Industrial Fiberglass Specialties, Inc.
521 Kiser Street
Dayton, OH 45404-1641
Tel: 937-222-9000
Fax: 937-222-9020

UV Resistance of FRP Composite Architectural Products

The powerful rays of the sun can help the human body create Vitamin D. At the same time though, these sun rays can cause fading, surface chalking, and color changes in paints, coatings, and thermoplastic and thermoset polymers.

For many applications of the FRP composites (such as corrosion resistant piping, duct, tanks, etc.), the sun (UV) attack on their outer surface is not significant. Prior testing work by Dow Chemical found that UV degradation of FRP composites is only several mils deep, and does not affect the structural or corrosion resistance of the laminate. (See our Technical Bulletin: *How Important is UV Resistance for Thermoset FRP Composites*.)

However, for many consumer, marine, and architectural products, the surface appearance is of importance and consideration by the architect or designer. For example: An owner wants to make sure their sidings, wall panels, porch columns, architectural light posts, or other architectural products stay colorfast and non chalking.

The purpose of this technical bulletin is to discuss how the architect or designer can insure that the FRP composite products they a buy for architectural applications stay smooth, nice and shiny, and blemish free for years to come.

Base Resin: The selection of the base thermoset resin used for making the FRP composite is the single most important design consideration. This is particularly true for products pigmented white. All of the styrene based thermoset resins, such as polyester and epoxy vinylesters, will have their exposed outer surfaces degrade over time when exposed to the UV rays of sunlight. Whites will tend to turn yellow, and blacks and other colors will tend to lose their original sheen. This is more likely to occur in those polyester resins that include on poly-glycol, or similar glycols, as part of their polymer structure.

Polyester resins based on neopentyl-glycol (NPG) have proven in sunlight exposures to have superior UV resistance, and stay white much longer, than other types of thermoset resins. It is for this reason the NPG based resin is used extensively for all classes of boats, including yachts. The urethanes, acrylics, and urethane hybrids have also shown to have improved UV resistance. (This is one of the reasons that acrylic based paints are so popular for exterior house paints.)

The first step in gaining the best UV resistance for FRP architectural composites is to then specify and have the fabricator use, the proper base resin, such as an NPG thermoset polyester. As discussed above, NPG resins' UV resistance in gel coats and marine applications have demonstrated that they should also be the resins of first choice for architectural applications and products. The NPG resin can be used as either a top gel coat, or used throughout the architectural or structural panel.

Pigmentation: The proper selection and use of the correct percent of pigmentation will also provide enhanced UV resistance. There are pigments - and then there are pigments. Long term UV exposure has shown that the pigments of some manufacturers are superior to those of others. Even for the same manufacturer, they often offer superior pigments (at a higher price) that provide superior UV stability. In all of our products, including architectural products, we use only the highest grade, and most UV stable and resistant pigments.

UV testing has also demonstrated that there is an optimum pigment level for each resin system and color. The optimum level of pigment is higher than just the level required to achieve the initial color. Again, we utilize those higher (optimum) levels of pigment, to provide our customers maximum UV resistance for architectural products.

UV Stabilizers: There are chemicals, known as UV stabilizers, that can be added to both thermoplastic and thermoset resin systems that will improve the UV resistance, appearance, and life of the exposed polymer surface. An entire industry has developed around the manufacturing of proprietary UV stabilizers and the hindered amines. As with pigments, there are UV stabilizers and UV stabilizers. In UV exposure testing, significant differences in performance have been found between the different UV stabilizers.

The UV stabilizer that we have selected to use in our architectural products has proven, in long term UV exposure testing, to have the best performance.

Veil Reinforcements: The use of a synthetic veil, such as the polyesters or nylon, at the exterior surface can reduce the impact of UV degradation. This is particularly true of white pigmented architectural products. The properly specified and selected veil reinforcement can help block the sun's rays from attacking the styrene based resin systems.

As with UV stabilizers and pigments, UV exposure testing has shown there that there is a measurable and significant difference in the enhancement of UV resistance between the different types of surfacing veils.

The proprietary surfacing veil we use in our architectural products has demonstrated to out perform the other alternatives.

Fillers: The use of selected fillers, such as talc and calcium carbonate, have proven to also enhance the UV resistance. (The fillers block the rays of the sun.) However, these fillers, when used at higher levels, can also significantly degrade the physical properties of the FRP composite laminate. Thus, we use them carefully, and only typically for surface gel coats.

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UV "Tougheners": There are reactive thermoplastic enhancers that can be added to the thermoset resins that will provide significant improvements in resistance to color retention, fading, and surface degradation. These materials have to be carefully selected and used at precise ratios to obtain the UV toughening; and still not degrade the physical performance of the composites.

The thermoplastic additive, and the percentage, we use for our architectural products has been again selected on the basis of exposure UV testing. These test results also have been backed by years of field exposure experience.

Coatings: The simplest, but the most expensive, way of achieving enhanced UV resistance for architectural products made with styrene based resins; is to apply a coating to the exposed surface. Polymer coatings - such as the urethanes, polyureas, and acrylics have, when properly formulated and applied, have good to excellent UV resistance. These coatings can be applied either prior to installation of the architectural products, or post installation. And, as with all coatings, at some point in the future, follow-up re-applied coatings in the field may be appropriate.

As with any material where a coating is applied, proper preparation of the surface product prior to the application of the coating is necessary. FRP composite surfaces to be coated need to be free of any residual mold release, abraded or roughened to insure bonding, and clean without dust, moisture, and other contamination.

Pultruded and compression (gunk) molded FRP composite products that are made with internal mold releases present challenges for application of post fabrication coatings. Special consideration needs to be given to the type of internal mold release used. With these products a primer may be needed. Some internal mold releases, such as zinc sterate, will even after abrading, continue to work their way to that interface, causing loss of bond between the substrate and the top coating or even structural adhesives.

If you are going to be applying polymer coatings to FRP composites that have been molded with internal mold releases, please make sure you work with the fabricator to determine what types of releases were used; and what special procedures and steps need to be taken to insure long term bond (adhesion) of any top coatings applied.

Summary: To obtain the longest UV resistance and color retention for architectural FRP composite profiles, including pultrusions, select a fabricator that has the knowledge and experience to provide you the optimum resin system.