



A Better Alternative to Fusion Bonded Epoxy for Corrosion Protection

By Kira Kaleps
Corrosion Protection Division
RMB Products



Fusion bonded epoxy (FBE) coatings have been a widely used method of corrosion prevention for pipeline fittings in oil and gas, chemical processing and other harsh environment industries since their introduction in the 1960s. Although a popular choice, FBE has limitations.

Newer technologies and materials have been developed over the last twenty years that offer a compelling improvement compared to the FBE materials of the past. This paper describes how roto-lining, a rotational molding process, provides a more durable, longer-lasting solution for pipelines and is proven effective in hundreds of the most demanding applications and service environments around the world.

Roto-lining molds a permanently bonded liner to the inside diameter of a pipe or to the working surfaces inside of a pipe fitting. Its chemical and mechanical properties provide a variety of performance enhancements that cannot be matched by fusion bonded epoxy coatings.

RMB Products Technology Is the Ideal Solution in the Most Critical Applications

- Chemical Processing applications in aggressive (acidic or alkali) environments
- Installations where customers have experienced failures with prior corrosion protection technology, such as when corrosive fluids get between the pipe and liner
- Coatings (fluoropolymer or epoxy) used wear more quickly than anticipated
- Liner material used distorts and creates gaps that can corrode or wear
- Fluids being pumped contain grit (sand) or other abrasive media, as well as corrosive chemicals
- Pipes that include geometry changes with the piping, such as neck downs, elbow and tee joints, or other complex geometries that are not easily or consistently coated or lined

FUSION BONDED EPOXY COATINGS

To fully understand the differences between FBE and roto-lining, we need to first take a look at how fusion bonded epoxy coatings are applied.

Whenever a surface coating is applied, the finished quality of the coating generally depends upon the thoroughness of the surface preparation. This is true when painting a car, staining a piece of furniture, or applying a corrosion protection liner. For both FBE and roto-lining, the surface first needs to be cleaned of any grease or oil and then taken to a condition called "near white metal" by shot or sand blasting. The abrasive process creates additional surface area on a microscopic level and leaves the surface chemically active. Both of which improve bonding.

If the working surface is not completely clean of contamination prior to application, the coating will fail prematurely, due to lack of adherence. Poor bonding can lead to voids between the liner and the surface, eventually causing delamination of the liner from the surface to which it was applied. The process of applying fusion bonded epoxy is very similar to powder coating. An epoxy resin powder that has been positively charged is applied to a negatively charged and heated part to be coated. The electrostatic attraction between the two holds the epoxy powder in place until it liquefies and flows uniformly over the hot surface. The coated part is then cooled at a controlled rate to promote uniformity in the coated surface. When properly prepared and fully cured, FBE linings provide a seamless, permanently bonded method of corrosion prevention.

However, there are some inherent limitations of FBE liners that negatively impact their durability. Due to constraints in the application process, coating thicknesses with FBE are limited to 0.04", roughly the thickness of a credit card. While this

will provide some degree of corrosion prevention when used as a liner in a pipe fitting, its durability is limited by its minimal thickness. FBE is typically applied with a spray nozzle or gun, with long, straight lengths of pipes being coated relatively easily with automated equipment. However, the complex geometries that can be in pipe fittings present a significant challenge for FBE liners. Typically, these parts have to be coated manually, if they can be coated at all, which can lead to inconsistencies in the coating that then lead to liner failure.

Solid particles in flow media, such as sand, will wear out FBE liners rapidly. For any sections of the piping system that are not straight or that do not have a constant cross-sectional area, this wear will get even worse. Geometries such as elbows, tees, or throats will cause turbulence in the flow media, which accelerates wear on these internal surfaces.

ROTO-LINING

Roto-lining is a highly effective alternative to FBE, providing the same or better protection without FBE's limitations.

Roto-lining shares the same surface preparation requirements as fusion bonded epoxy. All working surfaces are cleaned of grease and oil and then abraded to near white metal. A polymer chosen for the appropriate corrosion protection qualities is applied in granular form inside the fitting or pipe section. It is then heated while being simultaneously rotated about two perpendicular axes. During the heating cycle, the polymer particles melt and adhere to the metal substrate, forming a uniform layer of thermoplastic. Typical wall thickness extends up to 0.450", depending on the size of the part and service requirements. Some of the most common liner materials are HDPE (high-density polyethylene), ETFE (Tefzel), PFA (Teflon), PVDF (Kynar), and Nylon 12.

After being fully coated the fitting is then cooled by a combination of forced air and water mist. The resin solidifies and permanently bonds to the substrate with a bond strength exceeding the tensile strength of the liner, creating a seamless fully protected component. The liner material extends out onto the flange face and is machined to tight tolerances to provide a sealing surface. This added benefit of roto-lining may eliminate the need for gaskets between fittings. The entire process of lining a part can usually be completed in less than a day, depending on the complexity of the geometry and the amount of surface preparation that needs to be done.

There are some size restraints on parts that can be roto-lined, as the parts need to be able to fit into the oven used in the lining process. However, straight lengths of pipe up to 20 feet long and fittings or other parts such as storage vessels that will fit within a 12 foot sphere are possible.

THE UNDENIABLE VALUE OF ROTO-LINING

The ability to line parts with complex geometrics, to a much greater thickness, while using a wider variety of coating materials, gives roto-lining a distinct advantage over fusion bonded epoxy. FBE and roto-lining are both capable of providing a seamless protective coating, roto-lining lasts longer over a much broader range of operating environments.

Why does durability really matter? Because the longer a process fitting can stay functional without concern of corrosion, the longer the process can run without downtime. Beyond the cost of lost production associated with downtime, there is the cost to replace the affected fitting, which might be 20 feet underground. Decommissioning of a line and excavation are costly undertakings. It is obvious that the run-time that between maintenance shutdowns should be extended as long as possible.

Of course, the cost differences between these two coating methods does need to be considered as well. Roto-lining can cost up to twice as much as FBE for a given part. However, a roto-lined coating can be expected to last three times longer FBE, in the same operating environment. So, while initial purchase price alone favors FBE, roto-lining is the clear winner for life-time cost.

There are additional “soft cost” issues worth noting. Because of their limited durability, FBE-coated fittings require more frequent inspection and maintenance. Additionally, potential safety and environmental risks associated with a liner failure are minimized by using roto-lined parts.

Roto-lining technology is newer than FBE; and, as a result, not familiar to some engineers. However, its use is growing as it becomes better known in the industry. With the wide range of available lining materials and thicknesses, more than ten times those of FBE coatings, the corrosion protection performance of roto-lined coatings makes it a compelling choice – especially for the most demanding applications.

RMB Products provides highly engineered polymers and corrosion protection technology for demanding, mission-critical applications in aerospace, chemical processing, semiconductor and biopharmaceutical industries. The company offers a variety of superior rotational molding and additive manufacturing technologies that have proven reliable and indispensable to customers around the world. RMB offers a unique rotational lining capability that provides seamless, bonded linings that offer superior corrosion protection for pipes, fittings, tanks and vessels compared to competitive lining materials and methods.