In Memoriam

Composites Pioneer Dr. Frank A. Cassis

The Certified Composites Technician-Corrosion Study Guide is dedicated to composites pioneer Dr. Frank A. Cassis.

Dr. Cassis began working in the composites industry in 1955, as a member of the Amoco team that helped develop the resin chemistry for the Chevrolet Corvette. It was in the corrosion market that he most deeply made his mark, establishing isophthalic polyesters as the workhorse material system in the corrosion-resistant equipment sector. He is hailed as the founding father of underground gasoline storage tanks.

Dr. Cassis was a very active member of the American Composites Manufacturers Association and was a central figure in the Composites Institute for many years. He was instrumental in starting ACMA’s Conference on Construction, Corrosion and Infrastructure.

In 2003, ACMA recognized his many contributions to the industry by unveiling a new award: the Dr. Frank A. Cassis Award for Exceptional Achievement in the Corrosion and Composites Industry; he was the first recipient of the award.

In 2005 Dr. Frank A. Cassis was awarded ACMA’s Lifetime Achievement Award. He was one of only nine composites industry pioneers ever to receive the award. He is profoundly missed.
The CCT-Corrosion Study Guide would not have been possible without the generous assistance of many industry members who volunteered their time and shared their expertise, especially those on ACMA's Corrosion Committee. We are grateful for your efforts and willingness to serve the industry.
When you apply to become a Certified Composites Technician-Corrosion, you take the first step towards achieving excellence in the composites industry, advancing your career, and pursuing comprehensive corrosion composites knowledge.

The CCT program is designed to elevate standards in the industry by enhancing individual performance and recognizing those who demonstrate critical knowledge of the composites industry. The CCT-Corrosion designation is a noted symbol of education among employers, employees, and industry professionals. As the industry advances, being a CCT will become increasingly important.

If you have worked in the composites industry for at least one year and are committed to developing your career, attaining the CCT-Corrosion designation will allow others to recognize you as a certified composites corrosion industry professional.
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Section 1
Differences Between Structural Layers and Corrosion Barriers (a.k.a. Liners)

General Differences
There are different performance expectations from a corrosion barrier and a structural laminate layer. As the name implies, the corrosion barrier is a protection and containment layer against the chemical environment it is in. It is very important that the correct resin is used to make the corrosion barrier. The resin-to-glass ratio of the corrosion barrier is significantly different than that of the structural laminate layer.

The structural laminate layer is for structural formation. This structural layer is not a uniform thickness but is fabricated to meet the needs of the service it is intended for. The corrosion barrier and the structural layer should be composed of the same resin system unless there are very special requirements stated for specific applications.

Why and How a Corrosion Barrier Works
The corrosion barrier is the first line of defense in the containment of a chemical environment. This barrier layer has to be as corrosion-resistant as possible. The chemical resistance of this layer comes from the resin used. That is why it is very important to use the correct resin for the application. It the wrong resin is used, it could potentially cause the equipment to catastrophically fail.

There are two parts to a corrosion barrier. The first is the veil layer. It is normally 10 to 20 mils (0.254 to 0.508 mm) thick. There are several types of veil that are used depending on the chemical environment the equipment will be exposed to and the temperature of the exposure. The resin-to-fiber ratio in the veil layer should be a minimum of 90%, which is far too “rich” to add much to the structural integrity of the total laminate. The veil is used to help prevent cracking in the resin rich layer of the corrosion barrier. The types of veil normally used are C-glass veil, synthetic polyester veil and carbon veil. These were described in Module 3.

The second part of the corrosion barrier is a layer with chopped glass fibers. The
resin-to-fiber ratio in this layer is 25% to 30%. This provides additional corrosion protection from the chemical environment reaching the structural portion of the equipment. This portion of the corrosion barrier is normally 0.1 to 0.2 inches (100 to 200 mils) thick (2.54 to 5.08 mm). This layer can be applied using hand lay-up or spray-up. These processes will be described later in this module.

The quality of the corrosion barrier will have a direct influence on how well the equipment will perform in the application. There are industry standards that state how many air voids or visual defects are allowed in laminates used in corrosion applications.

Section 2
Processing a Synthetic Veil Using Open Molding

Eliminating Air Bubbles and Pockets
The best way to minimize air bubbles when working with synthetic veils is to expel the air ahead of the resin by bringing the excess amount of resin from the mold side out through the synthetic veil. On rotating mandrels of all sizes, take advantage of the high strength of the veil by winding the veil on the underside of the mandrel, under even tension, while keeping a bead of resin between the mandrel and the veil. On larger mandrels, over-the-top winding can be done with the resin being sprayed on the mandrel just ahead of the veil contact line. In either case, with proper tension, only very light rolling is required.

Pre-wet stationary molds with a small amount of resin by spray or brush before the veil is applied. Lightly roll the veil to wet it. Repeat this procedure for each layer of veil applied. Light to moderate pressure should always be used to achieve the best results. Carefully keep line contact and avoid point-to-point contact and high pressure since resin will be forced out when the veil is heavily compressed and air will be taken back in as the veil springs up behind the roller. Point contact with high local pressure results when rollers are angled on small and medium diameter mandrels or when straight rollers are used on compound curves. Spring-activated, flexible rollers should be used on small-radius, compound-curved molds.

Veil surfaces should always be covered by brush or sprayed with resin before chopped-strand mat is applied. If chopped strand mats are laid over the wet-out veil layers, the ends of the dry chopped strand glass will start to wet-out by wicking resin from the veil layers. This lets air back into the layers, resulting in quality problems.
Pre-forming
The mechanical binding of synthetic veil and the thermoplasticity of its fibers can be used to pre-form the veil to the contours of compound curves before use. Hat-shaped pre-forms can be made by pulling the veil down over a male form. Better forming is obtained if heat is applied to the synthetic veil. Always drape, shape, fit and cut the veil before pre-wetting the mold. Do not wet the veil and then try to brush and roll it over compound curves.

Review of Synthetic Veils
1. A synthetic veil has many purposes in FRP fabrication.
2. Using a synthetic veil improves corrosion-resistant properties by producing a resin-rich layer.
3. The corrosive environment in which an FRP part is used often requires a synthetic veil instead of a glass veil.
4. Synthetic veils should be handled differently than glass veils when fabricating.

Section 3
Structural Walls

After the corrosion barrier has been made, the structural portion of the laminate can be applied to the mold. The structural portion of the laminate does just what the name implies; it provides the structural integrity to the finished part.

Several lamination processes can be used to produce the structural portion of the equipment. The first, traditional method, is a combination of hand lay-up and spray-up. This process normally employs a combination of chopped strand glass mat or chopped glass, sprayed from a chopper gun plus woven roving that is alternated. The number of layers of each type of glass used is determined by the strength and stiffness required for the part being built. A structural design engineer determines this and the information is shown on the fabrication drawings. Different areas of the part can have different numbers of layers and different types of glass mats used so always pay close attention to the fabrication drawings.

Filament winding is becoming the most common fabrication method for the structural walls of corrosion laminates. This process wraps continuous glass roving at various angles and then it is wet-out with resin to form the structural laminate. Filament-wound structural walls have a high glass-to-resin ratio and will give higher strength and stiffness properties compared to those made with hand lay-up or spray-up. The