CORROSION PROTECTION REGULATIONS TO IMPROVE SHIP’S SAFETY?

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SUMMARY

The International Maritime Organization sets new standards in the corrosion prevention of seawater ballast tanks on steel ships. With the adoption of an international valid coating standard a uniform quality shall be achieved to raise ship’s safety. This means at the same time that new requirements come into force with partly huge impact on the shipbuilding industry.

1. INTRODUCTION

From a corrosion point of view, seawater ballast tanks on steel ships are one of the most critical areas. Hence the following article deals mainly with the corrosion protection in these tanks. Specific corrosion problems and protections through coatings will be discussed with reference to a newly released, internationally valid standard for the corrosion protection of seawater ballast tanks on steel ships.

With the constant contact to seawater, different levels of filling and possibly extreme varying temperatures, a proper corrosion protection in these tanks is essential. With a damaged or improper corrosion protection in ballast water tanks severe corrosion rates are possible. These can, if not detected in time, lead to immense damages with devastating consequences for the construction and therewith possibly for humans and the environment.

Unprotected ship steel shows considerable rates of corrosion in seawater. In average, rust-off rates of 0.4 to 0.8 mm per year have been observed, unprotected steel in water ballast tanks of ships showed partly up to 3 mm per year. The corrosion rates in these tanks are subject to considerable fluctuations and can rarely be determined in a precise way. Operational area of the vessel, frequency of water changes, the corrosion protection system and its condition, the character of tank design and especially the composition of the ballast water are key factors.

With the knowledge of the occurrence of corrosion in these tanks corrosion factors are added to the calculated steel thicknesses. In addition, an effective corrosion protection system is to be applied in ballast water tanks usually by a hard coating system, sometimes in combination with sacrificial anodes.

2. NORMALLY USED PROTECTION SYSTEMS IN SEAWATER BALLAST TANKS ON STEEL SHIPS

Typical paint systems for ballast water tanks are epoxy based systems with a nominal dry film thickness of around 300 µm. The main coating is most commonly applied in two layers. One of the key issues for a resistant coating system is the surface preparation which consists of the surface profile and the surface cleanliness. Furthermore special attention has to be paid to the preparation of the welding seams and the edges of profiles and stiffeners.

The steel plates and profiles to be used for the ship’s hull and therewith in the ballast water tanks are normally blasted to a surface cleanliness of Sa 2 ½ acc. to ISO 8501-1 with a defined roughness profile. To protect the surface during the following building period an overweldable shop primer is applied on the steel surface afterwards. Depending on the compatibility with the main coating system it is not unusual that the shop primer partly remains on the surface and therewith forms the underground layer of the following main coating system.

Further critical factors for a good surface preparation are the salt and dust level on the surface. Especially the salt level is often intensified with most shipyards lying close to the sea. With a too high salt level the risk of blistering and loss of adhesion of the coating system is given. The same problem of loss of adhesion might occur with too much dust on the surface whereas with dust, the amount and the size have to be observed. The salt and dust limits for a coating system are specified by the paint manufacturer in the relevant coating specification.

Another critical area within the coating process of ballast water tanks on ships is the surface preparation of profile edges and welding seams. Sharp edges have to be ground to give the possibility of reaching the specified dry film thickness.

The same applies to welding seams which often have to be smoothened if not welded automatically. Weld spatters have to be removed to ensure smooth and even surfaces for the paint application. Edges and welding seams not only have to be smoothened but it is essential to apply a stripe coat by brush or roller (usually one or two stripe coats are necessary) to ensure the achieving of the nominal dry film thickness (see pictures). The full coat is then applied by spraying.

In some water ballast tanks in addition to the coating system, which forms the passive barrier against corrosion, an active corrosion protection system by sacrificial anodes is installed. The anodes are a supplementary...
protection if installed in a proper way. This means that they have to be evenly distributed in the tank to avoid shadow effects and to have an overlap of the ranges of the anodes. It is also very important to ensure a permanent electrical connection. Special attention has to be paid to the fact that sacrificial anodes only work when they are submerged in the electrolyte (seawater), which might not permanently be achieved in a ballast water tank. Further it has to be proven that the coating system is compatible with a cathodic protection system.

3. CORROSION PROTECTION RULES AND REGULATORY BODIES

3.1 CLASSIFICATION SOCIETIES

In the shipping industry, classification societies are non-governmental organisations that promote the safety and protection of the environment of ships and offshore structures. This is achieved by setting technical rules, confirming that designs and calculations meet these rules, surveying ships and structures during the process of construction and commissioning, and periodically surveying vessels to ensure that they continue to meet these rules.

Classification societies employ or comprise of naval architects, engine specialists, material and welding specialists, electrical engineers, etc. and are usually located at ports around the world. The ships are accompanied and surveyed during the new building process and periodically during their entire lifetime. Marine vessels and structures are classified according to the soundness of their structure and design for the purpose of the vessel. The classification rules are designed to ensure an acceptable degree of stability, safety, environmental impact, etc.

In particular, classification societies may be authorised to inspect ships and other structures and issue certificates on behalf of the state under which flag the ships are registered.

Concerning the seawater ballast tanks the classification societies are publishing rules requiring not only routine inspection of these tanks but also a corrosion protection system in order to avert the risk of an unprotected or not sufficiently protected seawater ballast tank.

Thus, the International Association of Classification Societies (IACS), an association of the leading classification societies of ships, elaborates so called ‘Unified Requirements’ (binding standards for all members), which define certain minimum requirements for seawater ballast tanks among other things concerning corrosion protection.

These minimum requirements released by IACS state that the seawater ballast tanks are to be provided with an effective protective coating system. However there is no defined standard of how to achieve an effective protective coating system which means that there are no requirements concerning surface preparation, dry film thickness, qualification of the coating system for the range of application, application method or the like. The interpretation and technical implementation of these minimum requirements is left to the associated IACS members, which determine – more or less precisely – the details of admissible methods via their rules and under consideration of other standards.

The classification societies have extended these minimum IACS requirements by setting further demands concerning the corrosion protection of seawater ballast tanks. Germanischer Lloyd (GL) requires a corresponding corrosion protection in all seawater ballast tanks on every GL-classified ship – independently from dimension and ship type. This means that a product certification of coating systems applied in ballast water tanks is necessary, i.e. qualification tests have to be carried out by laboratories, independent from the coating manufacturer, in order to prove the performance of the product. After passing these tests successfully (normally following ISO 12944), the coating system will receive a type approval valid for seawater ballast tanks by Germanischer Lloyd. A list of every GL type approved seawater ballast tank coating is published in the Internet. Furthermore is in the current edition of Germanischer Lloyd Rules a minimum dry film thickness for the ballast water tank coating system of 250 µm required as well as an appropriate surface preparation. These requirements are part of the drawing approval, i.e. the coating specification for seawater ballast tanks has to be submitted to Germanischer Lloyd for examination and approval at an early state of construction and especially prior the starting of the coating work. Other classification societies require similar additions exceeding the minimum ‘Unified Requirements’ defined by IACS.

The coating requirements will change in the future which is described under point 4.

These measures of corrosion protection only determined by minimum requirements are very different concerning their quality. These differences shall now be harmonised on an international level. The measure representing the greatest scope of an international harmonised standard is the development of a coating performance standard by the International Maritime Organization (IMO), which shall be applied to the coating of seawater ballast tanks of ships above 500 GT and on the double skin spaces of bulk carriers longer than 150 m.

3.2 INTERNATIONAL MARITIME ORGANIZATION

The International Maritime Organization (IMO) with its head office in London has been established in 1948 with the intention to improve the safety of ships by developing and adopting international regulations, which have to be observed by the Member States. Today the IMO consists of 167 Member States.

IMO's first task was to adopt a new version of the International Convention for the Safety of Life at Sea (SOLAS), the most important of all treaties dealing with maritime safety. This was achieved in 1960 and adjusted in 1974. Further Conventions and Resolutions have followed and will follow with the permanent adjustment.
of these conventions. Surely, the main focus of IMO is and will remain the ship’s safety, but there is a further task which needs international regimentation and conventions – the protection of our environment. IMO’s Convention for the Prevention of Pollution from Ships (MARPOL) is the most important regulation in this matter.

IMO is divided in different committees and sub-committees; the committee responsible for ship’s safety is the ‘Maritime Safety Committee’ (MSC). In the scope of further development of the safety of tankers and bulkers, MSC decided in December 2002 that it is necessary to address the need to develop an international coating standard for seawater ballast tanks and void spaces in the double hull of these ships. IMO’s sub-committee ‘Ship Design and Equipment’ (DE) was charged with this task.

The main reason for this decision lies in the required double hull construction of tankers and bulkers which have a greater surface exposed to possible corrosion problems. Further the inspection of these areas is much more difficult due to its construction. Moreover the reigning atmosphere in double hulls makes corrosion effects very probable, which may lead to a higher rate of corrosion.

In June 2005, MSC decided – based on an already existing draft of an international coating performance standard for ballast water tanks and void spaces on tankers and bulkers – to extend the scope of this standard also to ballast water tanks of every ship type. As before, this duty was delegated to the sub-committee DE.

At the beginning of December 2006, MSC finally adopted the designed coating standard for ballast water tanks (meanwhile void spaces are considered separately). The coating standard is settled in the IMO Resolution MSC.215(82). It will be made internationally mandatory by an amendment of the SOLAS Convention.

4. CONTENT OF IMO’S COATING STANDARD

In detail IMO’s Performance Standard for Protective Coatings implies new requirements that, by far, exceed and render more precisely the above mentioned ‘Unified Requirements’ by IACS and even the classification societies’ standards. Today one can say that the adoption of this standard means extensive changes for shipyards, ship owners, coating manufacturers and classification societies.

The aim of the coating standard is to achieve a coating lifetime of 15 years in the seawater ballast tanks. Up to now there is no regulation that specifies the intended lifetime of a coating in seawater ballast tanks. The intention is that the coating remains in good condition after 15 years. The future will show whether this target can be obtained following the new standard. The intention is that the lifetime shall be achieved by the definition of concrete requirements, limit values and control mechanisms during the construction phase. Accordingly, the coating standard indicates clearly defined limit values for the surface preparation concerning cleanliness, surface profile, salt level, dust grade, dry film thickness, etc. Precepts are also given with respect to the selection of an appropriate coating system, application methods and required pre-qualification tests of coating systems.

Naturally limit values and application requirements are already existent and come along with each coating system. However they are usually defined by the coating manufacturers with regard to specific characteristics of the coating systems and not by an international unified standard. Moreover verification and inspection methods concerning these requirements and limit values in practice are not regulated in a harmonised way nowadays and are fulfilled with a very varying diligence.

Three main items shall specifically be amplified because they are completely newly introduced and representing at the same time major consequences for the shipbuilding industry.

4.1 PRE-QUALIFICATION AND CERTIFICATION OF THE COATING SYSTEM

According to the IMO PSPC, coating systems have to be pre-qualified in a laboratory test prior to be used on board. The laboratory test is clearly described in the standard including the testing facility, the panels to be tested, the test duration and the acceptance criteria to be achieved after the testing period. The testing facility simulates the conditions in a seawater ballast tank including ship’s movement, adjacent heated tanks and different levels of filling. In the testing tank different panels, coated with the coating system to be tested, are positioned. One panel is assembled with a sacrificial anode whereas on other panels the coating is artificially hurt. The testing period in the tank is 180 days.

![Figure 2: Wave tank for testing of ballast tank coatings](image)

Figure 2: Wave tank for testing of ballast tank coatings

Further the coating on two test panels is tested in a condensation chamber also for 180 days. One more panel will be exposed to dry heat for 180 days to simulate boundary plating between a heated bunker tank and a ballast tank in the double bottom.
With successful testing results the coating will be certified by a type approval or statement of compliance issued by the administration or recognised organisation which is usually the classification society. The control of this certificate will be part of the coating inspection process.

4.2 COATING INSPECTORS

Another big issue that comes along with the IMO Coating Standard is the implementation of verification, inspection and documentation items. Those items shall ensure that the defined limits concerning surface preparation, salt and dust limit, dry film thickness, etc. are achieved and obeyed. This means that new control persons in form of coating inspectors have to be included in the ship yard’s quality control system. Coating inspectors need a special qualification which has to be verified by the administration or recognised organisation. They inspect and document the complete coating process of the ballast water tanks. The inspection and documentation items of the coating inspectors are clearly defined in the standard.

4.3 COATING TECHNICAL FILE

The documentation of each single step of the coating process will be filed in a Coating Technical File (CTF), the third major introduction of the IMO standard. The CTF will include, amongst others, the reports of the coating inspector, technical data sheets of the coating system, type approval certificates, procedures for in-service maintenance and repair of coating systems, etc. The CTF remains on board of the vessel and shall be maintained throughout the life of the vessel. This means that inspection and maintenance of the coating shall be continuously recorded including location and work specification.

5. IMPLEMENTATION PROCEDURE AND DATES

The IMO PSPC will be made mandatory through an amendment of the SOLAS Convention (see point 3), settled in Resolution MSC.216(82) Page 3, and is therefore a statutory requirement. Basically all commercial vessels are built under the SOLAS Convention nowadays which means that with the amendment the coating standard will be made internationally mandatory. IMO has set three different dates to activate the new coating standard. It will apply to seawater ballast tanks of all types of ships of not less than 500 gross tonnage and double-side skin spaces arranged in bulk carriers of 150m in length and upwards

- for which the building contract is placed on or after 1 July 2008; or
- in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 January 2009; or
- the delivery of which is on or after 1 July 2012.

An exception from the a.m. dates exists for tankers and bulkers built under the Common Structural Rules (CSR) released by IACS. For those types of vessels the coating standard is already mandatory from its date of adoption on which was 8 December 2006. This date applies to the contracting date of vessels.

6. CONCLUSIONS

With the intent of the constant improvement of the ship’s safety the newly developed standard might be a good contribution from a corrosion protection point of view. With seawater ballast tanks being one of the most jeopardised areas on a steel ship and with devastating damages in these areas still appearing, it can been seen as a good approach to set international valid rules and technical requirements concerning the coating of these tanks. It is however to be awaited the issue how the technical requirements will be realised and if it is practicable to have one standard for ballast water tanks on different types of vessels. All involved parties (shipyards, owners, classification societies, painting manufacturers, application companies, etc.) will be faced with partly big changes.

Certainly Germanischer Lloyd will give all necessary support that is needed and will provide the class relevant inspection requirements that come with this standard.

It is already decided by IMO to develop and release further coating standards for steel ships. This includes regulations for the coating of void spaces on certain type of vessels, the coating of the cargo tanks on crude oil carriers and a maintenance standard for the seawater ballast tanks as a supplement to the described coating standard.

It is obvious that the ship’s safety can be improved by proper corrosion protection. It has however to be paid attention that the regulations are a good compromise between sufficient protection and economical efficiency. This ensures the acceptance of such regulations and therewith the optimum realisation.

7. AUTHORS’ BIOGRAPHIES

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