

Thermosetting Resins Used in FRP Pipe

Epoxies

Epoxy resins offer a combination of toughness and temperature resistance that makes them ideally suited for high performance fiber reinforced plastic pipe. Dow, Hexion, and Huntsman produce a variety of liquid epoxy resins particularly suited for FRP pipe applications. The choice of epoxy resin and curing agent combination depends on the fabrication method and the performance requirements of the pipe.

Vinyl Esters

FRP pipes made vinyl ester resins exhibit exceptional chemical resistance in oxidizing agents and high acid-concentration environments. Some vinyl ester resin systems are better suited than others if additional chemical and temperature resistance is needed. Brominated vinyl ester resins are used for fire retardant pipe.

Polyesters

Polyesters are less expensive than other resins used in FRP pipe, but offer only moderate strength and chemical resistance. Polyester pipe is often an economical choice for less demanding, low-pressure service.

Curing Agents

Several different types of curing agents or catalysts can be used to chemically harden thermosetting resins. The curing agent affects not only the speed of the chemical reaction, but in the case of epoxies, also the physical properties of the finished pipe. There are two basic classes of epoxy curing agents used in the manufacture of FRP pipe: anhydrides and amines. In general, anhydride-cured resins exhibit good chemical resistance, but modest temperature resistance. Amine-cured resins generally have good thermal properties as well as excellent chemical resistance. For vinyl ester and polyester resins, peroxides are used as the catalysts.

Typical Thin Wall Pipe Properties @ 75°F

Physical Property Method	Vinyl Ester	Epoxy	Test
Ultimate Tensile Strength	9,000 psi	12,000 psi	ASTM D-2105
Modulus of Elasticity in Tension	1,400,000 psi	2,000,000 psi	ASTM D-2105
Ultimate Tensile Elongation	2%	0.02	ASTM D-2105
Ultimate Hoop Tensile Strength at Burst	44,000 psi	45,000 psi	ASTM D-2105
Thermal Conductivity	1.5 Btu*in/ft2*°F*hr	1.5 Btu*in/ft2*°F*hr	AOSI TM 16-15

Material Properties

The following article is taken from Dow Chemical publications about FRP pipe. The materials and processes discussed are similar to the ones used in fabrication of FRP booms. The article gives an independent third party assessment of the three most common resin materials and three most common processing options used for making FRP booms.

Waco Boom uses high-performance epoxy resin and the most modern filament winding production methods. Other manufacturers are still using polyester resin and the Hand Lay-Up method to make their own booms. One manufacturer is still using vinyl ester resin with the Centrifugal Casting method to make many of its booms.

The only way to know that you are getting an epoxy filament wound boom is to ask for a Waco Boom.

