# DESIGNING STEEL TANK COATING SYSTEMS FOR COMPLIANCE WITH TODAY'S STANDARDS

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ABSTRACT

New standards and regulations are being developed for coating steel tanks that include health effects for drinking water as well as atmospheric pollution. In addition, removing old coatings is no longer a simple task. This paper addresses the effect of these standards on the tank coating industry and discusses the process involved in designing the optimum coating system. Economic considerations of coating options are also presented.

Designing coating systems for use on the exterior and interior surfaces of steel tanks has never been a simple task. Many factors including economics, service life, ability to topcoat, tank location, and aesthetics weigh heavily in the decision-making process. Each factor carries a different priority for each tank. The introduction of environmental legislation and regulation has resulted in standards concerning both the application of new coatings and the removal of existing coatings. These regulations make the design of an optimum coating system even more complex. When designing a coating system, it is critical that the tank owner and specifier be aware of all performance criteria for each coating system. They must also consider all potential environmental repercussions, and the coating must be in compliance with all current regulations.

## PRE-COATING DESIGN QUALIFICATIONS

The specifying engineer needs to address all aspects of anticipated operating requirements and conditions. Whether the tank in question is a new tank or an existing tank, the specifying engineer must consider the following questions:

1. Where is the tank located? Is it in a corrosively aggressive environment or a heavily populated area?
2. Will the proximity of adjacent structures or transportation routes restrict either initial coating application or future maintenance operations?
3. Are prohibitive maintenance costs inherent with the style of tank?
4. What is the condition of the existing coating system? Does the coating contain lead-pigments? Is the coating thickness and adhesion acceptable for topcoating?
5. How long can the tank be out of service for the required maintenance? Are there any seasonal restrictions or preferences for performing the work?
6. How important is the aesthetic appeal of the tank?
7. What are the plans, both long-term and short-term, for the tank?
8. Will the economics of applying a shop primer affect the coating system selection?
9. Is there a recurring mode or type of coating failure present?
10. Is there an area of concentrated corrosion present on the tank?

After the coating specifier has answered these questions, specifier can turn to published standards and literature for potential, acceptable coating systems. The most widely used standard for determining coating system candidates for use on water storage tanks is the American Water Works Association Standard for Painting Steel Water Storage Tanks (AWWA D102). Other applicable standards include the Steel Structures Painting Council (SSPC), as well as independent coating manufacturers published literature and product data sheets. The specifier will also need to determine

which environmental regulations must be satisfied, depending upon the area of the country the tank is located in. Examples of environmental requirements that may need to be met are those standards set by the National Sanitation Foundation (NSF), and state and local Environmental Protection Agency and Health Department regulations. The environmental standards mandate acceptable levels of a variety of items including the amount of lead present in the air and on the ground during cleaning operations. The regulations also address the amount of volatile organic compounds (VOC's) released into the air during painting operations, and the amount of metals, organics, and microbiological growth present in the water.

## DESIRED COATING SYSTEM CHARACTERISTICS

After the specifier has determined what the individual tank requirements are, which environmental standards must be satisfied, and the potential coating systems available, the designer must then determine the requirements of the coating system itself. To accomplish this, the specifier should consider the following questions:

1. What is an acceptable initial cost?

2. What is the minimum acceptable anticipated service life?

3. Will the proposed coating system minimize or eliminate the need for on-site exterior abrasive blast cleaning during either new tank construction or existing tank rehabilitation?

4. Will the proposed coating system be easily maintained by touch-up and maintenance topcoating, thus eliminating the need for abrasive blasting to bare steel until the coating has been topcoated several times?

5. During coating system application, will the level of VOC's released into the atmosphere comply with applicable environmental regulations?

6. Will the coating system mitigate crevice corrosion associated with unsealed or uncoated interfaces of steel surfaces?

7. Does the proposed coating system meet ANSI/NSF standards or those developed by state and local primacy regulatory agencies?

8. Is the proposed coating system identified by generic performance terms to allow a number of qualified manufacturers to submit competitive bids?

9. Is the proposed coating system identified by performance terms which are so generic that they would not uphold the expected standards of quality or performance?

10. Is the coating easily applied under field conditions utilizing equipment that is readily available to the contractor?

11. Is the coating system recoat window one that allows for flexibility or unanticipated delays?

12. Does the coating have exterior application options that could minimize the probability of paint damage to adjacent property?

The specifier must also consider individual coating system characteristics such as graffiti resistance, fading, chalking, gloss retention, and fallout. The specifier can perform a relative comparison of typical, generic coating systems for specific coating system characteristics using Table 1 at the end of this paper.

## ENVIRONMENTAL CONCERNS AND REGULATIONS

In the past, the coating system specifier needed only refer to those requirements set forth in AWWA D102-78 and satisfy those interior coating requirements listed by USEPA and state or local EPA agencies and health departments. However, AWWA D102-78 has been in the state of revision for the past ten years, and the USEPA has not accepted new applications for protective coating approval since July of 1988. On April 7, 1990, USEPA withdrew all present approvals and NSF Standard 61 was to be available for individual state acceptance. As of the writing of this article, approximately thirty water tank coating systems have been approved for use in contact with potable water. Many others are undergoing the testing process. Because of the delays in the certification process, state regulatory agencies do not have a reasonable number of approved coatings from which to choose. Most states have indicated that they will ultimately use Standard 61 as their criteria for acceptance. But many states are allowing a "stay of execution" until more coatings can complete the testing and approval process. The American Water Works Association has recommended that the earliest implementation of NSF's listing should be July 1, 1992.

ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, covering indirect additives, was officially adopted in 1988. NSF was the lead organization of a consortium contracted by USEPA to develop standards using a voluntary consensus process. NSF was charged with the task of establishing minimum requirements for the control of potential adverse health effects from products in contact with potable water. Besides the leaching of dangerous metals such as lead, chromium, or mercury into the water, Standard 61 also establishes allowable limits of leaching of organic chemicals like methyl ethyl ketone and xylene into potable water. The testing laboratory will report the coating's ability to support microbiological; however, the coating will not be failed based on this criteria.

The testing of coatings to determine their compliance with Standard 61 is a two phase process. The first phase is the Toxicology Data Review Submission. During this phase, coating manufacturers submit for review the composition of formulation of all coating components including materials, ingredients, reactants, and processing aids. The second phase is the testing of the coatings when applied to glass test slides and exposed to test water. The test water is evaluated for leaching of suspected dangerous ingredients at various exposure times. The NSF has the responsibility of determining if the coating system complies with the unfavorable health effects limits set by the EPA. Determining the ability of a proposed material to perform its intended function is not a mandate of the NSF.

There are two important areas of coating approval and regulation which Standard 61 does not address. One of these areas is the testing of a coating system to determine its potential to impart taste or odor to potable water. The other area not addressed by Standard 61 is the status of the coating once it leaves the manufacturer's facility. All the control and auditing up to this point will be to no avail if the coating is not stored, shipped, mixed, and applied properly.

The coatings specifier must also consider the VOC content of a coating system and its impact on the environment. The allowable VOC content of a coating system varies from one state to another. For example, a solvent-based vinyl coating may be acceptable in the Midwest, but might not meet the restrictions enforced in California, New York, or other large metropolitan areas. In addition, regulations concerning allowable VOC limits are changing quickly. Limits on coating VOC content are also dependent upon whether the tank is painted in the field or in a shop. Additionally, variances could be granted to perform a topcoat application with a coating system which has an excessive VOC content if it is proven that the topcoat application will release lesser amounts of VOC's into the atmosphere than a complete multi-coat application of a lower VOC system. Therefore, the specifier must choose a coating system designed to comply with the regulations in effect in that area of the country, under those application techniques that he or she specifies. The specifier must also keep in mind that allowable VOC limits will most likely be lowered soon, thus reducing the flexibility of a topcoat maintenance operation.

## COATING SYSTEMS AND SURFACE PREPARATION REQUIREMENTS

The surface preparation requirements of individual coating systems are important design criteria. Whether the abrasive blast cleaning of a tank is exposing the environment to toxic levels of lead, or the abrasive blast is simply creating an attractive nuisance, the degree of cleanliness and the method of cleaning are design criteria which must be evaluated.

### New Tanks

The shop cleaning and priming of new tanks has been found to be an economically viable alternative. The cleaning of steel surfaces in the shop costs about 1/10 that of field abrasive blast cleaning using conventional air-abrasive methods. However, the shop priming of tanks exposes the prime coat to moisture, ultraviolet rays, and abrasion and damage during handling, shipping, storage, and the erection and welding process. In addition, the recoat window of the prime coat must be closely monitored to prevent hindered adhesion of ensuing coats.

The specifier has the opportunity to circumvent these apparent obstacles during the design phase. The specifier can choose a prime coat that has the characteristics to resist abrasion, ultraviolet rays, moisture, and other damage. The proposed coating system should also have a recoat window of up to 400 days to allow for the fabrication and erection process to take place. An example of a coating system that incorporates all of these characteristics is an SSPC Type I-C Solvent Based Two-Component Inorganic Zinc Primer. Cleaning the areas around the welds, fitting scars, and scaffold bracket clip attachments using a profile-producing non-woven abrasive disk will alleviate the abrasive blast cleaning of the coating damaged during the erection. This can best be done if the welds have proper contour, with no undercut or overlap.

Existing Tanks

When considering a coating maintenance repair, the specifier must first determine if topcoating the existing coating system is a viable alternative. The specifier can determine this by examining the type, age, thickness, and adhesion of the existing coating system. Another critical factor when deciding upon the viability of a topcoat repair is whether or not the existing coating system contains lead-pigments. Federal, state, and local environmental agencies have placed stricter controls on the removal of lead-based paints from steel structures by the use of conventional abrasive blasting techniques. Regulatory agencies may consider the coating and blast residue to be hazardous waste depending on the concentration of lead or other particles in the residue, and the results of toxicity leaching test.

The Resource Conservation and Recovery Act (RCRA) of the USEPA has modified the regulations concerning the transportation of hazardous waste. The new regulations prohibit the disposal of untreated hazardous waste at the previously approved dumpsites. Now, certain hazardous waste may have to be chemically treated and neutralized before disposal. Before eliminating the possibility of topcoating the existing coating system, the specifier must weigh the costs for removal, containment, and disposal of any spent abrasive blast debris that is tested to be hazardous.

CONCLUSIONS

The specifier must consider a wide variety of performance criteria in addition to compliance with government and environmental regulations before specifying a generic type of coating system. The specifier must also evaluate the requirements of the tank and the tank owner before finalizing the type of coating repair to be performed. However, the time and effort required to choose the optimum coating system for each tank is essential to insure that the maximum life expectancy of the coating is realized, and the economics of tank maintenance are optimized.

TABLE 1

| | Zinc-Primed Epoxy Poly-urethane | Epoxy-Primed Epoxy Poly-urethane | Modified Acrylic | Vinyl | Silicone Alkyd | Zinc-Primed Water Emulsion Acrylic | Water Emulsion Acrylic | Alkyd |
|---|---|---|---|---|---|---|---|---|
| Ease of Application | P | F | G | F-G | G | F | G | E |
| Resists Abrasion | E | G | F | P-F | F | G | F | F |
| Resists Graffiti | E | E | P | P | P | P | P | P |
| Resists Fading | E | E | F | F | G | F | G | P |
| Resists Chalking | E | E | F | F | G | F | G | P |
| Retains Gloss | E | E | F | F | G | F | G | P |
| Apply over Alkyd | No | No | No | No | Yes | Yes | Yes | Yes |
| Easy to Topcoat | F | P | G | E | G | E | E | G |
| Dry Fallout | P | P | G | G | P | E | E | P |
| Corrosion Resistance | E | E | G | G | F | E | P | F |
| Life | E | E | G | G | F-G | G | F | F |
| Cost | High | High | High | High | Medium | Medium | Medium | Low |
| Meet VOC's | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |

P = Poor F = Fair G = Good E = Excellent

(Revised 3/18/92)