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Numerically Analysis of Corrosion Resistance and Control Plate

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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, usually a metal, 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 short time, showing the familiar color of red-brown iron oxide. Depending on the environment the rust may develop in minutes. In this project corrosion resistance with salt water desalination process & analyzed for catholic production analysis various operating parameters to enhance the performance of the corrosion less analysis coating and without coating of the process experimentally and numerically by using comsol with Radiographic Testing process Best Corrosion resistance –salt Water treatment model optimum will be validated experimentally.

Keyword: salt water, corrosion resistance,expermentally,Numerically,catholic production,comsol.

Introduction

Corrosion is defined as the deterioration of a material, usually a metal, because of a reaction with its environment.

Types of Corrosion Resistance

- ✓ Underground corrosion
- ✓ Electronic corrosions
- ✓ Ccorrosion influence in flow
- ✓ Galvanic corrosion
- ✓ Water corrosion

Problem Finding

Losses are economic and safety:

- ✓ Reduced Strength
- ✓ Downtime of equipment
- ✓ Escape of fluids\
- ✓ Lost surface properties
- ✓ Reduced value of goods

Figure 1.2 Effects of salt corrosion problems

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

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.

Cathodic reactions

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

hydrogen ion reaction e= -0.24 –0.06ph

$$o_2 + 2h_2o + 2e^- \rightarrow 2oh^- + h_2o_2 \text{-------} 1$$

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potential range 0.6 to -0.5v(sce)

$h_2o_2 + 2e^- \rightarrow 2oh^-$ -------2

potential range -0.7 to -1.2 v(sce)

$h^+ + e^- \rightarrow h$ -------3

potential range -0.66 v and below(sce)

$h_2o + 2e^- \rightarrow 2h^{++}$ o --------4

potential range -1.2 v(sce) and below
reactions 1,2 are diffusion controlled.

Objective Our Project

Protective Coating

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

Galvanizing

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

The zinc oxidizes forming a tough protective coating.

Corrosion-Resistant Metals

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

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.

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.

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

Methodology

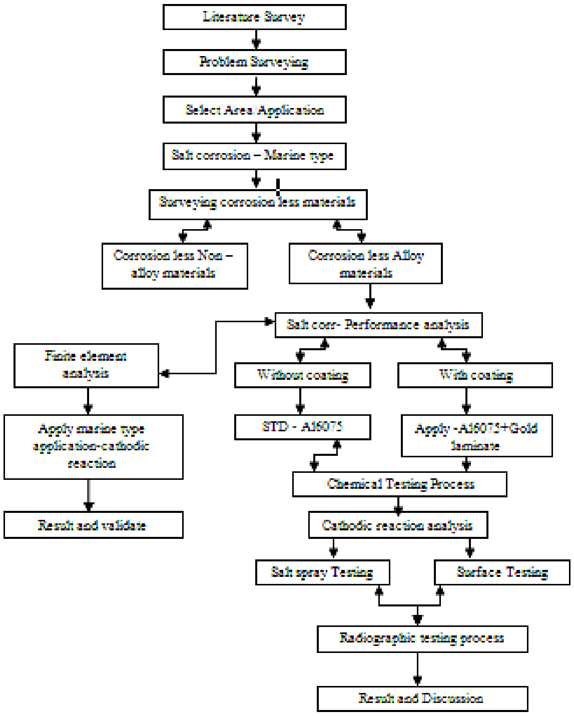

Figure 1.3 Methodology

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 PTFE insulators tested for 1000 h

Alloy	Corrosion rate, mpy (mm/a)	Pitting	Crevice corrosion*	SCC
ALLOY 6075	0.5 (0.01) 0.6 (0.02)	No No	No No	No No
INCONEL alloy 800	<1 (<0.025)	Yes Yes	No Yes	No No
INCOLOY alloy 825	<1 (<0.025)	Yes Yes	No No	No No
70-30 Cu-Ni	0.5 (0.01) 0.5 (0.01)	No No	No No	No No

Steps In Finite Element Analysis (Comsol).

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.

Solution

The solution phase can be performed in the model solution task of the simulation

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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.

Post Processing

Post-processing involves plotting deflections and stresses, and comparing these results with failure criteria imposed on the de sign 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.

Simulation Tasks In Comsol

Modeling Of Comsol

1. Establish a working plane.
2. Gentrate the Boolean operations.
3. Activate the appropriate coordinate system
4. Generate other solid model features in the following order as ke
5. Points, lines, areas and volumes as needed.
6. Use Boolean operators or number of controls to join separate
7. .Solid model regions together.

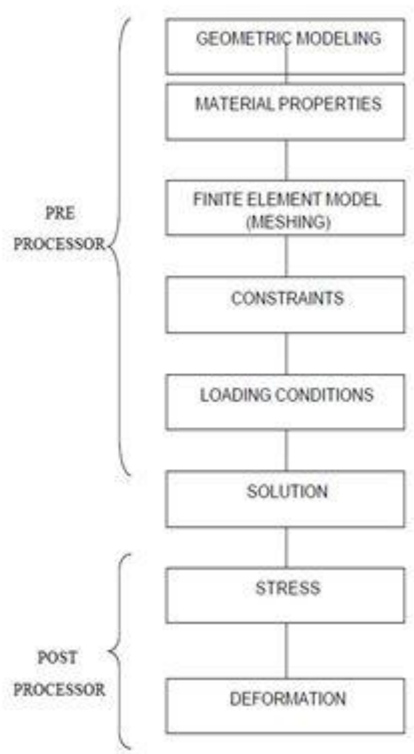

Figure 1.8.1 process methodology in Comsol

Create The Geometry:-

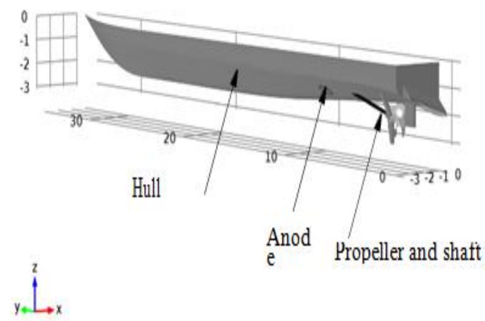

Figure 1.8.2 Create The Geometry

Generate Meshing:-

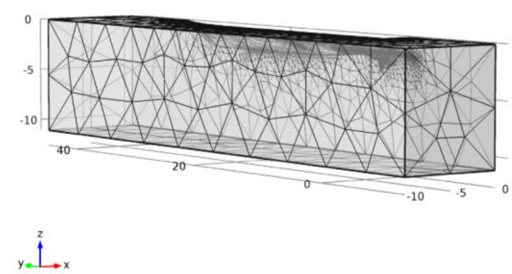

Figure 1.8.3 Generate Meshing

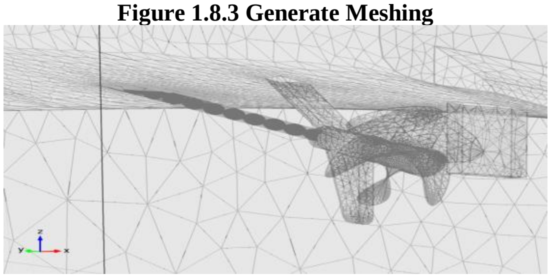

Figure 1.8.4 Propeller Shaft Meshing

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.

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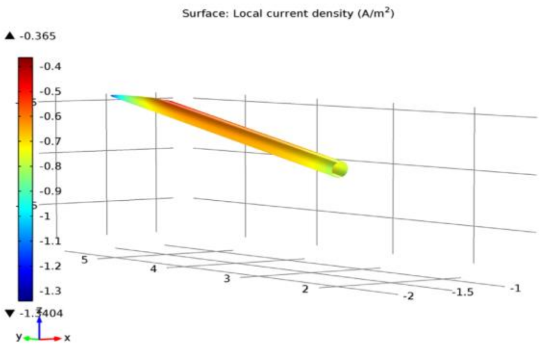

Figure 1.9.1 A surface plot of the local current density for the shaft surface in the coated propeller

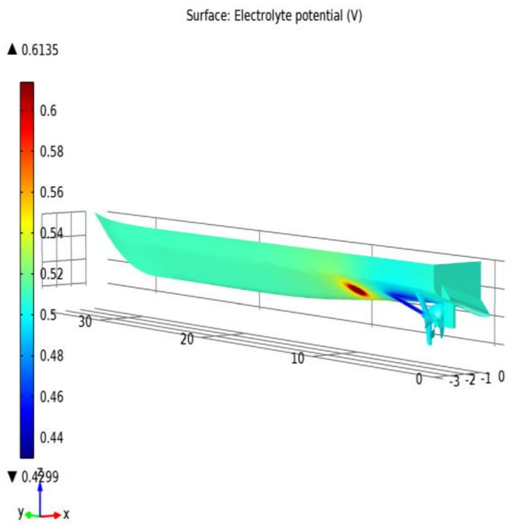

Figure 1.9.2 Dielectrode Potential system

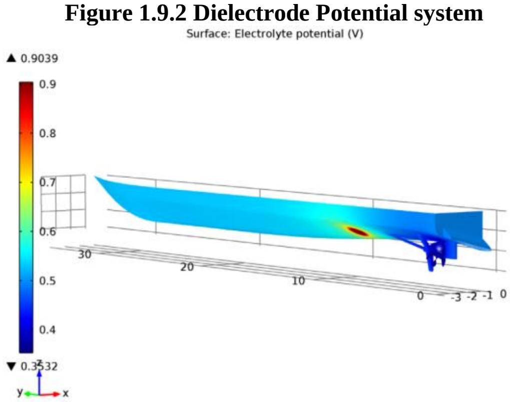

Figure 1.9.2 A surface plot of the electrolyte potential for the ship hull surface in case of an uncoated propeller.

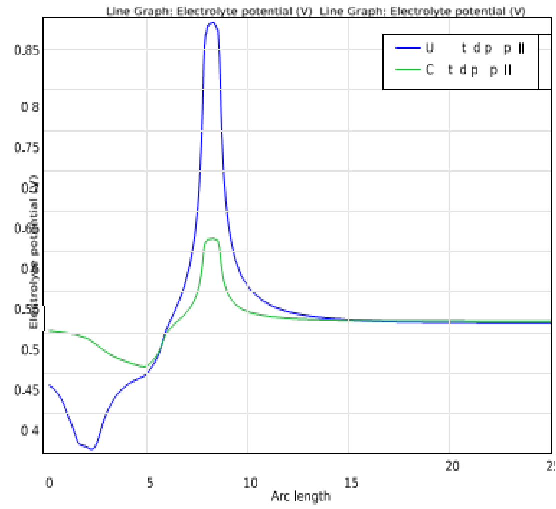

Figure 1.9.3 arc length with graph

Summery

This deviation is less significant in the case of a coated propeller. Thus, the electrolyte potential produce defects in a 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.

Future Project Scope

In our project the role of cathodic reactions in degrading materials will be examined. To apply corrosion less materials with coating and without coating to validating and experimentally comparing salt spray testing considering with numerical results are simulating comsol values in different temperature conditions.

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