HOW COATINGS PROTECT WASTEWATER PRETREATMENT EQUIPMENT IN FOOD AND BEVERAGE PROCESSING

Selecting the Right Protective Coatings and Linings Leads to Longer Service Life, Reduced Maintenance and Cost Savings

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Food and beverage processors have an essential responsibility with the wastewater created from their operations. What goes into that water must come out before it can depart facilities and make its way to municipal treatment plants.

As a result, most plants are in the wastewater treatment business themselves. Many even have extensive treatment facilities where filters, basins, coagulation tanks, flocculators and other equipment filter out various contaminants before releasing the pretreated water downstream.

Such steel and concrete equipment must be in contact with the sometimes highly corrosive contaminants, necessitating the use of protective coatings and linings to keep this essential treatment plant infrastructure from degrading. Using the right coatings to keep those chemicals, acids and abrasives from deteriorating equipment is necessary to ensure long asset service lives, minimize maintenance needs and protect a facility's bottom line. This paper will review the various coating and lining solutions food and beverage processors can use to accomplish those goals, as well as cover some specific applications that meet those objectives

KEEPING THE TREATMENT PLANT OPEN FOR BUSINESS

Pretreating wastewater is a critical legal and community responsibility for food and beverage processors, with regulations in place and the need to prevent fats, oils and greases (FOGs), suspended solids, highly acidic wastes and even cleaning agents from entering municipal plants. Those treatment facilities aren't designed to filter and process the level or type of waste materials common to food and beverage manufacturing plants.

Being in the wastewater pretreatment business introduces unique challenges to processors and the need to understand how to keep equipment operational when exposed to corrosive, acidic food substances and the chemicals that scrub contaminants from wastewater.

Pretreatment plants may include equipment that first screens the water to remove large solids and abrasive particles before moving it into equalization basins that stabilize the flow for treatment downstream. Microbubbling dissolved air flotation (DAF) tanks may be used to remove FOGs and suspended solids that result from meat and dairy processing. The wastewater is likely to be treated with chemicals to adjust its pH and run through coagulation and flocculation tanks to clump solids together for easier removal. Membrane bioreactors (MBRs) may also be used to remove microcontaminants before transferring water to the municipality.

This complicated equipment faces the threat of corrosive attacks from chemicals and alkalines that corrode steel, as well as fatty acids and microbiological bacteria that eat away at concrete. Protecting assets from those attacks means coating steel and concrete with the right materials that are designed to resist the specific stressors they'll encounter.

This is not a place to skimp on materials, as the last thing a plant wants is to have to replace coatings that didn't work in a couple of years. That's true not only for new wastewater treatment assets when building a new facility or replacing previous equipment, but also when choosing replacement coatings based on how the previous solutions performed.

When food and beverage processors get their coating and lining material selections right – for each pretreatment asset and the specific environment and exposures it will face – their next maintenance cycles will be farther away. Reduced maintenance needs lead to fewer and shorter shutdowns, as well as minimal emergency repairs, both

of which reduce a plant's total cost of ownership for operating assets. They also contribute to more sustainable operations.

When coatings maintenance is necessary – as it will inevitably be – that process needs to be as efficient as possible. Many food and beverage plants schedule planned maintenance shutdowns in which they'll address everything they possibly can within a week or even a weekend or short holiday break. To complete these tight turnarounds, plants need to ensure the coatings they use have fast return to service times, which can be enabled by fast curing times that allow foot and equipment traffic and even full immersion within hours of installations. Such products are especially advantageous during emergency shutdown situations, so plants can get back online as quickly as possible.

WHAT COATINGS AND LININGS TO USE

Selecting the optimal coating materials to enable the longest maintenance intervals and service life for any asset begins with an understanding of the food substances and chemicals that asset will encounter. That includes not only the cleaning agents themselves, but also any reactions that may occur when multiple chemistries are used, as some combinations of chemicals will create even more aggressive environments when they interact. The specified coatings will need to meet a minimum performance standard – or better yet, a higher standard – to resist attack from the most aggressive exposures.

For concrete assets, such as MBR basins, coagulation tanks and transfer pipelines, thick, chemical-resistant linings are a necessity and may require additive materials like glass flake for additional durability. The same is true for carbon steel tanks, with micaceous iron oxide (MIO) being a common additive, as the flakes settle into a lamellar orientation to create a tortuous path for water and contaminants to penetrate. Other steel assets may need flexible coatings to enable expansion and contraction when they encounter thermal shock from heated or chilled wastewater.

For linings that may be used on concrete tanks, basins and secondary containment areas, thicker films offer better barrier protection in these harsh environments, as do formulations containing reinforcement additives. While thin-film epoxies may be used in potable water applications, less permeable thick-film epoxies are needed to combat the aggressive contaminants that make up wastewater. Today's preferred technologies include 100% solids epoxies such as Sherwin-Williams Dura-Plate® 6000. The material is relatively impervious to moisture penetration, as it contains reinforcing glass flakes that stack on top of each other and create a tight crosslink that prevents moisture from reaching the substrate. Applicators can build the lining to a 125-mil dry film thickness (DFT) or higher within a single pass, bringing efficiency to the process of creating a high-strength, reinforced epoxy lining. Further efficiencies are realized when applicators use single-leg equipment to spray the two-component material rather than more complicated plural-component sprayers. In addition, Dura-Plate 6000 has fast-curing capabilities that allow applicators to accelerate project completions and return assets to service in 10 hours. Dura-Plate 6000 can also be used on steel tanks.

Sher-Glass® FF is a similar product that also features glass flakes and works on concrete and steel assets. The two-component flake-reinforced amine epoxy reduces permeability and can be applied in a wide range of harsh immersion conditions – but typically ones that are less aggressive than those where Dura-Plate 6000 would be the ideal solution. Sher-Glass FF features impact and abrasion resistance for durability and a long service life. It's also able to be applied via single-leg equipment for efficiency.

Figure 1 *An especially robust protective coating system for MBR basis may include reinforcement with fiberglass matting. In this installation, applicators applied Sherwin-Williams Dura-Plate UHS Clear Laminate as a base layer and then tinted the material green to provide contrast when sealing in a 1.5-ounce fiberglass mat for reinforcement.*

Concrete assets with especially severe chemical exposures may require even more robust lining systems. For example, linings for MBR basins must be able to withstand the highly corrosive 2% citric acid used to backwash and clean filters. In this case, the basins may require a lining system embedded with fiberglass matting. Following surface preparation, applicators may first apply a base layer of Sherwin-Williams Dura-Plate® UHS Clear Laminate, top that with a 1.5-ounce fiberglass mat **(Figures 1 and 2)** and seal that mat with more of the clear laminate material. Next, they may spray-apply Dura-Plate UHS Epoxy White as a high-build topcoat to protect the layers below **(Figure 3)**. This ultra-high-solids epoxy amine coatings system with fiberglass reinforcement provides superior protection with high-build, edge-retentive properties.

Figure 2 *Using aluminum fiberglass rollers, the applicators worked the green-tinted laminate material into the matting to ensure full wetting and proper adhesion.*

Figure 3 *For the final layer of the MBR basin linings, applicators spray-applied Dura-Plate UHS Epoxy White, an ultra-high-solids epoxy amine coating engineered for immersion service that features high-build, edge-retentive properties for superior protection.*

Figure 4 *For added protection in steel tanks, applicators commonly apply stripe coats of Dura-Plate UHS Primer, using a combination of brushing and rolling techniques, to ensure full coverage on weld seams, bolts and edges.*

For steel tanks that may be used to store or process wastewater, products like Sherwin-Williams Nova-Plate® UHS Epoxy are recommended for added durability in areas subject to high-wear and abrasion. The ultra-high-solids epoxy novolac amine was developed for immersion service and offers superior protection compared to conventional epoxies due to its advanced high-build, edge-retentive properties.

Inside such tanks, applicators may first apply a stripe coat of Dura-Plate® UHS Primer **(Figure 4)** to critical areas such as weld seams, edges, angles, bolts and more to ensure complete coverage on these surfaces. This ultra-high-solids, two-component epoxy amine has exceptional surface wetting and adhesion properties and is recommended for immersion service.

As chemicals increase in quantity, acidity and/or corrosiveness, food and beverage plants may need to look at different formulations that offer even greater durability. Dura-Plate® 8200 is one such option. Developed to handle the rigors of storing high temperature crude oil/water mixes and aggressive acids for the oil and gas industry, the high-temperature and chemical-resistant novolac tank lining can readily handle the rigors of severe wastewater pretreatment service. It acts as an insulating material to reduce the effects of thermal shock as higher-temperature contents fill an ambient temperature tank. The product offers the ease of single-leg application and cures rapidly, allowing assets to return to service within 24 hours, saving the added expense of additional downtime.

Another common line of coating solutions for wastewater service are vinyl esters and novolac vinyl esters, as they are highly resistant to organics and chemicals, as well as extreme corrosion. For example, Magnalux™ 2100FF is an epoxy novolac vinyl ester that's glass flake filled. Magnalux™ 2500WX is an acrylic co-polymer novolac vinyl ester that features wax in its formulation to improve chemical resistance and product purity. Both topcoat materials provide resistance to many aromatic and aliphatic solvents, organic and mineral acids, and strong oxidizers. They also offer excellent resistance to thermal degradation, making them suitable for use with heated contents.

Magnalux™ 1100 serves as a primer for the two topcoats. The polyester coating promotes adhesion to concrete and metal substrates and improves mechanical stresses such as impact, tensile and flexural stress, helping the topcoats last even longer.

Interestingly, vinyl esters are also used for resinous flooring installations for this same ability to resist acids. In fact, flooring is part of the wastewater treatment process that's hardly top of mind for plant managers since it's underfoot. But these surfaces will need to resist many of the same materials that tank linings and other coatings do, as wastewater may spill or splash onto floors. So, flooring also needs to be specified carefully.

HOW TO ADDRESS MULTI-SURFACE COMBINATIONS

Sometimes both steel and concrete are used in the same equipment – with the steel even embedded inside concrete in some situations. This particular combination creates a challenging situation for coatings, as steel and concrete expand and contract at different rates, creating multi-directional stresses on the materials.

Consider a small cheese plant that uses a 150-foot diameter, all-in-one tank unit to pretreat wastewater, removing FOGs, solids, acids and cleaning chemicals from the plant's wastewater stream. Operators first add various coagulants to the tank, which destabilize suspended particles via chemical reactions so the waste solids begin to clump together. Next, a steel flocculation arm gently mixes the contents to allow larger clumps to form for easier separation of waste from the water. During this process, the tank and its related equipment are exposed directly to highly acidic and caustic contents, necessitating robust coatings to protect their integrity.

Interestingly, the tank is made from different materials, with steel walls embedded in a concrete foundation. This steel-to-concrete transition creates a unique challenge for protecting those different materials with coatings. As the tank contents are heated, the steel walls expand in one direction, while the concrete foundation expands in a more limited fashion. Therefore, the leading edge of the steel-to-concrete transition will experience significant stress that could potentially cause coatings to crack and peel, allowing tank contents to reach both the steel and concrete substrates.

In some cases, the solution would be to leave the concrete uncoated since it would be beneath the oxygen level and therefore wouldn't have enough oxygen available to corrode. However, that foundation will likely need to be coated in most cases.

For this tank, applicators used a two-fold solution to coat the concrete and steel, while limiting the stress placed on the 90-degree transition from the steel walls to the concrete floor. They first installed a cant cove at the transition, adding flexible material at the base of the walls to create a 45-degree angle instead. That Resuflor™ Topfloor MER I (Mechanical Equipment Room) material offers flexible epoxy crack bridging capabilities to reduce stress at angles and allow movement as the steel and concrete expand and contract at different rates. They next added fiberglass mesh to the transition area, overlapping it a couple of inches each way to reinforce the transition. Finally, they applied a topcoat of Dura-Plate 8200, with Nova-Plate® UHS also being an option as a durable, high-build protective topcoat.

COATINGS SELECTION SUPPORT AND SITE SURVEYS ENABLE SUCCESS

Given the array of assets used in the food and beverage wastewater pretreatment process and the multitude of coating and lining solutions available to keep that equipment in peak operating condition, selecting the ideal protective solutions can be a challenge. To get those selections right, food and beverage plant managers are best served by consulting with coatings manufacturers to identify what exposures the equipment will face and

what coating solutions can be considered to mitigate those corrosive threats. In many cases, a certified coatings professional will be able to provide an array of solutions that algin longevity of service with operating and maintenance budgets, giving plant managers a range of options to meet the needs at hand. While the most robust coatings solution will be desired in most cases, some situations will call for more budget-conscious or short-term fixes before the plant invests in a longer-term solution.

A certified coatings expert can help in other ways, as well, including engaging in site surveys to help plant managers identify any current deficiencies and prepare for future coatings maintenance needs. During a site survey, a certified coatings expert will look for areas of paint cracking, blistering or peeling that indicate an imminent coating failure, as well as observe all areas where coatings are used or could be used to maintain assets. They'll then prepare a report listing recommended maintenance protocols for each asset and provide a list of vetted contractors that have been approved to install the suggested coating systems. This comprehensive report thereby readies facilities for any coating maintenance-related needs – from having a tiered selection of potential solutions at the ready to providing qualified leads for getting the job done.

With the right materials specified and the right contractors doing the work, food and beverage facilities can be poised to realize longer service lives for their operating assets, which in turn leads to reduce maintenance needs and unplanned shutdowns, as well as a healthier bottom line.

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