

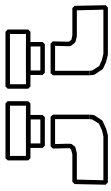
Furan Composites = *Industrial Fiberglass Specialties*

Industrial Fiberglass Specialties, and our sister companies, are synonymous with furan technology. It has been estimated that over the years we have built as much furan corrosion resistant equipment as the rest of the industry combined. Up to 30% of our annual volume of composite equipment is built with these furan resins.

This experience spans over 27 years, and includes the initial industry research and development with E. I. DuPont, Hooker and Quaker. Furan composites are unique in the fabrication techniques required. Successful fabrication requires knowledge, experience, shop expertise, and equipment that only a select few companies possess.

Our background in furan composites. Or, what is important to know about furans?

1. Material requirements for furan laminates are different than for polyester composites. We use special types of reinforcements that optimize the physical properties. The selection of these reinforcements, and their proper application, are part of our proprietary knowledge. While these special materials are more expensive, their use provides composites with significantly improved corrosion resistance and physical properties.
2. The product design requirements for furan laminates are also different than for polyester composites. Over the years we have developed good empirical data for the physical properties of properly made furan laminates. We use this data to adjust the design and wall thicknesses required for furan composites. In analyzing competitive proposals for our customers, we often find that the less experienced fabricators fail to recognize, and take into design consideration, the reduced physical properties of furan laminates.
3. The fabrication techniques for furan composites require more than just a bucket of resin, a brush and some glass reinforcement. Just like the old Model T Ford, when it comes to furan - you can have any color you want, as long as it is black. The black color in a laminate can hide defects - including air and delaminations. Since the laminate can not be easily inspected, these defects can go undetected until the equipment is in service for a period of time. This is why our experienced personnel, many with 20+ years of "hands on" working with furan laminates, is so important. When it comes to furan composites, there is no substitute for experience.
4. The polymerization or curing of furan composites requires considerable skill. There is a lot of "art" in knowing how to successfully complete the cross linking process. This polymerization process for furan is significantly different than that of polyesters, vinyl esters, or epoxies. The polymerization reaction is a condensation reaction. For every cross linking point on the molecule, there is one mole of water released. If the polymerization exotherm is not carefully controlled, this water turns to steam. The release and expansion of the steam causes blisters and delaminations in the composite, along with porosity. We have seen furan laminates several inches thick that were so porous that you could literally blow tobacco smoke through the



laminates.

5. To develop the required corrosion and physical properties of furan laminates requires a carefully controlled post cure. Unlike the polyesters and vinylesters, complete laminate reaction or cure does not occur at room temperatures. Taking the reaction to ultimate cure requires a carefully controlled “step” temperature sequence. You can not just “sock” the heat to the furan composites using salamanders, heat lamps or stem injection.

The entrapped reaction water must be slowly and carefully driven from the laminate through a programmed series of increasing temperature cycles. Again, it is critical to prevent this moisture from turning to steam. Yet, the final cure must reach temperatures of up to 250 deg. F. We use controlled temperature, forced hot air recirculating ovens to achieve the accurate “soak” temperatures required for complete cure. Temperature data loggers record the temperature and time profiles through each curing stage. Our largest oven (16'x16'x40') will handle mammoth size vessels and complex piping isometrics.

6. Be prepared to pay more initially for furan corrosion resistant equipment. After adjusting for specific gravity differences, the “raw” furan resin costs 30% to 40% more than vinylester resins; and over 100% more than many polyester resins. If you use a knowledgeable fabricator, that takes the time to “do it right”, labor input will also be higher. Yet, because of furan’s many corrosion benefits, furan equipment will often have a lower cost per year of service life - becoming your true “best buy”.
7. What should you be looking for in selecting the “right” fabricator for furan composite equipment? (A) proven experience, (B) knowledge of design and physical laminate properties, (C) knowledge of the proper materials to be used, (D) know how in achieving full cure for the best physical and corrosion properties, (E) the proper equipment to stage and record the critical polymerization reaction, and (F) a skilled workforce with 25+ years of experience in building critical FRP composites. Industrial Fiberglass Specialties can provide you that complete package - and thus, your “best buy” in furan technology.