



## **Why a Corrosion Barrier/Liner for FRP Composite Pipe?**

It has always been our thesis that all FRP composite pipe for fluid service should have an internal corrosion barrier/liner. Therefore, it has been our policy to supply all pipe, except pipe used as a conduit, with such a corrosion barrier/liner. The type and thickness of this corrosion barrier/liner will depend upon the specific service environment. The thickness of a corrosion barrier/liner can range from a 40 mil (0.040") for cooling water applications, to over 200 mil (0.200") SPI type for wet chlorine gas service.

The purpose of this bulletin is to detail why we believe it is important to provide FRP composite pipe with an internal corrosion barrier/liner.

**Corrosion Resistance:** We realize that some pipe manufacturers market a pipe without a corrosion barrier/liner (typically called unlined pipe). Interestingly, in most cases, the resins used for the unlined pipe series also have lower corrosion resistance capabilities, and lower service temperatures limitations. All pipe manufacturers provide a corrosion barrier/liner in their pipe intended for moderate to severe corrosive applications.

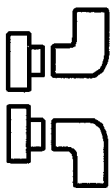
Since fiberglass reinforced composite pipe is typically used for applications where corrosion is a consideration - it seems only logical to use a corrosion resistant product. In FRP composite pipe, the corrosion resistance is provided by the resin matrix. The higher the resin content of the laminate exposed to the service environment, the "better" the corrosion resistance. Also, within the limits of the resin system, the thicker the corrosion barrier/liner, the greater the corrosion resistance.

Unlined pipe typically has a resin content of just 30 to 40 percent in the surface exposed to the service environment. In pipe built with a corrosion barrier/liner, the resin content is typically 80 to 90 percent.

What does all this mean to the end user? In a filament wound composite pipe, the cost of adding a corrosion barrier/liner is not all that great - in comparison to the true cost of the pipe. (Just as with "stripped-down" automobiles, sometimes unlined pipe is used as the loss leader to get your foot in the door.)

The selection of the proper type and thickness of the corrosion barrier/liner can more than double the service life of the pipe. Since fiberglass pipe is typically being bought to provide longer service life than other alternate materials, the addition of a corrosion barrier/liner can become an important cost savings to the end user - providing the lowest cost per year of service life.

**Structural Integrity:** While typically the corrosion barrier/liner is not counted on for adding strength to the pipe - it does enhance the structural integrity. (Depending upon the service environment, sometimes the structural properties of the SPI type corrosion barrier/liner are included in determining the pressure rating of the pipe.)



One of the advantages of properly designed and manufactured fiberglass filament wound composite pipe is that it will typically show signs of "weeping" through the pipe wall when over-pressurized, long before a catastrophic failure occurs. Such weeping occurs by fluid wicking following the continuous glass roving used in filament winding. The weakest portion of the structural wall is the glass/resin interface. The corrosion barrier/liner, thus, serves to prevent the fluid media from getting to that continuous fiberglass filament.

From a purely structural viewpoint, the ideal corrosion barrier/liner would be a rubber bag. This rubber liner would continue to stretch, allowing the structural wall to fully take advantage of the super-strong, continuous glass filaments - until they actually broke. A properly designed resin corrosion barrier/liner serves the same function - letting the structural wall take the full load without concern of pipe wall weepage.

**Abrasion Resistance:** There is an element of abrasive wear in almost all fluid service applications. In the concern for corrosion resistance, this abrasion element of the environment is often overlooked. Especially for pipe subjected to high flows; or, where there may be particulate matter contamination (i.e., cooling water applications, river water, waste handling, etc.); abrasion design needs to be considered for all FRP composite pipe.

As with corrosion resistance, the resin matrix provides the abrasion resistance. With a properly designed and selected corrosion barrier/liner, the abrasion resistance (and, thus, the pipe life) can be up to ten times greater than for unlined pipe, where the glass filaments are directly exposed to the service wear. With unlined pipe, very rapid wear can occur, with the roving filaments being "picked" away from the surface. Through further modifications of the corrosion barrier/liner - consisting of proper resin selection, proper type of non-glass reinforcement, and armoring modifiers - the abrasion resistance of the corrosion barrier can be further improved.

**Insurance:** Another compelling reason for always using a corrosion barrier/liner in FRP composite pipe is to provide the capability for changes in service environment. Even if the current service environment would not benefit from the additional protection of a corrosion barrier/liner - the addition of a corrosion barrier/liner provides insurance that future changes in the service stream can take place without concern for the life of the pipe.

Perhaps the nature of the waste stream may be different five or ten years from today. Perhaps even for relatively mild cooling water or river water service, the end user may want to add treatment chemicals in the future.

Recent headlines have been made by the zebra mussel that is attaching itself to the insides of pipe. The addition of a corrosion barrier/liner for pipe would provide additional abrasion resistance in removing, by mechanical means or hydroblasting, such mussel buildups. The small additional cost for a corrosion barrier/liner can be a very inexpensive insurance policy for the future.



***Industrial Fiberglass Specialties, Inc.***

521 Kiser Street  
Dayton, OH 45404-1641  
Tel: 937-222-9000  
Fax: 937-222-9020

***Lined vs. Unlined  
FW FRP Composite Pipe***

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Page #3 of 3

**In-Service Costs:** One of the advantages of FRP composite plastic pipe is its internal smoothness, over its entire service life - especially when compared to other materials such as concrete, steel, etc. This smoothness is translated into less friction and, thus, lower pumping cost. In some cases, even a smaller diameter pipe can be used.

Even small differences in the smoothness of the pipe interior can be translated into dollar savings in electricity or fuel (for the pumps). The glass smoothness of the high resin content corrosion barrier/liner is measurably better than for unlined FRP pipe. In addition, the energy savings advantage of the resin-rich corrosion barrier/liner increases with age.

**Summary:** Except for conduit, in almost all instances, a corrosion barrier/liner can be economically justified for FRP composite pipe. We recommend as a minimum, a 40 mil thick C-veil and/or Nexus reinforced corrosion barrier/liner. For moderate and severe corrosive environments, an even thicker corrosion barrier/liner should be considered.

We will be glad to work with you and your customer in selecting the best corrosion barrier/liner for their service environment. We are confident that "lined" pipe will provide the end user their lowest cost per year of service life and, thus, their "Best Buy".