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# Cast Iron Soil Pipe for Aggressive Sanitary Applications

In the 1890s, cast iron soil pipe emerged as the plumbing pipe material of choice in the United States. The term "soil pipe" was used as it described the functional purpose: to remove soiled effluents from the building. Over the years there have been many advances in soil pipe production and quality, but functionally it continues to be the predominate pipe for removing waste from a building.

Soil pipe systems are required to convey an increasing amount of aggressive waste. Today, stronger cleaning products are commonly used by hospitals, schools, and other institutions, often with less dilution. Viral and biological events like COVID have led to an increase in the use of hand sanitizer and subsequently, a decrease in hand washing with soap and water. This, combined with low-flow water fixtures, greatly reduces the amount of clean water used to flush the drainage system. By their very nature, the food service industry drains fats, oils, and greases, and oftentimes these drainage systems are compromised due to undersized or improperly maintained grease interceptors, resulting in hydrogen sulfide gas build up. So, while the cast iron pipe itself has not changed much over the years, the effluent being introduced into the soil pipe has changed dramatically. Cast iron systems today are required to convey effluents with a pH of anywhere from 2 to 12. Traditional cast iron can handle pH of 4.3 to 10. New requirements necessitate a new product.

Over the last several years, engineers and facility operators have moved away from traditional cast iron soil pipe in favor of various sanitary Drain, Waste, and Vent (DWV) piping materials. Products like PVC, CPVC, and stainless steel are being specified more often. While these alternatives can be effective in some applications, each have drawbacks. These downsides include limited temperature capability, susceptible to chemical attack, or dramatically increased cost. The most recent solution gaining popularity is enhanced coated cast iron soil pipe.

Charlotte Pipe

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John Muir

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## Coated Cast Iron Soil Pipe

Enhanced coated cast iron soil pipe products offer all the benefits of traditional cast iron while negating the major drawback of cast iron in aggressive applications: corrosion. On the surface, this seems to solve the problem. However, specifying any enhanced coating by any application method does not solve the problem. While the coatings offered by both domestic and foreign pipe manufacturers offer excellent corrosion protection, that protection is only effective if the coating remains on the pipe. Experience has proven that the most important factor in protecting the iron from the corrosive environment is not the coating itself. Rather the effectiveness of the protection is based on how the coating is applied. Before selecting an enhanced coated product, one should consider the coating application process.

Enhanced coated cast iron soil pipe products are all made to the existing cast iron soil pipe manufacturing standards used in the United States: ASTM A74 for Service and Extra Heavy cast iron and CISPI 301 or ASTM A888 for Hubless (No Hub) cast iron. These standards have vague requirements for coatings. In essence, they require coatings to be "suitable for the purpose" and applied evenly. These general requirements worked well on traditional cast iron soil pipe for decades. However, with the necessity for a high-performance coating in aggressive DWV applications, many manufacturers have sought out more rigorous coating requirements to ensure adequate performance. All the enhanced coated cast iron soil pipe products offered in the US have utilized a European standard, EN 877, *Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings - Requirements, test methods and quality assurance*, to provide a specification for the coating performance by providing a quantifiable method to determine the quality of the coating and coating application.

## Coating Processes

There are several enhanced coated cast iron products available in the US market. Most of the manufacturers who offer these products employ different processes to apply the coating. Pipe and fittings have different coating requirements, so they will be discussed separately.

The one common step employed in

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**Pipe and fittings have different coating requirements.**

the coating of pipe is surface preparation to the interior and/or exterior. Some, but not all, manufacturers use a special slurry in the pipe casting process. This makes the pipe OD more receptive to the coating. Next, all manufacturers ream the interior of the pipe. Some manufacturers will ream it twice and one even adds a shot blast to the OD in the process. Preparing the pipe's surfaces prior to coating is crucial for proper adhesion and performance.

After surface prep, there are two basic coating application processes used. The more common approach is to spray on the coating. This process entails applying one or two coats of either an epoxy or urethane coating on the interior of the pipe. If the exterior of the pipe is coated as well—and not all manufacturers provide this—it is applied in a separate step. In this process, the coating is mechanically joined with the metal. In order to work properly, the pipe must have a 4 – 6 mil anchor pattern and be free of debris prior to spraying on the coating. While cost-effective and efficient, mechanical adhesion can be easily compromised in a commercial DWV system. More on that later.

The second method is a much more sophisticated, multi-stage process known as electrocoating. In this process, the iron is first rinsed and then coated with zinc phosphate, a corrosion inhibitor. Then, the pipe is given an electrical charge and the coating is given the opposite charge. Through a series of immersion tanks, the coating is micro layered until it achieves a certain specification. Then the polarities of the metal and coating are reversed, and the process is repeated. The benefit of this process is that the coating is not mechanically bonded to the metal. Rather, it is fusion bonded. This technology has been used in the automotive industry for decades due to the effectiveness of protecting metal parts.

For fittings, again there are two basic methods for coating application. The more common application process is to mechanically bond the coating to the fitting by an immersion (dip) or spray on process. Unlike the pipe coating process, no special fitting preparation is employed. The other method for enhanced coated fittings is employing both electrocoating and a powder topcoat. While fittings are not reamed like pipe, they are cleansed in an immersion tank and receive a zinc phosphate layer. The fittings and coating are then charged with opposite electrical charges. Finally, a powder topcoat is applied as an additional layer of protection.

## Protecting Cut Ends on Pipe

When pipe is cut in the field, uncoated ends are exposed to the effluent flowing through the piping system. While the pipe stops incorporated into the neoprene fluid seals provide a limited degree of protection from the aggressive effluents, some manufacturers and / or resellers require additional protection.


**It is important for installers to account for the additional labor and materials necessary to protect cut pipe ends.**

A reseller of enhanced coated pipe using the spray on method requires the use of a special polybutylene fleece tape in any application where the pH of the effluent is below 4.3 or above 7.1. As stated previously, cast iron soil pipe and fittings are well suited to handle effluent with pH levels ranging from 4.3 to 10.0, so this requirement indicates that extra protection must be employed to prevent delamination even in some non-aggressive applications.

One of the manufacturers of spray-on coated pipe does not address the issue as part of the installation process but offers a resource to secure additional coating if coating the cut edges is desired or specified.

A manufacturer of the electrocoated pipe does not require pipe cut ends to be protected. The electrocoating process ensures that the effluent will not get under the coating and cause any delamination. However, they too offer a resource to secure additional coating if protecting the cut edges is desired or specified.

With the various requirements of different manufacturers and resellers, it is important that specifiers and installers understand the requirements of the particular system they are using. It is also important for installers to account for the additional labor and materials necessary to protect cut pipe ends.

## Mechanical Cleaning

As with any sanitary system, solids can build up or clog drainage lines. Typically, clearing these lines requires the use mechanical devices like augers or snake heads. While the cutters on these devices are intended to break up solids and move them downstream, they can also remove the interior coating on the pipe and fittings. Coatings that rely on mechanical adhesion are apt to chip off with repeated passes of these devices. Coating that is electrically fused to the metal perform much better with mechanical cleaning.

## Analysis

When the two coating processes, spray on / immersion and electrocoating, are analyzed objectively, the choice is clear. Spray on / immersion is a quick and economical process that requires minimal capital investment. It is an inexpensive method for a manufacturer to bring an enhanced coated product to the market at a lower price. However, for the specifier and, more importantly, the end user, this process does have an issue with delamination.

Because the spray on / immersion processes rely on a mechanical bond, it is susceptible to peeling, chipping, or flaking from snap cutting, handling on job sites, or mechanical cleaning with auger bits and snake heads. Once the coating is removed, the aggressive effluents are in direct contact with the bare metal and corrosion occurs. The corrosion will propagate throughout the pipe as the effluent gets under the coating, exacerbating the problem. Remember, the coating is only effective as long as the coating stays on the metal. To mitigate delamination, some manufacturers who employ the spray on / immersion method require the cut ends of the pipe to be coated.

With electrocoated pipe and fittings, delamination is a non-factor. Since the coating is permanently bonded to the metal, delamination of the ecoat layers is not possible. The only way to remove the coating is to take away metal from the pipe wall.

## Conclusion

As with any new product, it is important that specifiers, installers, and end-users understand the characteristics and capabilities of the materials under consideration. While the technologies involved, both spray-on / immersion and electrocoating, have been successfully used in many different industries for decades, the application of enhanced coatings on cast iron soil pipe is an emerging product category. Since these new products are handling aggressive effluents typically installed below the slab or other hard-to-access locations, material selection is critical. While both coating applications provide excellent protection, remember that protection is only effective as long as the coating remains on the pipe and fittings. C

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