Corrosion Protection of Tanker Structures – Existing and new challenges

Presentation at Ship Structure Committee Symposium by
Dragos Rauta
INTERTANKO

Abstract
Some 20 years ago and even as recent as 10 years ago, the tanker industry was associated with large accidental oil spills. Today, the tanker industry is associated with safe, environmentally and increasingly sophisticated operations. This rapid evolution is the result of pressures exercised on the tanker industry from a combination of extreme liabilities and responsibilities, an avalanche of new regulations but, also of an imposed self-discipline which led to increase in standards of tank vessels structures, increase in the quality of crew training, significant improvements of ship operations and of new industry-safe practices.

The rapid evolution on tanker vessels standards is mainly the result of great contributions from all stakeholders: designers, builders, classification societies and ship owners but it has seldom attracted the general public's attention and it has seldom been recognized. This paper intends to give an insight review of the last 10 years developments, including less known details but which indicate all changes and improvements were initiated and worked out by the industry itself. I was privileged to be part of most of these developments and I hope some insight details might be of interest to the SSC members. This is not an intent to blow my own trumpet but a tribute to an industry collective effort which is rarely noticed.

The paper also shares some views on new challenges for the tanker industry and the shipping industry. These new challenges come as a result of a continuous struggle to improve ships' environmental performance without having a negative impact on ships' safety. Some of these challenges are quite demanding but the INTERTANKO members consider these as new opportunities for designers, builders and tanker operators.

IACS Common Structural Rules
The first development and significant change I wish to address is the adoption of the IACS Common Structural Rules (CSR). Great recognition has to be given to the Classification Societies which initiated this project but also to IACS as they collectively picked up the challenge and developed CSR for Tankers and for Bulk Carriers.

However, very, very few know that the idea behind the initiative on the CSR was emerging from a series of meetings between OCIMF and INTERTANKO on one hand and a number of Classification Societies on the other hand. These meetings, held in 1999 and 2000 had two items on the agenda: the quality of periodical surveys on tankers in operations and the structural robustness of new tankers. Both OCIMF and INTERTANKO were increasingly concerned with the downgrading of tanker fleet standards and initiated these consultative meetings.

As far as tankers in operations were concerned, charterers had developed their own vetting systems while Class Societies have upgraded the scope and the extent of their survey. The additional class CAP notation was harmonized and it became an additional selection tool for charterers.

With regard to new building standards, the trilateral meetings were facing a difficult task to define a quick and efficient system to ensure good quality of new buildings. At that time, it was publicly recognized that new ship designs, particularly those offered by shipyards were on the edge of not complying with the structural standards imposed by class societies' regulations. Class societies were under strong pressure to approve designs with "optimized" structures which would have doubtfully met fatigue assessments and which had minimized all corrosion margins.

OCIMF, INTERTANKO and the Class Societies involved in these trilateral discussions had finally concluded that the best medicine to contra-act the negative competition between different class societies' regulations for new building structures is to promote the concept of Common Structural Rules. This idea which came out of these meetings was first followed by three class societies but rapidly adopted by all IACS members. The rest is history. But this is a significant example showing that major changes are initiated and completed by the industry. CSR would remain a historic reference for modern and progressive thinking.

IMO Performance Standards for Protecting Coatings (PSPCs)

Steel structures are exposed to corrosion. Tanker structures are even more exposed to corrosion due to the highly corrosive environment within the ballast tanks but also in the cargo oil tanks. IMO MARPOL Convention has imposed major changes in tanker design which were environmentally driven. Complete segregation between cargo tanks and sea water ballast tanks was an excellent step to minimise and possibly eliminate large operational discharges from oil tankers. But, these new designs have increased the area of tanker structures exposed to corrosion and added as a new challenge the corrosion effect of the sea water in the dedicated ballast tanks.

Coincidentally, about the same time the segregation between ballast and cargo tanks was introduced, more and more new ships were built with "optimized" structures which meant less and less corrosion margins. A series of bulk carriers and tankers experienced major structural weaknesses which prompted the industry to initiate coating of sea water ballast tanks as a preventive measure. IMO has followed up and took two measures: mandating coating of ballast sea waters and adopting the Enhanced Program Survey (ESP). The industry has had a major contribution for proper enforcement of these two provisions.

With regard to the ESP, a group of tanker operators and class societies called Tanker Structure Cooperative Forum (TSCF) has develop specific guidelines for an efficient enforcement of the ESP.

With regard to coating of ballast tanks, IACS and industry partners including ship owners associations and shipbuilders have jointly developed best practice guidelines for selection and application of coatings in sea water ballast tanks. These guidelines were instrumental to assist IMO in developing a solid and good mandatory Performance Standard for Protective Coatings (PSPC).

<u>PSPC for Ballast Tank Coatings</u>

The IMO PSPC for ballast tank coatings is a significant step for improving protection of ships' structures against corrosion. There is no better medicine against corrosion than a very professional job done at the time of construction. But the PSPC as such does not bring any novelty. The industry was able to perform for a long time high standard coating application and such best practices were exercised by some shipyards. The significant

change introduced by the IMO PSPC is mandating industry best practices for every new building and the work is subject to control and certifications by Administrations. So, the pressure to minimise coating costs by a superficial job has hopefully been eliminated. We hope the IMO PSPC has incentivised competition for providing good coatings. INTERTANKO Members' experience throughout the last decade shows a significant improvement as compared with condition of coatings applied before year 2000.

SOLAS Regulation and PSPC for Cargo Oil Tanks (COTs) Coating

Sometime in the mid 1990s, a number of double hull tankers have experienced serious pitting corrosion on the bottom and significant corrosion of the under deck structures of the COT. There are different mechanisms triggering each type of corrosion but basically the common cause is the corrosive environment created by the crude oil in double hulled COTs. Tanker owners reacted by initially coating the bottom and gradually the under deck structure of the COTs.

In 1998, INTERTANKO has called for an industry meeting to discuss corrosion aspects on the cargo oil tanks. The result of that meeting has been published as an awareness guide on which coating of the bottom and of the under deck structure of COTs was highly recommended. About the same time, OCIMF issued a paper explaining similar experiences on their members' tankers and promoting best practices and caution.

Basically, the tanker industry was taking action but it was not always easy to get a positive response from shipyards, particularly during a new building booming period. With support from a number of Administrations, the industry led an IMO rule development mandating coating the bottom and the under deck structure of tanks carrying crude oil and impose a mandatory PSPC for COTs.

There are many issues that can be discussed surrounding this new regulation and this new standard; coating testing, and the amount of power tool cleaning on the bottom areas, the permission to apply the epoxy coating over zinc silicate shop primers, just to mention a few. The new SOLAS regulation provides for alternative means of corrosion protection. One concrete suggested alternative is a Japanese industry developed "corrosive resistant steel". The new regulation also exempts COTs used to only carry "benign cure oils" from being coated. The industry struggles to define "benign crude cargoes" and many tanker operators are concerned about possible loopholes.

One can understand from this brief reporting that this was a hard-fought battle. INTERTANKO members do believe that it was worth going through a rather long process. We believe there comes a time when it does not help to say much more, but rather make the best of what we have! We also hope that this new SOLAS regulation and this new PSPC will become a common practice before being enforced in 2013. Although there are different views on the necessity and efficiency of coating COTs, it appears that more and more new buildings have at least the bottom of the COT coated.

Means of Access

In the aftermath of Erika and Prestige accidents, IMO adopted a new SOLAS requirement for "Permanent Means of Access" onboard ships to facilitate close up inspections of ships' structures. This new regulation was developed and approved in an unprecedented short time, in less than one year. The standards imposed by the initial new regulation were challenged by an united industry. The means of access were poorly defined, thus creating more safety problems to crew, inspectors and surveyors. The industry presented a

complete reviewed set of standards which were based on existing designs. Some tanker operators have already used such a concept in their new buildings for a number of years. The owners' designed means of access are not additional stages and platforms but are ship's solid structure elements, such as stringers with slightly modified dimensions to make passage safe and secure for the surveyor. This historic revamp of an IMO already approved SOLAS amendment was simply possible due to an excellent coordinated industry initiative as agreed through an industry forum called Tripartite where ship builders, class societies and ship owners meet to share experiences and seek progress.

Fixed Installation for Hydrocarbon Gas Detection

A large majority, if not all oil tankers, are equipped with fixed installations to detect hydrocarbon gases in ballast tanks and void spaces adjacent to COTs. This has been an industry practice and an industry standard developed and applied shortly after the double hull tankers were mandated by IMO. At the request of some Administrations, the fixed hydrocarbon gas detection installations will soon become mandatory under SOLAS. Once again, the regulation and the standards for such installations are basically a reflection of a tanker industry practice for some 15 years or more.

New Challenges

Ballast Water Treatment Systems

The issue of the spread of invasive aquatic species via ballast water is a real issue and there is no getting around that point. The issue of ballast water exchange, and ballast water treatment systems can be debated, but it will happen in the very near future. There will be a very large amount of ships that will need to install such units in a very short time, and there is not enough information published on which owners can make a good risk/financial assessment.

Some systems are based on oxidation to kill the bacteria to meet the very stringent requirements of the expert group at IMO, the GESAMP-BWWG. Oxidizers, however, do only one thing, they oxidize! That means degrade and destroy! They destroy not only the bacteria but anything else that comes in its way. This means that there is a risk, however, not known to what degree, with such systems. It shall be noted here that whether the chemical is added or produced on site matters very little, if it is an oxidizer it oxidizes.

The problem is that about half of the approved BWT systems use oxidizing agents, such as ozone, hypochlorite, hydrogen peroxide and others. The concentrations needed vary by methods. If the method is based on seawater electrolysis only, the needed concentration is high 2-10 ppm. If electrolysis is used in combination with other methods, the needed concentration (of the hypochlorite generated) is lower.

A friend of mine who is an excellent chemist and expert on BWT methodologies explained in simple terms the associated risks. Swimming pools use hypochlorite at 1 ppm to keep the danger of spreading diseases under control. He is swimming in average 90 minutes a week and probably not more than 40 weeks/year. This means he is in the swimming pool water some 60 hours a year. The result was that the rubber waistband of the swim trunks was "shot" after one year and the colour of the swimming trunks was less "glowing" at the beginning of the year. Naturally the trunks was also washed a few times, so there was additional stress outside the pool, but still!

The point is that some of these BWT units use up to 10 ppm, and the coatings are to last 15 years! We know from onshore fresh water tanks that blistering is a common early

defect, and some claim it is caused by the chlorination (much lower concentrations than what is used in BWT). My friend has an easy solution: change the swimming trunks every 6 months or even often. To maintain the integrity and to repair coatings of sea water ballast tanks is somehow a different challenge to address.

This is only one example why the tanker owners operating ships which use excessive ballast water, raise concerns. Oxidizers oxidize anything blindly, coatings, plastic, steel, anodes. Small amounts oxidize less, large amounts oxidize more.

We do not have an answer and definitely not a solution to these concerns but we are again encouraging an industry effort to address these matters as soon as possible. The challenge is however to learn and eventually correct problems which may be generated by already approved BWT. We do not know how well they have been tested. As far as we know now, there is little or no evidence and guarantee to remove our concerns. What is clear is that there is a hunger for information among the vessel owners world wide.

Emission Issues

Use of Lower Sulphur Content Fuels

This is an issue surrounding MARPOL Annex VI on reduction of nitrogen oxides (NOx), sulfur oxides (SOx) and other polluting gases from ships. These pose real challenges to shipping globally.

NOx applies only to new construction and so far it is not perceived as a major problem. However, the NOx limit in Emissions Controlled Areas (ECA) applied to ships being built from 2016 poses a real challenge. The limit can be achieved by using Selective Catalytic Reducers (SCRs) in combination with the main engines. However, engine manufacturers say they cannot test large engines and large SCRs at the manufacturer's test bed due to lack of space. Therefore, it is suggested that the main engine and the SCR are independently tested by their respective manufacturers while the certification is given after onboard verification. It is not clear what would happen in case both the main engine and SCR fail to pass the verification, particularly for large ships.

SOx emissions reductions have a natural solution: use of low sulphur fuels. Onboard scrubbing is an alternative solution but the technology has yet to be well proven onboard ships. For sure, scrubbing would open for new interesting corrosion issues.

But one immediate and unsolved problem is that ships are required to use up to three different fuels in one voyage. Ships are not designed to facilitate storage and segregation between such fuels. Therefore, ships are challenged in meeting the requirements and sometimes experience loss of power and engine stop. New design of the fuel storage and fuel installations is highly needed but as usual, changes take time and ships will continue to struggle for a few years to come.

Hull Design and CO_2 emissions reduction

Finally there is the issue of green house gases (GHG) emissions reductions. IMO has embarked on rule development aimed to reduce the amount of GHG emitted from ships, in particular CO_2. There are ways that this can be done, but there is no one way that is the "magic bullet". The reduction in GHG will have to come from many sources. One being reduction in the vessel's hull friction against the water. The vessel's hull friction against the water is basically the sum of two main contributing factors: the wave resistance and the hull resistance. The wave resistance dominates at higher speeds, and the hull

resistance at more moderate to low speeds. There is not much one can do with the waves, they are generated by the winds, much outside the control of the ship operator. It is possible to a degree to avoid the worst effects of waves by weather routing – diverting the ship to take a longer route to avoid damaging weather patterns. That will though add to the distance travelled so there is a trade off. The hull resistance can, however, be controlled or managed! This is done by reducing the ship hull roughness by applying smooth coatings, and by keeping the hulls free from fouling.

Ship owners could also reduce fuel consumption through a better voyage management, minimising the waiting time in port and using it for a slower and constant steaming. They can increase efficiency by better logistics, namely minimising the ballast voyages and increase the cargo voyages. Of course this can only be done together with all stakeholders involved in the supply chain of which the ship is only a part of it.

However, GHG emissions reductions seem to open opportunities for a new possible major change in shipping, namely new design concepts which will indeed reduce the drag and provide a significant increase on ship's propulsion efficiency. The challenge opens opportunity for ship designers, particularly those daring to think "out of the box".

Conclusion

Although tanker operators' core business is transportation of oil and chemicals at sea, they are confronted with and involved in a large number of new design and construction standards and practices. The majority of these are brought in by environmentally driven regulations but which impact the safety of ships structure and of ships' operations. Transportation of oil and chemicals at sea should indeed be safe and environmentally driven but one has to recognize that most of the solutions to challenges mentioned today are in the hands of designers, ship builders, equipment manufacturers and other service providers, including class as the certifying body. Ship owners need safe and reliable ships and good, reliable and user-friendly equipment. For any other means of transportation like cars, trucks, trains and aircrafts, innovation and progress are triggered by manufacturers. The operators are able to meet new and higher standards because the cars, trucks, trains and aircrafts they buy meet the expectations, because the testing and certification are done properly before the operator can operate them and because the manufacturers have a responsibility for their products until these are scrapped. Maybe naïve but, we have a dream to see the same applying to the shipping industry. INTERTANKO Members will continue to be aggressively proactive to promote best practices and best standards. Any other industry partner who will adopt a similar attitude will always have support from INTERTANKO.

Thank you very much for your attention.

Houston, Tx
March 2011