FIBRE CRAFT INDUSTRIES

THE FIBRE GLASS PEOPLE

Fiberglass Reinforced Plastic (FRP)

Fiberglass Reinforced Plastic (FRP) lined Equipment are capable to handle most aggressive chemical environments. Resin selection, cure system, surfacing veil materials, and laminate construction details are critical elements that determine service life in corrosive environments. Similarly, all are meaningless without the expertise, consistency, and quality assurance of an experienced and qualified equipment manufacturer. Fibre Craft Industries (FCI) has fabricated chemical resistant equipment in composites for over 20 years. Our expertise and experience with success, in the evolution of material selection and laminate construction criteria makes us a uniquely qualified authority on construction of corrosive chemicals storage equipment that works for a long time! Following are specific criteria that must be rigidly adhered to in order to achieve and assure long-term performance. Refer also to the "Typical Specifications", for general requirements not specifically modified or called out herein.

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SPECIFICATIONS FOR CHEMICAL RESISTANT LINING ON RCC STRUCTURES

1. MATERIALS

1.1 Resin - The resin used shall be a commercial grade, premium, corrosion resistant Epoxy vinyl ester Or equivalent that has been evaluated in a laminate by test in accordance with ASTM C-581 for its chemical resistance behavior comparable to the intended service and recommended for this service by the resin manufacturer.
FCI shall strictly adhere to the resin manufacturer's recommendations, for surface veil materials, resin cure systems, and post cure requirements.

1.1.1. The resin shall contain no pigments, dyes, colorants, or fillers except as follows:

1.1.2. A thixotropic agent that does not interfere with visual inspection of laminate quality may only be added for viscosity control in resins that are not to be used in the interior secondary layers, and exterior top coats.

1.1.3. Resin pastes used to fill crevices may contain thixotropic agents provided that all such areas are subsequently covered with a full corrosion-resistant barrier laminate.

1.2 Reinforcement

1.2.1 Chopped Strand Mat - Chopped strand mat shall be constructed from commercial grade E-type glass strands bonded together using a binder. The strands should be treated with a sizing that is chemically compatible with the resin system used.

Note: Based on FCI's experience with most premium corrosion-resistant resins and their inherent cure characteristics and shop handling qualities, we suggest the following for Corrosion resistant service. Ashland's, or some equivalent supplier- Epoxy Vinyl ester resin (resin is selected on the basis of chemical compatibility of resin, selected as per its' chemical resistance chart by supplier), cured inner corrosion barrier with DBPO/DMA synthetic surface veil PGI (France) or equivalent like Nexus by Burlington Industries USA. The laminate construction section that follows is premised on the resin system suggestions above.

2. SURFACE PREPARATION AND GRP LAMINATION

2.1 Surface Preparation

2.1.1 The concrete surface shall be free of all surface contamination. Oil, grease and other contaminants shall be removed before blast cleaning by a suitable solvent or detergent. Salt

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contamination, chemical cleaning agents and remaining detergents shall be washed of using potable water. The steel surface shall be dried before blast cleaning.

2.1.2 All remaining weld spatter and irregularities shall be removed from the surface by chiseling and/or grinding.

2.1.3 The surface shall be cleaned of mill scale rust and other foreign matter by a blast-cleaning or other abrasive cleaning method to achieve a minimum surface cleanliness of Sa 2 ½ in accordance with ISO 18501-1, or better if required by the coating manufacturer.

2.1.4 Abrasives shall be stored and used dry. Expendable abrasives shall not be recycled.

2.1.5 During blast-cleaning the surface temperature shall be more than 3^{o}C above the dew point. The Structure surface temperature shall always be more than 5^{o}C. The humidity shall not be greater than 85%.

2.1.6. In case of concrete Structure, use good quality de-greasing agent or 10% HCl solution or both, if condition desire. After surface preparation sufficient time is desired to achieve dry surface then some primer or resin coat is applied before FRP lining.

3. LAMINATE CONSTRUCTION REQUIREMENTS

3.1 Surface Preparation

3.1.1 Before coating, the surface shall be cleaned of all dust and foreign matter using clean dry compressed air or vacuum cleaning. The compressed air shall be free of any trace of oil.

3.1.2 If require, suitable bolding primers may be used to protect the blasting surface before coating such primers shall be regarded as part of the coating systems and shall be used during system qualification. A premium grade Epoxy vinyl ester resin is most appropriate primer for all surfaces.

3.1.3 The sequence of use of the batches of coating material shall be in the order in which they were manufactured.

3.1.4 Different brands of coating shall not be mixed.

4. GRP APPLICATION

4.1 Sequence of Glass Fiber Layers with Epoxy Vinyl Ester Resin

4.1.1 Interior Layer. Apply non continuous glass fiber layer on steel protected surface after sand blasting, or cleaned surface in case of concrete substrate. Apply number of layers as per selected lamination design/thickness keeping in view margin to laminate outer corrosion barrier and final veil laminates' thickness. Alternate layers of woven and chopped strand mat are recommended where structural strength is also required.

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4.1.2 Corrosion Barrier - The layer/layers in between the inner layers and outer most surface is known as corrosion barrier (in can be called as the middle layer/layers); it should be composed of resin, reinforced only with non-continuous glass-fiber strands applied to a minimum thickness of 2.5mm. The combined thickness of this middle surface and the outer most layer shall be 3mm to 3.30mm and in no case less than 2.80mm.

4.1.3 The Surface In Contact With Corrosive Media - The surface exposed to the chemical environment(the outer most layer) shall be a resin rich 0.25 to 0.50 mm thick, reinforced with 0.02mm of synthetic fiber surface veil such as PGI (France) or equivalent like Nexus (Burlington Industries) or other approved equal.

4.1.4 Glass content of the inner surface and interior layer combined shall be 27% (minimum) plus or minus 5 % by weight.

4.1.5 Resin used in these layers shall be epoxy vinyl ester incorporating a BPO/DMA cure system as recommended by the manufacturer. Recommendation should be justified with resin Data Sheets of its manufacturer.

4.1.6 The degree of cure, after post cure (see Section 5) shall be such as to exhibit Barcol hardness on the outer surface at least 90% of the resin manufacturer's minimum specified hardness for the cured laminate with a synthetic surface mat.

4.1.7 The GRP laminates must be suitably anchored after building 60% thickness of specified coating by using stainless steel anchors 500 mm apart from centre to centre. This will ensure long life of the coating.

5. POST CURE

5.1 The completed lined Structure shall be post cured in accordance with the resin manufacturer's recommendations. Any internal repairs or rework must be completed prior to post curing. If repairs are made following post cure, an additional post cure cycle/time is required. Post cure could be either at atmospheric conditions or in a dry heat chamber, if so advised by resin manufacturer.

6. BASIC TESTS FOR GRP LINNING

6.1 VISUAL APPEARANCE

The coating shall be free from blisters, visual holiday's scratches or any other irregularities and shall have a uniform color and gloss.

6.2 COATING THICKNESS

The coating thickness shall be measured using a thickness meter based on Eddy Current or electromagnetic techniques in accordance with ISO 2808, Method 6A or 6B. Magnetic thickness gauges shall not be used, either for qualification testing or for quality control purposes. The thickness gauge shall be calibrated at least once. The special ultrasonic Thickness measurement equipment is also used for this test.

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6.3 HARDNESS

The degree of cure, after post cure (see Section 4) shall be such as to exhibit Barcol hardness on the inner surface of at least 90% of the resin manufacturer's minimum specified hardness for the cured laminate with a synthetic surface mat.

7.0 TIPS FOR LONGER SERVICE LIFE

- Maintain storage/service temperature below the decomposition point for the solution being stored.
- If corrosive attack of the stored/process chemicals is suspected:
- Inspect the interior through the man-way, (or by getting inside - when it's safe) for evidence of attack, such as loss of gloss, discoloration, mud cracking, or build-up of chemical residue.
- Consult the manufacturer or the resin supplier.

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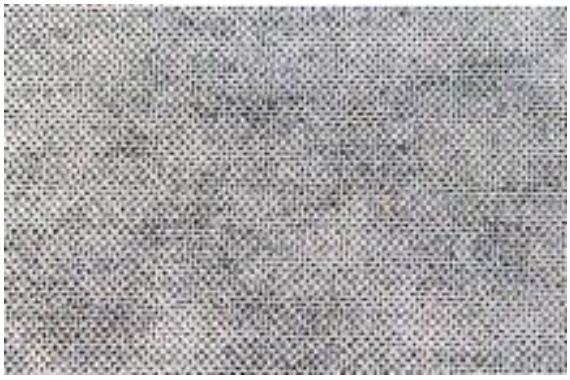
DIFFERENT FORMS OF REINFORCEMENTS USED BY FIBERTECH COMPOSITES FOR CHEMICAL RESISTANT LINING

The surface exposed to the chemical environment shall be a resin-rich layer 0.010inch (0.25mm) to 0.020 inches (0.50mm) thick, reinforced with a suitable chemical-resistant glass fiber surface (C-GLASS) or with a (SYNTHETIC) Organic fiber surface veil.



SYTHETIC VEIL (NEXUS)

C-GLASS VEIL

The interior layer shall be followed with a layer composed of resin, reinforced only with noncontiguous glass-fiber strands (CHOPPED STRAND) applied in a minimum total of 900gm/m^2. The combined thickness of the inner surface and interior layer shall not be less than 100 mils.

WOVEN ROVING

CHOPPED STRAND MAT

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