Is long-term corrosion protection of offshore wind structures just a dream?

Bjond's key word is innovation and their engineers are experts with a passion for complexity. Jo van Montfort, Sr Consultant, Director at Bjond tells PES about the short comings in the offshore wind industry, with regards to corrosion and how they want to change this. He says key factors include collaboration across the industry to collect the necessary data and a change in the testing requirements. It's an interesting read with the potential for real savings.

Offshore corrosion

Let's look at the challenges facing the offshore industry when it comes to protecting a steel structure in this type of environment. The first thing to be aware of is formulated perfectly by John Craven: 'All my students know how to respond to the question 'What happens when you use land-based technology in the ocean?' They learn from day one to answer in unison: 'You die'[1].

We as experts would add to the following:

The annual global impact of corrosion is estimated at $2.2 trillion and represents about 3% of the worlds' GDP.

The WCO (World Corrosion Organisation) concludes that 25% to 30% of annual corrosion costs could be saved, if optimum corrosion management practices were employed and knowledge put in to practice.

This is exactly where Bjond is operating as a knowledge based company, with a very strong bond to real practice.

It's our mission to implement our experience and knowledge for the benefit of our clients.

We are well known for our strong network, with knowledge based companies and laboratories, as well as with engineering companies, contractors and end-users. We are challenged to look beyond existing solutions and standards, without losing control of the risks.

We are very aware of our limitations, which make us a strong partner in the fight against corrosion. It's generally accepted that we will never be able to kill corrosion, we can only fight it. But fighting it begins with understanding it.

Offshore wind challenges

In the offshore wind industry, the top the three causes of failure are due to atmospheric, marine and bio-corrosion. Repairs are not always possible or have extremely high costs > €3000/m^2.

The main challenge we face is to fight this this unwanted phenomenon, which is complex and according to us related to:

- shortcomings in current standards and guidelines focus on lifetimes of less than 15 years
- lack of implementing changes learned from mistakes - failing systems are used again
- insufficient corrosion management as a part the project, although risks significantly increase when working farther offshore and with deeper installations
- only minor budget allocation to maintenance, resulting is extreme OPEX overspending
- insufficient focus on complete life cycle costs of an acquired asset

1 The Silent War, John Craven

Coating inspection

To summarise, we conclude that managing corrosion by implementing the fit for purpose knowledge, at the right time and place, would save a considerable amount of cost.

Current situation

When comparing the performance of a coating system, on an average modern car, we must conclude that this industry has understood how to manage corrosion. Cars are being built with zero corrosion allowance and coating layer(s) of approximately 100µm, which is about the thickness of a human hair. The coating systems used in this industry means vehicles are easily maintenance free for more than 15 years.

Car coatings are exposed to extreme outdoor conditions including de-icing salts, stone impact, temperature shocks, UV, etc. but last between 15-20 years. Even if they do get damaged, car coating systems perform much better than 'offshore wind coatings'.

So why is it not possible for offshore wind structures to have coatings which last as long? Both cars and offshore wind structures are commodities. The offshore wind industry is still in an early stage when it comes to managing corrosion.

We observe that 'painting' is still considered the final step of the building process based on mainly craftsmanship. When things go wrong, it's because the substrate preparation was not good enough or the paint was not applied under the right circumstances. In most cases the painter is blamed.

This is an accepted downside, which can only be managed by intensive control (QA/QC) and the hope things will improve. However, real life teaches us that whilst increasing control activities might improve quality, the required level that we see in the car industry, will almost never be achieved.

The offshore wind projects are always ruled by strict deadlines, time and cost savings, practical impossibilities related to e.g. accessibility, safety etc.

Achieving a coating system that performs maintenance free requires a balanced approach on three main issues:

- product
- process
- people

Currently products are primarily designed to pass tests. All prescribed tests are performed on small, flat panels without any relation to real life usage.

Coating failure is mainly observed on the edges, welds, bolts, etc. and rarely on flat surfaces. We think it's time for a change, having a Norsok approval has become more important than providing relevant track records.

The paint process has to be checked according to the current specs, in terms of dew point, dry film thickness, adhesion etc. However, issues with a major impact on the quality and performance of the coating, such as internal (shrinkage) stresses, curing, solvent, retention, etc. are not checked because they are not part of the standards.

Moreover, in most cases, there is insufficient awareness about the impact of these uncontrolled parameters. There is a full reliance on general protocols, which actually provides the illusion that the main risks are sufficiently reduced.

Bjond approach

In our opinion it is possible to improve corrosion management for these projects by choosing a slightly different approach. The Bjond approach is looking beyond existing standards and protocols and using material based knowledge in product selection, process control and personnel training.

Painting over rust

Paint testing

Products

The Bjond approach, in terms of product selection, means using products with a proven track record, with a demonstrated tolerance during the application conditions. This will mean not just using products tested on perfect substrates, applied under perfect circumstances. The selection of products needs to be done according to use and technical requirements, fit for purpose and based on proven results, because the price of a coating product is second to the consequential effects and costs.

The selection of products needs to be done according to use and fit for purpose technical requirements, based on proven evidence, because the price of a coating product is second to the consequential effects and costs.

During product selection, the possibility of repairing the coating system offshore is not a requirement, which is included in the standards. Although this appears not to be an issue, experience has taught us, that this must be dominant in the selection criteria.

Process

The industry needs to be more aware that perfect substrates are a myth and that's why more tolerant coatings systems are needed, instead of intensifying substrate quality controls.

All parties involved need to get more of a grip on the parameters which control coating materials' behaviour, as well as the performance of a coating system.

Everyone involved in the application process needs to understand what's going on inside the coating during application.

Therefore more coating material data needs to be collected on the degree of curing, together with solvent retention and internal stresses, as a function of the temperature and moist in the environment and the steel substrate.

We like to refer to the world of welding, where welders need craftsmanship, but also sufficient understanding of the parameters which influence the final quality. Welders are qualified for different welding methods and/or positions. We call for this type of approach to coating, especially for the offshore wind business.

People

Last but not least and the biggest risk within the whole process is people. For each project a fit for purpose training is recommended. This training should include learning about all specific product characteristics, including the specifications for real life application, under various circumstances.

During the training there should also be the opportunity to discuss different problems and solutions, so that all participants learn and benefit from each other's experience.

New Specifications

It is essential to develop new specifications which force coating suppliers to provide more in depth data related to the tolerance or their products, instead of just results of the performance tests (Norsok).

Also EIS-measurements (Electrochemical Impedance Spectroscopy) of their track records could help to provide the evidence needed to prove suitability and sustainability.

Bjond approach

The Bjond approach results inevitably in costs savings (CAPEX&OPEX) such as reducing unnecessary corrosion allowances, through put times and operational costs (maintenance repairs offshore).

Bjond strongly advocates working together, in order to improve the quality of coating systems in the offshore wind industry. This will have a significant impact on the CAPEX and OPEX and a direct effect on cost savings.

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