achieved with special resins and/or with varying degrees of additives such as antimony trioxide. FRP laminates can be made non-burning and self extinguishing. Smoke generation needs to be considered in conjunction with fire resistance. FRP with these specific properties needs specific design and verification.

More Questions?

Please submit your questions to ARMATEC and we will endeavour to answer them for you.

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