

By Paul Oman

Epoxy Issues in Manhole Rehabilitation Projects

Manhole rehabilitation and wastewater coatings is a fascinating niche in the coatings and linings industry. Perhaps because municipal decision makers in that industry must wear so many hats (engineer, administrator, coatings expert and contract negotiator), they tend to be more influenced by the coating manufacturers than other coating decision makers. In one respect this is good. Quality products are brought to their attention. However, the downside is that these manufacturers shield their municipal contacts from competitors and downplay the weaknesses of their products.

As a worldwide distributor of epoxy coatings, I deal with many city employees, resin/epoxy manufacturers and contractors. More than in any other market,

Coating Thickness

Perhaps the biggest disservice resin manufacturers have done is to place a major emphasis on coating thickness. Not surprisingly, their recommendations of mil thickness (100 mils = 1 inch) tend to follow their product line specifications and thus exclude their competitors from consideration. The general perception is that thicker is better. It certainly is for the resin manufacturers. A solvent-free epoxy with both a wet and dry thickness of 16 mils will yield 100 feet of coverage, while the same coating applied at 160 mils will cover only 10 square feet. That is the difference between a 1,000 gallon order and a 100 gallon order. No municipality would be willing to pay 10 times as much for the 160 mil coating. They expect similar cost

crude visual feedback mechanism of thick and thin spots in the coatings.

Coat Application Issues

All parties want an experienced and knowledgeable applicator applying the coatings. Yet the requirements to become a "certified" applicator is a real issue with contractors and one that many manufacturers would rather keep hidden from the municipal decision makers. There is more money to be made in application than in the sale of the epoxy. Too many resin manufacturers see no problem with double dipping (profiting from both the sale of the product and the "certification" of the contractor or bidding contractors). Municipal decision makers need to find out if the manufacturers require contractors to be certified to even bid a job with their product. More importantly, they need to learn what cost, if any, is charged to contractors for training and certification. A \$10,000 fee is not unheard of in the industry and that alone could eliminate many local and minority contractors from bidding or accepting jobs to which they legally should have equal access.

Another coating application issue is the application method. Specialized equipment and crews initially sound good but if problems develop during application or in the future, costs can go through the ceiling. Coatings that can be applied or repaired with a brush, roller or common spray equipment by almost any contractor can prevent a budget and planning disaster.

Along the same lines is the issue of the transportation of the epoxies to the job site. Many or most epoxies must be shipped as regulated hazardous material (haz-mat) cargos. Some epoxies are not haz-mat regulated and can be shipped via the United

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when it comes to manholes and wastewater facilities, each of these three groups has its own story to tell and its own unique set of problems and concerns. A successful, on-time and on-budget rehabilitation project takes the cooperation of all three groups, yet rarely, if ever, do they share their concerns to the point of modifying existing rehabilitation specifications. This article will provide a wastewater epoxy primer as well as try to include issues and topics that are of concern to all three groups. While there are alternatives to epoxy linings, they are beyond the scope of this article.

per square foot pricing. That means in order to make the 10 square foot per gallon epoxy price competitive with the 100 square foot per gallon epoxy, it has to be 10 times cheaper per gallon. The only way to cut the price of epoxy is to use inferior resins and/or lots of fillers and extenders. The bottom line is that the epoxies with the thinner coverage may well be the better product.

Often two coats of contrasting colors are better than one single coat, especially when working with thin coat epoxies. The two coats help reduce the possibility of pinholes and the two colors provide a

States Postal Service or UPS. Shipping haz-mat epoxies in quantity is not much of a problem, but try to ship a few gallons for a repair or because the contractor was short a few gallons and the problems and costs quickly escalate. Smart contractors make note of whether the epoxies to be used are haz-mat regulated. City officials should, too.

Decision makers also should look closely at the manufacturer's mixing directions when selecting manhole coatings. Things such as difficult mixing, humidity, restrictions, mixing ratios with very little room for error, induction times (a period of time the mixed epoxies must sit after mixing and prior to application if they are to harden/cure. Generally, better epoxies have no induction time requirements), and inconvenient packaging all increase the probability of Murphy's Law kicking in.

Substrate Condition

Too often manufacturers promote a single solution to manhole rehabilitation without regard for the condition of the substrate. Thinner coatings are more likely to penetrate into the substrate than thicker (and thus drier) coatings. Not only will dry, thick coatings have more trouble sticking to dry, porous substrates, their shear mass (especially if it contains quartz or sand) will tend to stress the surface bond as well. Epoxy technology offers two solutions.

- Use a thinner penetrating epoxy to fortify a weakened substrate and provide a slick, non-porous surface for the thicker and drier topcoat to bond with, and
- Use a thin penetrating epoxy that remains tacky for a long period of time and serves as both a mechanical and chemical bonding surface for the epoxy topcoat.

Odors and Moisture

Many manhole epoxies are now solvent-free (zero percent VOC) and have almost no odor or fumes to endanger or annoy workers. While odor may not be much of a problem, moisture certainly remains a curse to most epoxy manufacturers. Let's face it, most manholes are either wet, damp, moisture saturated, highly humid or wet from dew, rain or waterjet surface preparation. Nothing ruins the coating properties and test results faster than moisture. Add a trace

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of moisture in the long buried manhole and adhesion numbers can go from awesome to deplorable in one brush stroke.

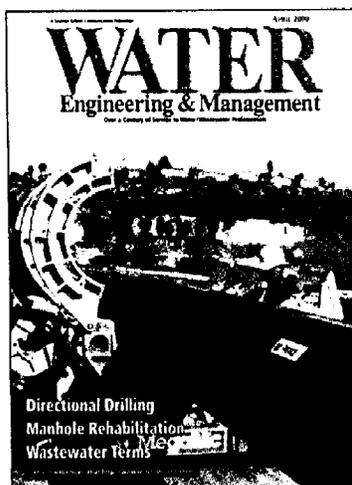
There are several epoxies that claim moisture tolerance or even the ability to be applied and to bond underwater to various substrates. From my perspective, it seems complete stupidity to use a "dry surface/low moisture only" coating in a manhole environment. Unfortunately, the performance of the so called underwater epoxies varies greatly and city officials literally should put

each such epoxy to a real and practical on-site test. An epoxy that will solidly bond to a wet or submerged surface (at least the better performing epoxies) will have the bond strength to prevent the influx of water from the outside.

Some of the underwater epoxies can be applied to fresh concrete without the traditional 28 to 30 day waiting period as the concrete sets. Reducing this wait down to perhaps 15 days helps keep new wastewater construction projects on-time and on-budget.

Grouts, Patching and Liners

I am surprised how often cement-based grouts and patches are recommended when lightweight, moisture tolerant epoxy patching and filler products are good alternative solutions. Cement-based grouts tend to bond poorly to existing cements, are heavy and tend to suffer the same problems experienced by the original damaged substrate. In this area, price or tradition, rather than technology, tends to guide the thinking of the decision makers.



Our Cover: Accelerating the design and bidding process, the Leucadia (CA) County Water District replaced 1,100 feet of pipe in 33 days. For a look at this trenchless project, see the story on page 28.

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Generally, the same epoxy used as a manhole lining can be used in conjunction with fiberglass cloth to provide a stronger, more structural lining. The result is something like a boat hull built inside the manhole. The technology to do this does not have to be cutting edge. The same laborer rolling on the epoxy coating can lay down a yard or two of fiberglass cloth over his paint job and then re-roll an additional layer of epoxy on top of the fiberglass.

There is a growing list of companies that mechanically insert sleeves of fiberglass into manholes and sewer lines. These companies almost universally use polyester resins instead of epoxy resins to do their work. Polyester resins are much cheaper than even average quality epoxy resins and thus economics, and not necessarily performance or quality, determine the end result.

Reinforced Epoxies

Some epoxies contain fibers of Kevlar, fiberglass strands or other materials as an internal reinforcement. These fibers tend to act like rebar in concrete or "rip-stop" nylon.

They help resist cracking, crack growth and chipping. These reinforced epoxies should not be confused with flake or mica additives that sometimes are added to low-quality epoxies that have a permeability problem. These plates or flakes are intended to reduce permeability within the epoxy. A better epoxy is a wiser choice.

Epoxy brittleness is a related topic. Epoxies are naturally brittle. Most traditional epoxies (often phenolic epoxies) have an elongation factor of only 2 to 3 percent. Modern ring-structured epoxies have increased this number to perhaps 7 to 9 percent—still brittle but usually more elastic than the surfaces they are applied to. Some epoxy vendors offer epoxies with resistance and permeability. While the idea of a flexibilized epoxy sounds good, the real benefit of their use in rehabilitation projects has yet to be determined.

New Non-Epoxy Concrete Primers

What is new in the concrete coating industry is a group of products best

described as water-based, zero thickness concrete sealers and fortifiers. Rather inexpensive, these single component products are rolled or sprayed on exposed concrete where, like water, they quickly soak into the concrete. There they form tiny crystals inside the pore spaces along the surface of the concrete. This process reduces both porosity and permeability, essentially fortifying the concrete and making it waterproof. Pinholing also may be reduced since there is likely to be fewer air filled voids in the surface after treatment. Because they soak into the concrete, these products leave nothing on the surface to add or detract from subsequent epoxy coatings. Their primary purpose is to aid in the waterproofing of the concrete. They also aid in protecting the concrete from hydrogen sulfide and other contaminants that literally invade the concrete surface and destroy it from within should the epoxy protective coating become breached or damaged. At a material cost of only a few cents per square foot, cities and pre-cast concrete manufacturers are moving toward these kinds of internal sealers as a pre-coat and insurance against the worst of nature.

Conclusions

There are many different products and approaches to manhole rehabilitation and much or most of the information available is biased toward one or another product or system. Issues such as minimum coating thickness necessary, shipping restrictions, applicator certification costs and the epoxy's moisture tolerance often are overlooked in the evaluation of different solutions.

It is in a community's best interest to have wastewater officials establish an on-site, low cost (to all parties) testing program of new and different coatings/products rather than to measure them against a set of criteria originally developed by a specific manufacturer for the purpose of promoting its products while at the same time locking out its competitors.

About the Author:

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