How to De-risk Large Coating Projects to Prevent Costly Failures

by PCN Editor

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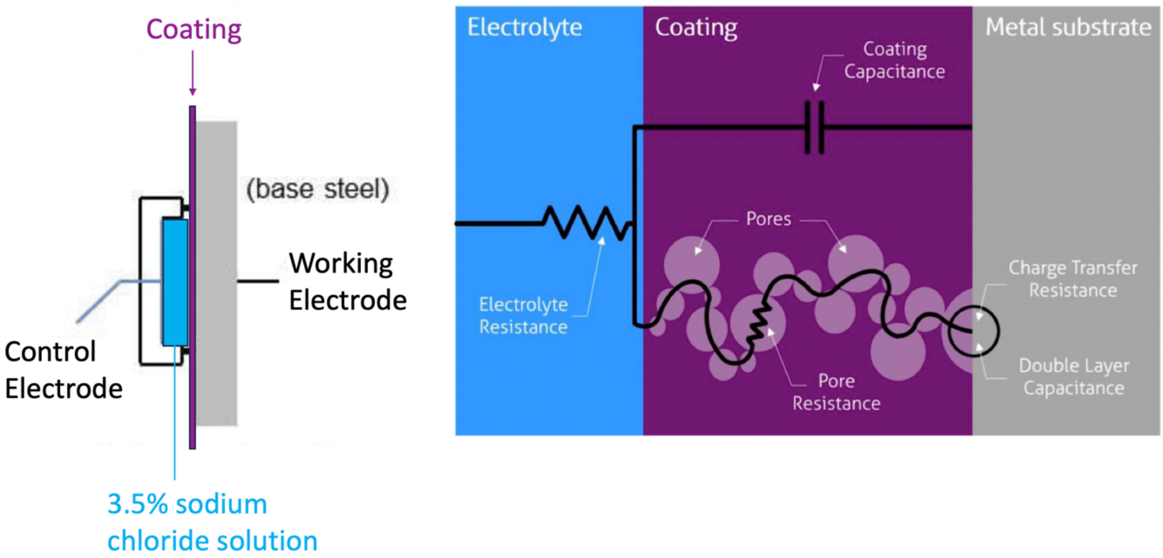
With Akzo Nobel staring down the barrel of a 1.5B Euro lawsuit it is timely and prudent to talk about de-risking large coatings products in LNG and Oil and Gas. Coating failures and corrosion in these industries can have billion-dollar price tags mainly associated with cost of coating remediation and financial losses associated with downtime and interruption to operations. Better to spend a small amount upfront to prevent the problem rather than a massive amount to fix the problem.

Here is where EIS comes in. EIS is a lab technique that mimics the early stages of the corrosion process and can determine the degree to which a protective coatings serves as a barrier to water and corrosive ions. It can determine in just days/weeks what takes years to occur in the field and its predictive powers are amazing.

Electrochemical impedance spectroscopy (EIS) is a well-established quantitative method for examination of the protective properties of organic coatings and their anticorrosion performance. Even a relatively short period of testing with EIS provides reliable data for predicting long-term behaviour of the coating. The result of EIS is the impedance of the electrochemical system as a function of frequency and the coated steel forms a capacitor in an electrical circuit as shown in the schematic below.



One of the most important factors of protection against corrosion by barrier coatings is through their resistance to ion transport though pores, defects and free volume in the coating and this is what EIS measures. As a guideline of the protective behaviour of coatings the following ranges of impedance denoted as $Z_{0.1\ Hz}$ are applied:

- $> 10^8$ Ohm.cm^2 [excellent performance]
- 10^7 - 10^8 Ohm.cm^2 [sufficient performance]
- 10^6 - 10^7 Ohm.cm^2 [doubtful performance]
- $< 10^6$ Ohm.cm^2 [bad performance]

As a reference point the protective coating (Humidur® FP by Acotec Belgium) has a starting EIS result denoted as $Z_{0.1\ Hz}$ of $> 10^{11}$ Ohm.cm^2 and an EIS result after 3 weeks of immersion of still $> 10^{11}$ Ohm.cm^2 hence demonstrating outstanding performance.

Generally for large coating products a coating specification is issued where 'equivalent' coatings are recommended from 6-8 of the key coating suppliers. What needs to be done is each coating is sprayed on blasted metal test plates/panels as per the specification requirements for number of coats, DFT and drying conditions (time/temp). These test plates are then all assessed by EIS and ranked from best to worst. Generally the differences in results can be orders of magnitude (i.e. 10-100 times). Coatings with effective barrier pigments such as glass flake and mica give much better EIS results than coatings with simple barrier pigments such as talc and barium sulphate. This result is also reflected in actual long-term service especially in harsh operating environments.

To give more insight into have the coatings will behave in specific operating environments such as tropic (hot/wet) and arid (hot/dry) the coating panels can be tested by EIS both before and after accelerated ageing such as by oven aging (dry heat), QUV exposure (UV/wet) and salt spray exposure (salt fog/wet).

This testing regime is not cost prohibitive not time intensive so there is no excuse for not performing it on large critical coating jobs especially mega projects in LNG and Oil & Gas. ExcelPlas Coating Labs have streamlined the EIS testing process and can offer a testing and evaluation package to suit the needs of large coating projects.

Key Take Away Messages

The protective coatings sector, especially in the fields of LNG and Oil and Gas, faces significant challenges due to the potential for costly failures. A proven strategy for de-risking large coating projects focuses on the use of Electrochemical Impedance Spectroscopy (EIS) as a predictive tool to assess the longevity and efficacy of protective coatings.

Large-scale industrial projects, particularly in the LNG and Oil & Gas sectors, require robust protective coating systems to prevent corrosion that can lead to operational disruptions and significant financial losses. The recent challenges faced by Akzo Nobel, involving a potential 1.5 billion Euro lawsuit, underscore the critical need for effective risk management strategies in coating applications. These industries often experience failures that could cost billions in remediation and downtime. ExcelPlas Coating Labs argue the advantage of upfront investment in predictive and preventive coating assessment technologies over the costly repairs post-failure.

The practical implementation of EIS in industrial settings involves:
1. Preparing blasted metal test plates with specified coatings.
2. Conducting EIS on these plates to rank the coatings from best to worst.

3. Using Accelerated Aging Tests to further predict how coatings will perform under specific environmental conditions, e.g. the test panels are subjected to accelerated aging processes like oven aging, QUV exposure, and salt spray exposure before and after which EIS is conducted.

Despite perceptions, the testing regime offered by EIS is neither cost-prohibitive nor time-intensive. It provides a cost-effective solution for assessing, ranking and selecting coatings for large-scale projects, helping to avoid the exorbitant costs associated with coating failures.

EIS represents a critical tool in the preventive maintenance of coatings in high-risk industries. By enabling early assessment of coating performance and informed actions in terms of coating selection, EIS helps in significantly reducing the financial and operational risks associated with protective coating failures.

Recommendations

1. Adoption of EIS screening testing in initial stages of large coating projects.
2. Selection of coatings based on empirical EIS data rather than solely on cost or material availability.
3. Continuous EIS monitoring and re-evaluation of coatings in service on test coupons/panels to anticipate potential failures.