

CHAPTER 17.1

WASTE TREATMENT PLANTS

by

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Since the signing of the Clean Waters Act in 1966 and the classification of most of America's waterways according to the type of effluent that can be discharged into them, there has been a tremendous increase in construction of new water pollution control plants and in upgrading and enlarging existing plants.

At the same time, the country has been undergoing an environmental and ecological revolution. The community is more aware of treatment plants and has made demands regarding the plants' appearance and function. Consequently, water treatment and water pollution control plants have changed rapidly and radically in design. Modern treatment plants can be beautifully designed and efficiently run. Between the influent and effluent channels, extremely complex physical, biological and chemical processes are conducted. They create some of the most severe conditions encountered by any mechanical equipment. Thus, these plants have needs for corrosion protection rarely found in other types of construction.

The ever-increasing role of complex chemicals in industry and the regulation of their discharge, together with household detergents and municipal biological wastes, have created new problems for water pollution control plant designers. Coatings that were accepted for many years to protect submerged surfaces in water pollution control plants are outmoded because of increasingly harsh sewage. During these years, coal tar epoxy coatings have come of age because of their high degree of chemical resistance. Recently, because of advantages in function, application and esthetics, the colored high build epoxies have found favor in submerged applications and are replacing coal tar epoxies in many instances.

Large, complex treatment plants take from two to four years to build and can treat anywhere from one million to 100 million gallons or more of wastewater per day. The equipment and steel fabrications required can come from dozens of manufacturers and fabricators from various parts of the country. They often sit around at the construction site for months before being used.

I. SPECIFICATION

Putting together a good protective coating job in large and complex water treatment and water pollution control plants is not easy. It certainly is not a one-man operation. A good protective coating requires teamwork. The engineer, applicator, coatings manufacturer and inspector must cooperate. Working together, they can produce maximum benefits, long term protection, pleasing appearance

and easy maintenance.

The corrosion engineer or specification writer carries a great deal of the responsibility. He must prepare specifications that include coating system, number of coats, film thickness, surface preparation, application and inspection procedures. The engineer often relies heavily on the cooperation of coatings suppliers with many years of experience in protective coatings.

Whether for new construction or maintenance painting, a good protective coating system begins with a properly written, well conceived painting specification. A complete paint specification covers every phase of the project. It helps assure uniform bidding, effective job timing and compatibility of shop- and field-applied coatings. It spells out to fabricators, equipment manufacturers and the painting contractor the surface preparation, number and types of coatings, dry film thickness of systems and application requirements. In determining dry film thickness for a coating system, the corrosion engineers must consider:

- Service requirements and environmental conditions
- Type of surface to be coated
- Type of coating system being used
- Volume solids content of the coating
- Number of coats
- Surface preparation
- Method of application
- Economics
- Physical Limitations

II. SELECTION OF THE COATING SYSTEM

In selecting the proper coating system for a water pollution control plant, the project engineer has three prime objectives:

- Long term protection
- Pleasing appearance
- Ease of maintenance during operation

The type of coating system selected should be dictated by service requirements and environmental conditions of the unit, the substrate to be protected and economics. In this application, economics means long-term economy. The high performance coating systems require sophisticated and expensive surface preparation and are often the most expensive; however, they represent the best value because they withstand severe service requirements, provide long-term protection and create considerably longer repaint cycles.

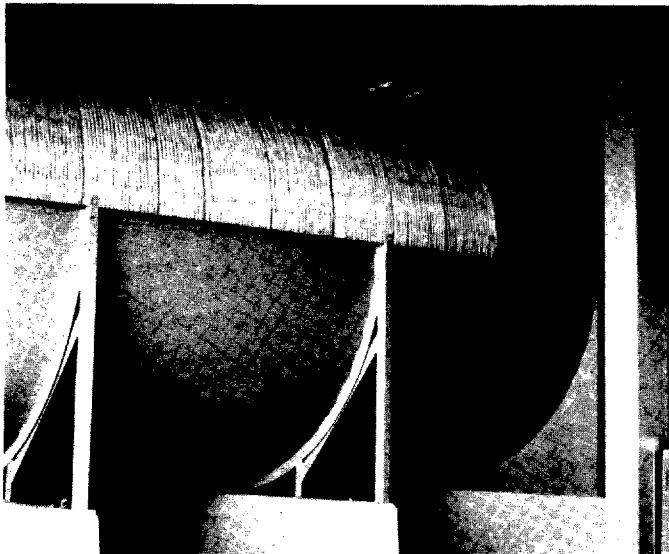
The best time to prepare and coat submerged service areas is during construction. When taken down for service at a later date, which can be extremely difficult and costly, painting conditions are almost never as favorable as during construction. This is particularly true of interiors of concrete process tanks.

Recently, coating specifications have been simplified by greater use of high performance coatings. Engineers are trying to make specifications simple by using as few coating systems and thinners as possible. Fewer product classes simplify inspection and application and minimize compatibility problems. There have even been a few suggestions that an entire facility be coated with high build epoxy on both submerged and non-submerged areas. This might be carrying simplification to extremes and slightly limits good color selection and long-term appearance because of early chalking and loss of gloss of epoxy coatings from sunlight exposure.

III. SUBMERGED EXPOSURE

There has been a growing use of colored, high build epoxy coatings on submerged steel and concrete surfaces. They are frequently used in process tanks in place of the coal tar epoxy coatings. The colored high build epoxy coatings offer functional and esthetic advantages.

Esthetic advantages are obvious. Coal tar epoxy is a black coating while high build epoxy is available in a range of colors. Light greens and tans are most popular for immersion. It is more pleasing to see a treatment plant with its large screw pumps, grit chambers, clarifiers, aeration tanks, chlorine detention tanks and other large process tanks coated with attractive and durable pastel colors instead of a drab black coating.



Courtesy International Paint Company, Inc.

FIGURE 1

Bio-disc filter. Primed with high-build epoxy, topcoated with tan epoxy gloss finish. Steel surface preparation SSPC-SP 10, Near White Blast.

Functionally, high build epoxy coatings offer certain advantages regarding recoat limitations and intercoat adhesion, when compared with coal tar epoxy coatings. Coal tar epoxy coatings, when cured, are very slick and solvent-resistant; consequently, they have intercoat adhesion problems. Most coating manufacturers place a recoat limitation of 24 to 72 hours, depending on the formulation. Top coats of coal tar epoxy applied after that time cannot be expected to yield optimum intercoat adhesion. Many engineers specify that coal tar epoxy be top coated within 48 hours. If this time is exceeded, all surfaces must be sweepblasted to provide "tooth" before top coating. Because of the complexity and size of today's plants, the recoat limitation presents serious problems. It also eliminates the use of coal tar epoxy as a shop coating and dictates using a catalyzed epoxy inhibitive primer as the shop primer with top coats applied later in the field.

More recently, high build, high solids coal tar epoxy coatings have been offered that can build films of 15 to 20 mils dry in a single coat. This one coat high build potential would certainly eliminate the intercoat adhesion and recoat limitations of multi-coat coal tar epoxy systems.

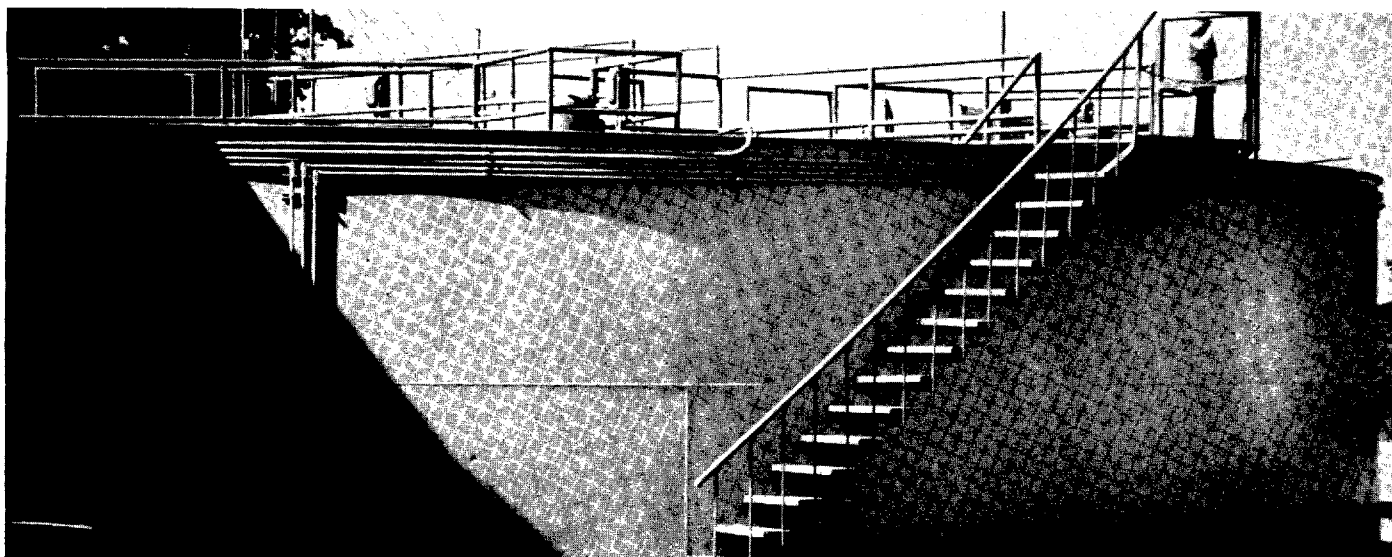
High build epoxy coatings, because of their pigmented matte finish, generally do not present the intercoat adhesion problems and time limitations for recoating. They can be used as shop primers or as fully shop-applied systems since they are easily repaired and recoated. Often a thin, two mil dry film thickness coat of high build epoxy is applied in the shop to abrasive blasted steel. The same coating can then be applied as two additional five mil coats at the job site during construction. The time lapse between shop primer and field coats could be several months or even years with no serious intercoat adhesion problem.

Another esthetic drawback of coal tar epoxy coatings is that they blush when applied or cured during periods of high humidity or if a condensate forms on the coated steel during curing. This leaves a streaky, mucky brown appearance that is not pleasing to the engineer or client, even though this blushing has no harmful effect on the coating system. Coal tar epoxy coatings lose gloss and can become dull in prolonged sunlight. It is not unusual for coated steel and equipment to be sitting at the job site for many months before being put into service.

Many high build epoxy coatings have the necessary approvals for use in potable water and are a major lining system for water storage tanks. This facilitates selection of coatings for a water treatment plant since the coating system can be identical to the wastewater plant.

The role of coal tar epoxy, despite its limitations, continues to be very important in waste treatment plants. These coatings are excellent for applying to the backfill, below grade surfaces of process tanks and buildings.

Coal tar epoxy coatings perform an important service in protecting concrete pipeline and manholes from the oxidation of hydrogen sulfide, which takes place mainly or exclusively above the water line. A two coat, 16 mil dry film



Courtesy International Paint Co., Inc.

FIGURE 2

Bio-sorption unit. Exterior tank shell coated with three-coat acrylic emulsion system in tan finish. Stairs, handrails and bridge over tank coated with light green epoxy system. Interior immersion area painted with two coats of coal tar epoxy.

thickness, coal tar epoxy system should be specified for concrete pipe carrying raw waste to the treatment plant. Polyvinyl chloride sheet linings have also been used extensively and successfully to protect concrete pipe carrying raw sewage. The vinyl sheet liner is mechanically built into the pipe when the pipe is constructed.

IV. NON-SUBMERGED — SEVERE EXPOSURE

Catalyzed epoxy enamels are used extensively for moist atmosphere, non-submerged service conditions on steel surfaces, machinery and equipment in indoor areas. Wherever wastewater surfaces are exposed, moisture condenses on cool steel surfaces and unites with gases to create highly corrosive conditions. These conditions are frequent in wet wells, grit and screen chambers, chemical mixing rooms, pump stations and dry wells. The enamel epoxy coatings are used because of the high gloss finish and broad color selection rather than the high build epoxy. High builds can certainly be used in this service area, particularly if a satin sheen appearance is preferred and if simplification of the specifications by fewer product lines is desired. Epoxy coatings should not be used in exterior moist atmosphere, non-submerged, severe service conditions because they lose gloss rapidly and chalk early. The chalking is non-progressive and film integrity is good; the problem is essentially an esthetic one.

For this service area, the vinyl coating systems perform well on exterior applications. In many cases bridges, catwalks, handrails and other steel equipment over clarifiers and aeration tanks are painted with a vinyl system in a color that matches the high build epoxy used on the submerged surfaces. The top sides of fixed and floating digester covers and floating gas holders can also be painted with a colored vinyl coating system. The vinyl

system in these applications offers the water and chemical resistance required for the service conditions and at the same time gives the esthetic benefits of good gloss and color retention.

V. SUNLIGHT AND WEATHER EXPOSURE

The selection of coatings for outside exposure is similar to selection in a normal industrial environment except for sewer gas. This is usually an esthetic problem since the sewer gas, hydrogen sulfide, can discolor coatings, particularly those containing lead. Although the concentration of gas is not sufficient to affect coating integrity, lead-free coatings should be specified and used in this service environment. Items to be painted under this service condition include exterior plant structures, piping, valves, ramps, doors, sash, handrails, motors, fences and other similar structures.

The coatings system generally used for outside exposure is the alkyd. The same vinyl coatings used in non-submerged severe conditions could also be used if the intent is to use as few products as possible. But alkyd systems usually offer much broader color selection than do vinyls and have fewer problems of compatibility with shop primers and other coatings. In addition, the alkyd coating offers simpler application properties to the contractor. Vinyls, because they dry quickly, cannot generally be applied by brush or roller.

The newer acrylic emulsion coatings make an excellent choice for this service in place of the alkyd system or over alkyd shopcoats. The acrylic emulsions offer better color and gloss retention than the alkyds, although their initial gloss is not so high as that of the alkyd system. The newer acrylic emulsion coatings meet all air emission regulations and present no discoloration problems. These



Courtesy International Paint Co., Inc.

FIGURE 3

Auger screw pumps coated with two coats light blue high build epoxy system, 10 mils dry film thickness over SSPC-SP 10 Near-White Metal Blast.

coatings can, however, present weather-related application problems. If applied below 50°F they do not coalesce properly and film integrity is weakened. This can be a serious shortcoming in new construction because painting cannot always be carried out under ideal conditions.

VI. INSIDE DRY EXPOSURE

This service condition includes laboratories, workshops, pump rooms, blower rooms, control rooms and similar facilities. Items painted include walls, ceilings, concrete floors, doors, frames, sash, control boxes, pumps, motors, handrails, piping, etc. The main reason for painting is generally for appearance and improved housekeeping. Hydrogen sulfide gas should not normally be present, but the possibility exists for minimal amounts that might cause discoloration in some coatings, so lead free coatings should be selected.

The alkyd coating systems are generally used on metal surfaces and on piping and equipment to provide color coding.

The above-grade walls, which are often concrete block, are filled with a latex block filler and often top-coated with a two coat catalyzed epoxy enamel to simulate an inexpensive tile-like finish. Ceilings are generally painted with two coats of a latex flat white. For sewage plant service, exterior latex coatings are preferred to the interior type because of the lower pigment volume and higher binder content.

There is a trend to use many of the emulsion type coatings for inside dry areas, particularly the new acrylic emulsions on walls. The acrylic emulsion coatings are single-package, tough, attractive coatings that become hard and serviceable. Since acrylic emulsions are water-thinned, there are no strong solvent odors to irritate the other trades working near the painting operations. Since they contain no solvent, they present no problems regarding environmental regulations for air emissions. They dry quickly, permitting more than one coat to be applied in a day and minimizing movement of staging and rigging. They are very easy to use for both new construction and maintenance painting.

These attractive and convenient semi-gloss and gloss acrylic coatings are replacing chlorinated rubber and epoxy coatings as wall coatings in buildings where surfaces stay dry most of the time and the service condition is normal industrial exposure. Today's modern waste treatment plants are generally well ventilated and heated, so there are many more areas where acrylic emulsion coating systems can be used.

Below-grade, poured concrete walls and ceilings are usually painted with latex emulsion flats, either vinyl acetate, vinyl acrylic or straight acrylic emulsions. Two coats of the same product are generally sufficient.

Concrete floors are another area of concern for painting inside the buildings in a water pollution control plant. They are generally painted for appearance and plant housekeeping, which is complicated by substantial abrasion and abuse in addition to spills of chemicals and water. The catalyzed epoxy enamels perform best because of their toughness, abrasion resistance and resistance to water and chemicals. A three coat system is usually applied with the first coat thinned at least 25% to increase penetration and promote adhesion. A non-skid additive is frequently added to the last coat to minimize slipping, particularly when the floor is wet. Care should be taken to properly prepare the concrete floor either by acid etching or sweepblasting.

Some water pollution control plants may have equipment with hot surfaces to be painted while in operation. It is important to know precisely the metal temperature involved. Heat resistant coatings require a good surface preparation, at least an SSPC-SP 6 Commercial Blast and preferably an SSPC-SP 10 Near White Blast for the higher temperatures. There is a great variety of heat resistant coatings available and each manufacturer has his own approach regarding temperature ranges. Instructions should be followed carefully. Generally, a silicone