In contrast to inland environments, developing scopes of work for coating and lining storage tanks at oil and gas terminals on the U.S. Gulf Coast requires attention to the challenges of frequent rain, high heat and high humidity. The presence of pervasive moisture and heat calls for the availability of expertise when selecting the appropriate products to keep the project on track and within budget, and most importantly, to provide outstanding corrosion protection to critical plant assets.

This article will discuss the latest coating technologies for protecting all parts of petrochemical storage tanks situated in these coastal settings. We will examine: 1) a fast return to service (RTS) tank lining; 2) a new approach for protecting a tank’s floating roof from ponding water; 3) a high-throughput polyaspartic urethane coating for atmospheric exposures; and 4) spray-applied thermal insulation as a permanent solution to the corrosion that occurs under standard insulation and cladding.

Internal Linings
From a macro viewpoint, standard-cure tank lining materials are a sound choice for protecting the internal floors and shell walls of most tanks in immersion service. These materials are easy to apply, cure to service in approximately five to seven days and generally perform well. However, in certain instances, putting tanks back into service the same day or overnight makes economic sense, and coastal environments can present such a scenario.

In Gulf Coast settings, dehumidification equipment and, in winter, heating equipment, must be supplied by the contractor to maintain required environmental parameters during the application process. Newer lining materials that cure in less than 24 hours can significantly reduce the costs of renting this equipment over the course of a project, and positively influence inspection time frames as well as the overall project schedule, while still maintaining a very high level of corrosion protection.

Fast RTS tank linings can handle a broad spectrum of cargos within the petrochemical segment including ambient temperature crude oil, gasoline, jet fuel, diesel fuel, kerosene and ethanol. These linings are most commonly medium-film materials (20 to 60 mils DFT) available in amine, phenolic and novolac resins. The resins are sometimes combined with micaceous iron oxide and/or glass flake/ceramic beads in order to enhance corrosion protection.

Fast RTS tank lining materials, many of which are self-priming, are applied with plurals...
The welded carbon steel roof is designed so that the roof floats on the commodity and rises and falls based on the level of the liquid in the tank. Thus the vapor space is minimized, reducing the evaporative and volatile emissions into the atmosphere.

In the Gulf Coast region, rainwater will collect and pond in the low areas of the roof. When combined with the fallout from the adjacent refinery or chemical processing facility, and exposure to UV rays, a severe corrosive condition is activated.

In traditional external floating roof new construction and maintenance, a thin-film two-coat system of an immersion-grade epoxy has been the standard in the oil and gas industry. The coating is applied at 5 to 6 mils DFT per coat with a total of 10 to 12 mils DFT. These systems are normally applied over multiple days and project schedules are often impacted by the fast-developing rain prevalent on the Gulf Coast.

However, nowadays owners are seeking solutions to achieve a 20-year service life for their external floating roof coatings. One option is to improve the coating system and the barrier protection by increasing the DFT to 20 mils with a medium-film coating system. Adding additional DFT brings with it extra considerations. The performance of the coating system at an elevated temperature range cannot be compromised in any way, and the heat of the commodity can raise the floating roof temperature to as much as 130 to 140 F. Therefore, the coating system will require application capability at this temperature.

External Floating Roofs

Because of its attributes, the fast RTS tank lining system is increasingly being employed to prolong the service life of a tank’s external floating roof. External floating roof storage tanks are utilized at terminals and refineries to store petroleum products such as crude oil and condensate. The point of view of the owner is making owners receptive to the idea of fast RTS tank lining materials. It can be a game-changer option for owners accustomed to standard-cure materials that may require weeks to put tanks into service, and it reduces the cost of onsite inspectors who will be able to oversee repairs and final inspections within a much shorter time frame.

A separate issue is the condition of the tank bottoms, i.e., whether the substrates are heavily pitted or new. It is important to note that in hot weather (above 90 F), the substantially shorter dry times of fast RTS materials must be factored in, in order to allow open time for the product to flow into and fill all pitted areas without producing excessive holidays and discontinuities.

Ultimately, the expense of heat and dehumidification is making owners receptive to the idea of fast RTS tank lining materials.
Coatings Work in Gulf Coast Environments

In addition to ensuring the suitability of applying the product on a hot steel substrate intended for ponding water service, specification considerations include application conditions and the flexibility of the product, as well as the need to address coating edge retention on the weld seams to avoid premature corrosion, ensuring the single coat will provide the same degree of coverage as it would on the flat surfaces.

It should also be noted that because it will take several days for the entire roof to be blast cleaned and fully primed, the substrate must be protected for the duration of the project as work is completed each day. To preserve the blast-cleaned substrate over the course of those days, a fast-drying epoxy primer or organic zinc-rich epoxy primer is applied at 2 to 2.5 mils DFT.

A fast-cure 100% volume solids edge retentive epoxy applied with plural component spray equipment is utilized as the finish coat. Also required is a stripe coat of the finish coat on the weld seams and edges prior to applying the finish coat. The fast RTS coating can be exposed to foot traffic in as little as one hour and cure-to-service is eight to 24 hours. This condensed curing schedule versus the standard premium three-coat zinc/epoxy/urethane system potentially removes several days and significant labor cost from the painting schedule, and the fast-cure properties of the polyaspartic urethanes include early moisture resistance, greatly diminishing the risk of rain or fog damaging the freshly painted finish coat.

External Cone Roof/Shell System

The qualifications for coating systems for a tank’s external shell and cone roof in a Gulf Coast environment are also in a state of evolution. The industry standard for dealing with the high humidity, salt spray and rain of these settings has been the three-coat zinc/epoxy/urethane system. However, over the past few years new materials have been developed that are extremely moisture tolerant, provide quick dry-to-handle times and offer superior corrosion protection.

Polyaspartic urethane resin technology provides a coating with the long-term corrosion resistance and exterior durability of a conventional urethane finish coat with dry-to-handle times the market hasn’t previously seen. These next generation coatings are capable of application to 9 mils DFT in a single coat, and cure to be rain resistant, even in high humidity, in as little as one hour.

For light to moderately corrosive environments, these coatings are available as single-coat direct-to-metal (DTM) one-coat formulations. In the highly corrosive Gulf Coast environment, they may be applied in one coat over either an organic or inorganic zinc primer after abrasive blasting to provide the total system thickness and performance previously only obtainable by installing the standard premium three-coat zinc/epoxy/urethane system.

Elimination of one coat of the conventional system potentially removes several days and significant labor cost from the painting schedule, and the fast-cure properties of the polyaspartic urethanes include early moisture resistance, greatly diminishing the risk of rain or fog damaging the freshly painted finish coat.

Thermal Insulation

In most petrochemical facilities, tanks, piping and valves in hot service are insulated by preparing and priming the steel, wrapping them with insulation materials such as mineral wool or calcium silicate, and then cladding them with light metal jackets to protect insulation from elements and minimize moisture intrusion.

Conventional insulation, while very efficient when dry, loses much of its thermal insulating properties once it is permeated with moisture. Frequent rains and high-humidity conditions provide endless moisture which infiltrates either as liquid or water vapor under the insulation cladding, saturating the insulation material. The result can be catastrophic in its effects, and is known as corrosion under insulation (CUI).

Two problems are set in motion here: first, the insulation value is greatly diminished as the air in the insulation material is replaced by water which is exponentially higher in thermal conductivity. Second, the moisture combines with airborne chemicals and salt as well as the insulation material itself to become an ideal electrolyte for corrosion cells to form on the asset substrate. This corrosive activity is hidden, and often not discovered until full rust-through of the substrate has occurred. To combat this safety and reliability issue, expensive spot inspection for CUI is often employed.

Increasingly, owners are opting to install spray-applied, non-clad thermal insulative coatings that provide a monolithic barrier to water, chemicals, UV rays and heat transfer. They also provide personnel burn protection, thermal insulation for energy conservation, condensation control and protection from radiant solar heating.

Formulated from waterborne acrylic resins with ceramic and glass beads or microspheres that minimize energy transfer through the film due to its high air content, these coatings adhere to the underlying primer and prevent water or moist air from corrodng the steel. The air content is so high in these coatings that the weight of a liquid gallon is only about 5 to 6 pounds, with much of that weight evaporating out during the drying process.

Because there is no cladding involved in the system, spray-applied insulative coatings can be monitored for corrosion and maintained like any
other external coating system. Thermal insulative values will remain constant and predictable. This means that assets insulated with this modern system can be removed from the expensive CUI monitoring protocol.

Thermal insulative coatings can be spray-applied on surfaces operating at up to 350°F over primers that are either zinc-rich (organic or inorganic), high-temperature-resistant epoxies or multipolymeric matrix silicones. All three of these primer technologies can perform well depending on expected temperature, the surface preparation that could be attained and the application technique available. They are also less labor intensive and safer to apply than conventional clad insulation.

To achieve the desired thermal properties, the coatings are applied in multiple fast-drying coats, then finished with a chemical and moisture-resistant acrylic topcoat for long-term performance. Unlike conventional insulation, this system will repel water and moisture vapor and maintain its original insulating properties in any weather condition. With an unlimited recoat window, maintenance personnel can handle periodic repair and touch-up, and the system can be washed to remove dirt, mildew and other surface contaminants.

Conclusions
Within the oil and gas market segment, owners, specifiers and coating contractors can benefit from being aware of the latest trends in protective coatings in order to extend asset life and achieve efficiencies in application and maintenance. Updating coating and lining specifications to include materials that will accommodate typical Gulf Coast weather conditions can pay significant dividends, both in short-term scheduling and over the asset’s lifecycle.

About the Author
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