

CATHODIC REACTION ANALYSIS OF SALT CORROSION RESISTANCE AND CONTROL SYSTEMS:

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Abstract

Salt water Corrosion resistance with can potentially replace the Special marine time applications. Corrosion is defined as the deterioration of a material because of a reaction with its environment. If we expose iron or steel to air and water we can expect to see rust form in a small period of time, showing the familiar color of reddish brown iron oxide. The environment based rust may develop in minutes. In this paper corrosion resistance with salt water desalination process & analyzed for cathodic production analysis. We can various operating parameters to enhance the performance of the corrosion less analysis, with coating and without coating process experimentally and numerically by using comsol with SEM Testing process Best Corrosion resistance salt Water treatment model optimum will be validated experimentally.

Key word

Cathodic production, Comsol, Corrosion resistance, Coating process

1.0 Introduction

1.1.1 Corrosion and corrosion protection

Corrosion is the gradual destruction of materials usually metals by chemical reaction with their environment. In the most common use of the word, this means electrochemical oxidation of metals in reaction with an oxidant such as oxygen. Rusting, the formation of iron oxides is a well-known example of electrochemical corrosion. This type of damage typically produces oxide(s) or salt(s) of the original metal. Corrosion can also occur in materials other than metals, such as ceramics or polymers, although in this context, the term degradation is more common. Corrosion degrades the useful properties of materials and structures including strength, appearance and permeability to liquids and gases.

1.1.2 Corrosion removal

Often it is possible to chemically remove the products of corrosion. For example phosphoric acid in the form of naval jelly is often applied to ferrous tools or surfaces to remove rust. Corrosion removal should not be confused with electro polishing, which removes some layers of the underlying metal to make a smooth surface. For example, phosphoric acid may also be used to electro polish copper but it does this by removing copper, not the products of copper corrosion

1.1.3 Cathodic Protection (CP)

Cathodic Protection is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell.^[1] A simple method of protection connects the metal to be protected to a more easily corroded "sacrificial metal" to act as the anode. The sacrificial metal then corrodes instead of the protected metal. For structures such as long pipelines, where passive galvanic cathodic protection is not adequate, an external DC electrical power source is used to provide sufficient current.

Cathodic protection systems protect a wide range of metallic structures in various environments. Common applications are: steel water or fuel pipelines and steel storage tanks such as home water heaters; steel pier piles; ship and boat hulls; offshore oil platforms and onshore oil well casings; and metal reinforcement bars in concrete buildings and structures. Another common application is in galvanized steel, in which a sacrificial coating of zinc on steel parts protects them from rust. Cathodic protection can, in some cases, prevent stress corrosion cracking

1.2 problem finding:

The scope of improving the corrosion resistance properly by identity suitable coating material



Figure 1.2 Effects of salt corrosion problems

1.3 production system:

For most applications of structural steel, some form of corrosion control is essential, as discussed next.

- ✓ Protective Coatings
- ✓ Galvanic Protection
- ✓ Corrosion-resistant Steels
- ✓ Cathodic Protection

1.3.1 Cathodic Protection

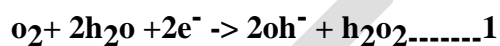
This method is used for structures located below ground or immersed in water, usually in conjunction with a protective coating. Because corrosion results from, or is accompanied by, a flow of electrical current between anodic and cathodic surfaces, it is possible to reduce or eliminate it by controlling the magnitude and direction of current flow. By reversing the current to the original anodic steel surface, the steel is made a cathode and does not corrode.

A protective coating, such as asphalt, tar, or an epoxy, is commonly applied to the structure to reduce power consumption.

1.3.2 Cathodic reactions

The second reaction possible is the hydrogen ion reduction to hydrogen atoms:-

hydrogen ion reaction $e = -0.24 - 0.06\text{pH}$



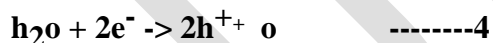
potential range 0.6 to -0.5v(sce)



potential range -0.7 to -1.2 v(sce)



potential range -0.66 v and below(sce)



Potential range -1.2 v (sce) and below

Reactions 1,2 are diffusion controlled.

1.4 Objective our project

1.4.1 Protective Coating

The simplest method is to simply cover the metal with a rust-inhibiting paint, tape or plastic coating

1.4.2 Galvanizing:

The process of coating iron or **steel with a thin layer of zinc**

The zinc oxidizes forming a tough protective coating.

1.4.3 Corrosion-Resistant Metals

Metals are combined to create alloys which are more resistant to corrosion

1.4.3.1 Cathodic Protection:

A form of corrosion prevention in which the metal being protected is forced to be the cathode of a cell, using either impressed current or a sacrificial anode.

1.4.3.2 Sacrificial anode:

A form of cathodic corrosion protection in which a metal is more easily oxidized than iron is electrically connected to an iron object. Galvanized steel is a common example of this.

1.4.3.3 Impressed Current:

A form of cathodic corrosion protection in which the metal object to be protected is attached to the negative terminal of a power source, making the object the cathode in a cell.



Figure 1.4.3.3. Impressed current

1.5 Methodology:

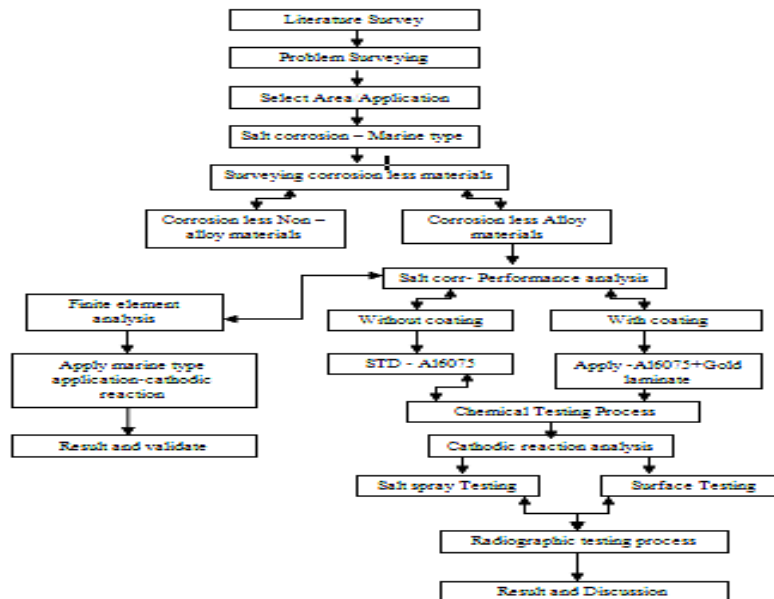


Figure 1.3 Methodologies

1.6 classification of corrosion material and process ranges:

Table 22 – Corrosion test results for various alloys in potash liquor at 235°F (113°C). Duplicate U-bent stress-corrosion cracking specimens with PIFE insulators tested for 1000 h

Alloy	Corrosion rate, mpy (mm/a)	Pitting	Crevice corrosion	SC
ALLOY 6075	0.5 (0.01) 0.6 (0.02)	Y	Y	Y
INCONEL alloy 800	<1 (<0.025)	Y	Y	Y
INCOLOY alloy 825	<1 (<0.025)	Y	Y	Y
70-30 Cu-Ni	0.5 (0.01) 0.5 (0.01)	Y	Y	Y

1.7 Steps In Finite Element Analysis (Comsol).

1.7.1 Pre-processing

Pre-processing includes the entire process of developing the geometry of a finite element model, entering physical and material properties, describing the boundary conditions and loads, and checking the model.

1.7.2 Solution

The solution phase can be performed in the model solution task of the simulation application, or in an external finite element analysis program. Model solution can solve linear and non-linear static, dynamics, buckling conduction heat transfer and potential flow analysis.

1.7.3 Post processing

Post-processing involves plotting deflections and stresses, and comparing these results with failure criteria imposed

On the design such as maximum deflection allowed the material static and fatigue strengths, etc. If we only wanted to know of the part would survive the load, all we would need to see yes or no answer. This is usually not the case. We would like to be able to see the results in different display formats, which will give us insight into why the part will fail and how to improve the design.

1.8 Simulation tasks in comsol

1.8.1 Modeling of Comsol

1. Establish a working plane.
2. Generate the Boolean operations.
3. Activate the appropriate coordinate system
4. Generate other solid model features in the following order as key

5. Points, lines, areas and volumes as needed.
6. Use Boolean operators or number of controls to join separate
7. Solid model regions together.

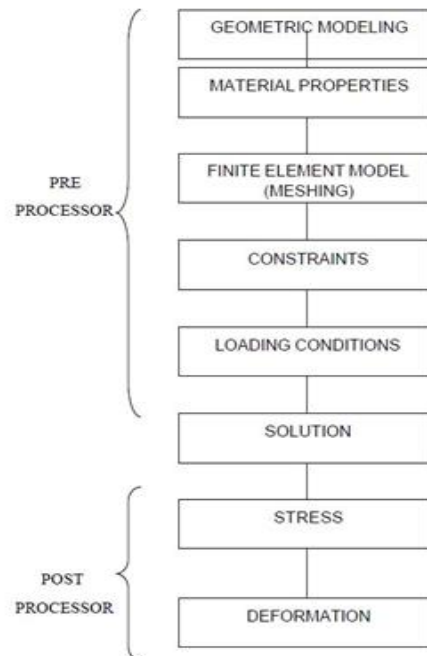


Figure 1.8.1 process methodology in Comsol

1.8.2 Create The Geometry:

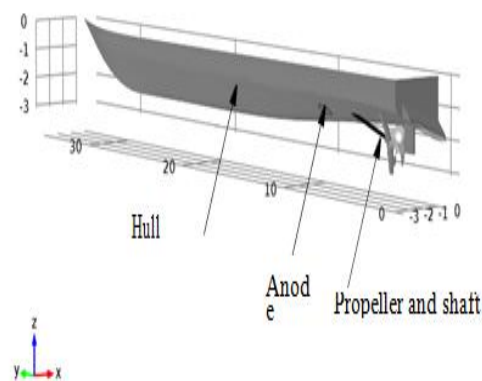


Figure 1.8.2 Create the Geometry

1.8.3 Generate Meshing:

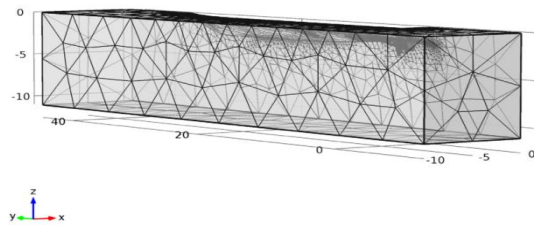


Figure 1.8.3 Generate Meshing

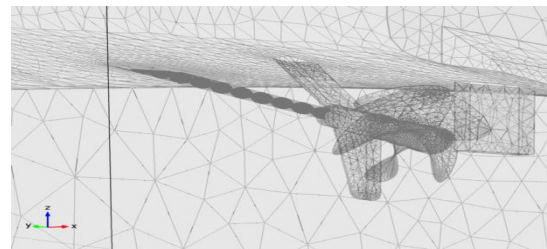


Figure 1.8.4 Propeller Shaft Meshing

1.9 Result and Discussion

A surface plot of the electrolyte potential for the ship hull surface with coated propeller is shown in figure 1.9. It can be seen that the potential distribution across the ship hull surface is quite uniform, except in the region close to the anode surface. The electrolyte potential is higher near the anode surface when compared to the rest of the ship hull surface. The over potential at the shaft surface is found to be well below its equilibrium potential indicating the cathodic activity at the surface.

Figure 1.9 a surface plot of the electrolyte potential for the case with a coated propeller.

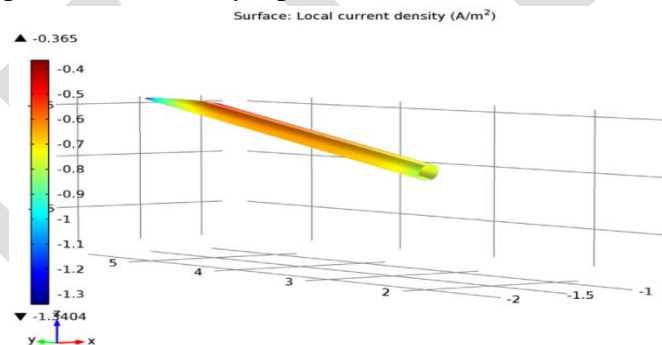


Figure 1.9.1 A surface plot of the local current density for the shaft surface in the coated propeller

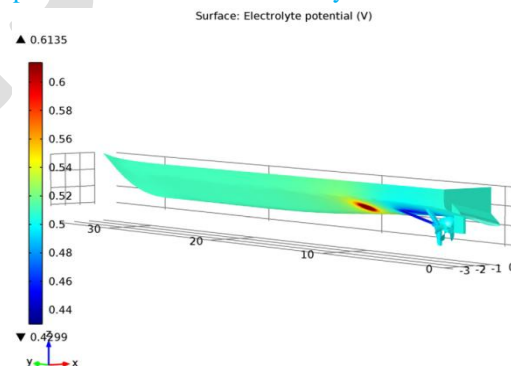


Figure 1.9.2 Dielectrode Potential system

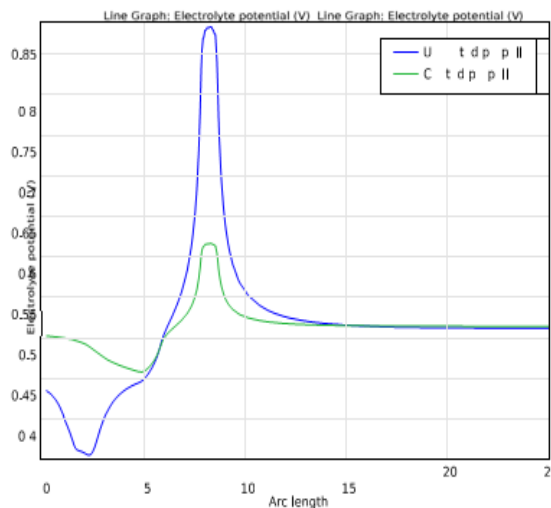


Figure 1.9.2 arc length with graph

2.0 Experimental Work

2.1 Before Testing



Figure 3.1 Aluminium Alloy coated and uncoated

2.2 After Testing



Figure 3.2 Aluminium Alloy coated and uncoated

TEST REPORT OF SALT SPRAY TEST

Item Description : Aluminium Alloy Uncoated

Sample ID No : White

Test Method : Refer ASTM B117

TEST REPORT OF SALT SPRAY TEST

(Refer: ASTM B117)

Description of Sample:

Nomenclature	Aluminium alloy uncoated	Identification	White
Test started	07.04.2015 at 12.15 PM	Duration of test	24 Hrs (Declared)
Test Complete	08.04.2015 at 12.15 PM	Method of test	Customer's Requirements (Duration)

1.SALT MIST TEST : (CI :10)

1.1 Test condition of sample:

The sample placed in the salt spray chamber for the following condition as per procedure.

SI.NO	Requirements	
1.	Distilled water by weight	95 parts
2.	Sodium chloride (AR) by weight	5 parts
3.	Specific gravity	1.0268 to 1.0413
4.	pH ($35 \pm 1^\circ \text{C}$)	6.5 to 7.2
5.	Temperature	($35 \pm 3^\circ \text{C}$)

1.2. Test Results

After 24 hours, the rust was not formed on the sample.

1.3. Appearance after test 24 hrs:

The Rust is not formed on the sample.

TEST REPORT OF SALT SPRAY TEST

Item Description : Aluminium Alloy coated

Sample ID No : Yellow

Test Method : Refer ASTM B117

TEST REPORT OF SALT SPRAY TEST

(Refer: ASTM B117)

Description of Sample:

Nomenclature	Aluminium alloy coated	Identification	Yellow
Test started	07.04.2015 at 12.15 PM	Duration of test	24 Hrs (Declared)
Test Complete	08.04.2015 at 12.15 PM	Method of test	Customer's Requirements (Duration)

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1.2. Test Results

After 24 hours, the rust was not formed on the sample.

1.3. Appearance after test 24 hrs:

The Rust is not formed on the sample.

3.0 Summery

This deviation is less significant in the case of a coated propeller. Thus, the electrolyte potential Produce defects in materials and can therefore result in mechanical failure of materials. Towards the stern in relation to the anode, is evaluated for the two cases, it is found to be the same (around 0.52 V) for both cases.

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