ENHANCED SERVICE LIFE USING FRP BRIDGE DRAIN PIPE, SCUPPERS AND TROUGHS

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ABSTRACT

Corrosion of bridges presents a costly, dangerous and unsightly situation. The use of FRP (fiberglass reinforced plastic) drains, scuppers and troughs eliminates the corrosion found on existing bridges and is ideal for new construction. FRP bridge drain pipe scuppers and troughs are a lightweight, corrosion resistant alternative to traditional metal products. The thermosetting properties of FRP offer tremendous strength and impact resistance over thermoplastic products such as PVC.

FRP pipe is manufactured by the filament winding process. This process provides the maximum physical strength in both the hoop and transverse directions, thus allowing support spans equal to and greater than metallic systems. The fittings are custom molded with accessories available such as cleanouts. The UV pigment is blended in the resin providing a monolithic color.

Installation of FRP pipe is a bonding method using high-strength thermosetting resin. The pipe and fittings are a socket system requiring only several hours of training to become proficient at installation. The lightweight product is easily handled by installers without the use of heavy lifting equipment.

FRP bridge drain piping and accessories were first introduced in the early 1980's to the Illinois Department of Transportation to help eliminate corrosion and provide a lightweight alternative to a project in downtown Chicago. The project's success has lead to hundreds of applications in over 30 states.

HISTORY

Two leaders in the industry for solving problems related to corrosion are Garland Westfall of Westfall Company, Inc. St. Louis, and Jeff Foster of Grace Composites of Lonoke, Arkansas. Over the last twenty plus years, these two have combined their skills in manufacturing, marketing and engineering to develop a lightweight, corrosion resistant, low maintenance and easy to install bridge drain system.

The first bridge drain pipe (BDP) project was completed in the early 1980's. The Chief Bridge Engineer for the Illinois Department of Transportation (IDOT) read an advertisement about corrosion resistant reinforced thermosetting resin pipe – known to most as FRP (fiberglass reinforced plastic). He contacted Garland Westfall to see if this product, normally used for chemical and water applications, could be modified for runoff water for a small bridge project in Chicago, Illinois. After several meetings, it was decided that the A.O. Smith Fiberglass Red Thread® II pipe (now Fiber Glass Systems) and standard pressure fittings could be used for the project. This first project had favorable results and received praise from the contractor and IDOT. The Chief Engineer for IDOT realized this product could solve his corrosion and stress problems due to heavy metal pipe currently being used on bridges and overpasses. This led to several other BDP projects over the next few years.

The Red Thread II pipe was prepped for accepting color pigmentation, but meeting the DOT standards for weathering and color presented a problem. The pigment did not adhere to the pipe as expected. The source for the FRP pipe supplied from A.O. Smith Fiberglass Pipe was problematic because their factories were designed to mass produce standard pipe and fittings. Westfall Company, Inc. had a relationship with a firm in Little Rock, Arkansas called FMN Industries. Jeff Foster, who now owns Grace Composites, was a lead designer and Manager for FMN. With input from Garland Westfall and Jeff Foster, a lightweight filament wound bridge drain pipe was developed with DOT approved color pigmentation throughout. In addition, matching fittings and accessories were developed.

The Missouri Department of Transportation (MODOT) visited the Chicago bridge site and admired the FRP bridge drain project. MODOT specified the FRP bridge drain pipe for a very large project on Interstate 70 next to the Gateway Arch in downtown St. Louis. The design called for non-standard pipe fittings, as well as scuppers, cleanouts and other unique equipment. This project was completed in 1984 and still looks like new today. This led to FRP Bridge Drain Pipe becoming a standard for MODOT, and many projects can be witnessed on Missouri's major interstates.

Figure 1 - Interstate 70 St. Louis, MO

The FRP Bridge Drain Pipe market was up and running. Over the course of a few years, seminars were conducted at 26 state level Departments of Transportation. Our participation in major bridge conferences as an exhibitor and speaker, has helped boost the presence of the product.

In 2001, due to the high demand and requirements for delivery, all production was moved to Grace Composites of Lonoke, Arkansas (near Little Rock, AR). Grace Composites proved their desire to join forces with Westfall Company, Inc. in manufacturing and developing the BDP market. FRP Bridge Drain Pipe has been installed in most states in the United States, as well as many locations in Canada.

MANUFACTURING

Fiberglass bridge drain pipe is manufactured by the filament winding process. Filament winding requires a spinning mandrel where resin impregnated “E” glass fibers are wound in a predetermined pattern under controlled tension. Repeated passes create a strong layered product of a desired thickness. This process is controlled to produce approximately 75% glass reinforcement, which provides optimal physical strength, stiffness and internal pressure.

Fittings are manufactured by the hand-lay-up process. This involves a mold resembling the finished product on which glass saturated with resin is layered upon until the desired thickness is achieved. Bridge drainage presents a unique challenge since many angles are custom. In addition to odd angles, cleanouts are incorporated into many fittings presenting challenges for production. Troughs, expansion joints and scuppers are made specifically for the design of the bridge drain projects. Pigment is incorporated into the resin to provide color per DOT specifications.

Bridge drain pipe is designed to meet or exceed ASTM specifications D2996 and the accelerated UV weathering performance requirements in ASTM D4329-99 per procedure ASTM G154.

DESIGN ADVANTAGES OF FRP

Fiberglass is classified as a thermoset resin material which means once the resin is cured, it can not be melted back to its original state. This property, coupled with high-strength fiberglass gives FRP advantages over metallic systems and differentiates itself from thermoplastics, such as PVC. Fiberglass bridge drain pipe and fittings do not become brittle with cold temperatures. In fact, the impact resistance and physical properties increase as the temperature drops (down to - 70° F).

Support spacing for FRP bridge drain pipe does not present the problems associated with thermoplastics and is compatible with metal systems. (See figure 2 for support spacing) FRP has the advantage of being stronger, lighter in weight and also has higher impact resistance than thermoplastic. The lightweight properties compared to metal systems are dramatic. 10” FRP weighs just 3.6 pounds per foot compared to many metal systems which weigh in at 40 pounds per foot.

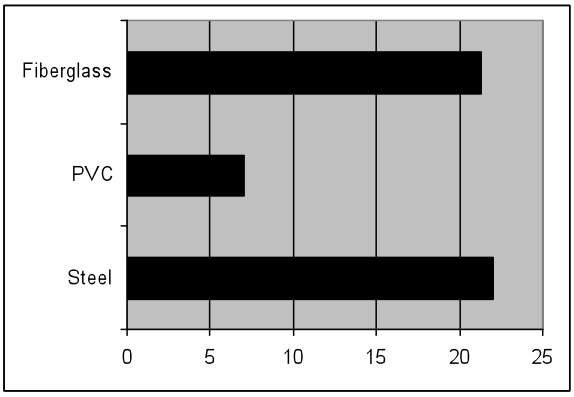

Figure 2 – Support Spacing in feet for 10” Pipe

DESIGN FLEXIBILITY

Development of FRP bridge drain systems has occurred over the years with input from Illinois, Missouri and Kansas Departments of Transportation. Due to corrosion, removal of nuts and bolts from flanges on drain cleanouts was a challenging task. Non-metallic cleanout female threads are now used, eliminating the rusting of traditional metal. Cleanouts on a 45° saddle provides easy cleanout access on a straight run. The drainage off the scupper is caught with a collector fitting. This collector acts as a funnel that reduces vibration from the deck and allows for expansion and contraction, as well as plumbing flexibility. A no splash-out is achieved because of the use of a floating fiberglass washer.

An all fiberglass expansion joint will allow several inches of water-tight movement. Anchors are utilized with the expansion joints to provide a total engineered system.

EASY INSTALLATION

A major advantage to using fiberglass systems during installation is its prefabrication capabilities. Directional changes, cleanout saddles and scupper collectors can be attached and fitted to sections of pipe and then lifted into place. The lightweight and high strength properties are a natural for this type of installation. Figure 3 shows two men can carry 40 feet of 8" pipe which has been fitted with two collectors, one cleanout and one coupling. The total weight of this pipe section, with fittings, is 120 pounds. A simple two-man lift can be used to place the pipe into pre-installed hangers.

Figure 3 – Two men carry 40' of 8" pipe in Topeka, Kansas

The FRP pipe and fittings are easily assembled and can be fabricated by any competent contractor. No welding, brazing or soldering skills are required. The fundamentals of the adhesive bonded joints are easily learned. Contractors in the St. Louis area have been installing this type of pipe for more than 30 years.

CONCLUSION

A proper FRP pipe designed system can satisfy support spacing equal to a metallic system. With the lighter weight burden on the structural, as well as advantage on installation cost, FRP pipe has proven its attraction as a material of excellent choice. Installation in over 30 states has been recorded with growing interest with consulting engineers and DOT's. Several high profile projects have used fiberglass for their deck drains. These project sizes have varied from 6" thru 30", such as the Commonwealth Of Virginia Department Of Transportation's bridge on Route 58 over the John H. Kerr Reservoir.

With Americas aging highways and bridges, the use of a lightweight, corrosion resistant, long lasting and easy to install system, makes sense for bridge drainage, scuppers, troughs and downspouts. More information can be found at www.frpbidgedrainpipe.com.