Ballast tank corrosion is a problem that can have serious consequences for the integrity of a ship at sea.

The necessity for ballast tanks to be fully protected against corrosion was brought into focus by the recent approval of the International Maritime Organisation (IMO) regulation SOLAS 11-1/14, which requires corrosion prevention systems for all tanker and bulk-carrier seawater ballast tanks.

As always, good surface preparation before maintenance painting is essential for effective, long-term performance of a protective coating system. Jotun Marine Coatings of Sandefjord, Norway, and Jotun Cathodic Protection have developed an electrochemical descaling technique to readily remove large quantities of corrosive scale (rust) from ballast tanks prior to maintenance painting.

This process is recommended for use in ballast tanks with more than 70 percent breakdown of their coatings as well as for economical upgrading of ballast tanks generally, according to Jotun.

Here is how the system works. Magnesium strips with an iron core are welded or clamped to the ballast tank surface. The iron core creates an electrical contact with the tank, and when it is filled with clean seawater, an electrochemical reaction occurs. The seawater should have high salinity for conductivity and a minimum temperature of 10°C.

As a result of the electrochemical reaction, hydrogen gas is formed at the surface of the steel tank. The tank needs to be completely filled with seawater and ventilated so all the hydrogen gas generated by the process is forced out of the hatch. If air space is left at the top of the tank, hydrogen gas could collect there. The electrochemical reaction produces a calcareous layer that causes rust, scale, and old coating material to loosen and drop to the bottom of the tank.

The tank is emptied just before dry-docking so it can be washed down with fresh water (at a minimum pressure of 220 bar) while the calcareous layer is soft and jelly-like. Once it dries, the calcareous layer, which remains on the surface after the scale has fallen off, becomes hard and difficult to remove. Just draining the ballast water out of the tanks is not sufficient, because it will not remove the deposit or any salts remaining on the tank walls.

The tank is then dried with dehumidifying equipment to prepare it for recoating and/or installation of sacrificial anodes.

The descaling process, which takes 8-14 days, depending on the nature of the scale, the temperature, and the quality of the seawater, can be carried out during a voyage, prior to a ship entering dry dock, thereby minimising the time needed in dock for pretreatment.

To demonstrate the effectiveness of this process, a trial was carried out aboard the container vessel Cardigan Bay in which the No. 7 double bottom ballast tanks (port and starboard) were descaled prior to dry-docking.

An initial inspection of the ballast tanks was conducted and considerable scale and rust were found. As a result, diagrams of each tank were prepared, and the magnesium strips were cut to length and fitted into place (Fig. 1).

The work, which was performed during four port visits—two at Southampton and subsequently at Rotterdam and Hamburg—did not interfere with the
ship’s normal trading, according to Jotun. The No. 7 tanks were kept dry until several weeks before scheduled dry-docking. Then, they were completely filled with water, and the ship continued trading until it reached dry dock in Kobe, Japan.

There, holes were cut in the tank bottoms to remove the remains of the strips (Fig. 2) and two tonnes of rusty scale (Fig. 3). The calcareous deposit on the walls (Fig. 4) was cleaned off with high-pressure washing. The tanks were dried with the aid of dehumidification equipment. Several small areas that needed additional treatment were easily cleaned with a disc sander to bare metal, and the holes in the tank bottoms were repaired.

Following the descaling process, two coats of a surface-tolerant epoxy coating were applied to the ballast tank (Fig. 5). The vessel was inspected after two years of normal trading and, according to Jotun, the tanks were found to be in excellent condition.

Benefits of the electrolytic descaling system, the company says, are that it avoids the need for blast cleaning or hand tool cleaning of the ballast tanks; the ship’s out-of-service time in dry dock is minimized; and life of the ballast tanks is extended.
disbonding and the influence of osmotic or internal coating stresses.

The single biggest advantage to a destructive examination is failure analysis. The presence of local contaminants (e.g., salts, solvents) within the blister may reflect on the application process. In such cases, analysis of the blister liquid may provide some insight to the likely spread of blistering throughout the rest of the coating. If the likely cause of the initial blistering is common to the rest of the coating, significant rework may be warranted.

In all cases, any destructive inspection should be repaired before placing the tank back into service.

Answer

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A thin-film epoxy polyamide system is generally applied as a lining in potable water storage tanks for immersion service. In my experience, there are three main causes for blistering of a lining in the wet interior of a water storage tank: oil contamination, effect of soluble salts, and improper cure.

Oil contamination that has resulted in blistering could come from machinery, oil in the air from the blasting process, or oil left on the substrate or preceding coats from workers’ hands. If the oil is not removed from surfaces to be coated, blistering or flaking of the coating applied over contaminated areas may result.

Soluble salts such as chlorides or sulphates promote blistering when present on any surface under a coating. This osmotic blistering results in pressure overloading of the coating applied over the soluble salts.

Blistering resulting from recoating an inadequately cured coating is generally a result of solvent entrapment.

ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints, can be used to rate the
size and frequency of blisters and to measure them. The blisters should be broken, and the substrate, if exposed, should be examined for corrosion and pitting. If the prime coat is found to be intact after the blisters are broken, the film thickness of the prime coat should be measured to determine if sufficient film build remains to provide continued protection of the steel substrate. If the examined blister exposes the steel substrate, the potential for active corrosion exists. Only by breaking the blisters and examining the exposed surface can a cause and recommendation for repair be determined. Once the cause of blistering is determined, similar pitfalls can be avoided through inspection procedures if the tank is determined to require repainting.

This evaluation system and the budgetary constraints of the client can be used to determine whether total repainting is required or installation of a cathodic protection system to protect the exposed surfaces is sufficient. However, in all instances, the substrate should be examined after the blisters have been broken (only enough should be broken to determine the cause). Only by this examination can the cause and effect of blistering be determined and remedies be recommended.

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