Corrosion mitigating techniques and the mechanisms: Comment

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Abstract
A lasting solution is required to curb the corrosion attack because of the very destructive effect it has on engineering materials. Corrosion is a material degrading phenomenon that reduces the significant properties of metallic materials, making them less useful. This paper has been able to highlight the very suitable methods or techniques that help to mitigate the effect of corrosion on metals and other helpful engineering materials. Some of these methods are electrodeposition and protective coatings like organic coatings, inorganic coatings, and metallic coatings.

Keywords: Coatings, electroplating, mitigation, corrosion

1. Introduction
Corrosion is a form of material degradation that affects its properties as a result of certain level of interactions that occurs with those materials and their environment. Corrosive degradation of most metallic materials amongst many others is evitable[1]. Although corrosion is affiliated with most metallic materials, but all other kinds of materials are also vulnerable to various kids of degradation. Ceramic materials also go through a certain level of degradation in form of selective dissolution. Just like humans try to avoid or do away with death and payment of taxes, corrosion in the essence of material science and engineering is something we always hope to avoid because of its destructive outcome[2]. However, it something we all must learn to adapt or deal with because it is outrightly inevitable. Most engineering systems have various components made with metallic materials. The effect of corrosive degradation cannot be overemphasized, especially on metallic pipelines, marine industry, oil and gas sector and so many other manufacturing industries [3, 4]. This has cost many companies a lot of financial losses because of the downtime effect of corrosion on the factories, increased maintenance cost and so many other ripple effects of these industries [4-7]. This challenge faced by most of these industries has long been tackled by several research
finding and still has the focus of most corrosion research specialist for sustainable solutions to resolve the ever-lingerering problem of corrosion. Some of the applied findings are organic and inorganic inhibitors inform of coatings and other protective layers to help mitigate the effect of corrosion. Thus, this study provide tangible cost effective and coating protection route for corrosion prevention in acidified and saline environment

2. Protection against corrosion

A surface is measured as being capable of having corrosion resistance in a given setting. Out of the many variations found by the metallic material in the corrosive setting, varieties of protective coatings for corrosion were thus created. For example, a fire-resistant coating should provide a means of resistance for the substrate. Despite the multiple problems metallic products encounter in corrosive conditions, coatings have been the way out to avoid metal loss. In other words, coatings are essential for improving the life cycle, property, and other specialties. Coatings have been found to be the most effective option to guard against underwater fouling from corrosion [5]. Protective coatings can be divided into metallic coatings, inorganic and organic coatings.

2.1. Inorganic coatings

Inorganic coating is a unique coating protection of surface which is generated by chemical action in the presence of electricity or not. This class of coating provides better corrosion resistance of metallic artefact on the surface layer either by film deposition of metallic oxide or natural flakes. It is often use in industrial application for alternative protection over paints [6]. Inorganic coatings often act as precoats until proper deposition is done.

2.2. Organic coatings

High performance organic paints and coatings have been put in place to protect materials and equipment from the environmental degradation of industrial equipment. Coatings of polyvinyl chloride, epoxy coatings are examples or organic coatings widely used in manufacturing industries to avoid metal attacks under the coating, such as water, oxygen, cathodic reactions etc. The oil sector has been the case study in creating such sustainable coatings. Indeed, coatings made from epoxy, polyurethane contain refined petroleum products. Olajire, [7] has studied the fact that organic coatings offer good ionic conductivity resistance to corrosion and thus offer good barrier properties.

2.3. Metallic coatings

Metallic coatings are used in the deposition of metal coatings by electroplating, deposition of vapour, electroplating, and hot dipping process. Materials (metallic) used mainly for such coatings contain copper, silver, chrome, etc. Armor coatings change the characteristics of the work-piece surface layer of the product being added. The coatings also give a durable, corrosion-resistant layer. Metallic coatings are renowned for their texture [8]. Chmielewski et al., [9] reported that the matrix properties of metals with low porosity and other positive properties have increased.

3. Mechanism of Electrodeposition Process

Electrodeposition is also known as electroplating. It is a surface deposition process that involves adding a layer of another metal or composite alloy or an electrolytic oxide film to achieve the desired surface properties in the metal. In metal finishing applications altering surface properties is crucial at arriving at quality required. Over the years, deposition practices were used to achieve improved performance[10]. It is a good placing practice that produces good coatings of anticipated thickness and fine size of aggregate. Electroplating is
employed in most industries to improve the surface of a metal, the properties (both mechanical and electrochemical), the characteristics that they possess and resist as much as possible to corrosion [11]. Electrolytic deposition over the years has evolved into today's science. This breakthrough is responsible for the many and huge methods of application in the field of engineering and practical science. Therefore, in the search for solutions to reduce the problems of corrosion of metals, surface treatment has become a profitable and useful tool. In general engineering applications, the use of composite materials and nanocomposite alloys has become the priority and many manufacturing systems have adopted their use.

Electrodeposition describes the relationship between the working material and the deposit. The properties of the coating are adapted to the prerequisites and properties desired. Therefore, the metals depend on the bath formulation, and frame work with conditions for depositing the materials properties of interest. Conditions for electroplating are not limited but include the nature of bath, current density, voltage and the anode [12]. Factors such as current density, careful selection of anodes and other conditions have to be considered for effective deposition to achieve excellent properties. Metal electroplating is electrolytically depositing a layer of metal, alloy or composites onto a surface material.

![Figure 1: Components of Electroplating [13].](image)

For deposition to occur, the potential at the cathode must be present. There is a flow of current through an electrochemical Cell. When current flow through the cell, the equilibrium value is deviated from the electrode potential. Over-potential then becomes the difference between the actual and equilibrium potential. It can be mathematically stated by:

$$E_a = E_c + \eta$$

In order to move ions across the interface between the electrode and the solution (electrolyte), an amount of energy is required which is Overpotential.

3.1. Other Plating Processes

3.1.1 Electroless Plating

Electrolytic coating is a process of autocatalytic reduction of metal ions in an aqueous solution used to deposit a metal anode layer on a substratum without electrical energy use. For example, in nickel electrolytic coating, the chemical reducing agent is responsible for reducing the nickel metal ions, as well as their deposits. Unlike electroplating, the use of
electric current to form deposition is not required hence coverage is achieved without difficulty and a uniform coating thickness is produced [15].

Due to its excellent corrosion resistance and hardness, it majors in vast applications in the industry (Oil) for machine parts like valves, pistons and pump parts in order to prolong the lifespan of equipment exposed to aggressive conditions. Immediately the catalytic material is plated, the plating continues because the deposited metal is also catalytic. Electroless plating also gives birth to improved physical and mechanical properties, quality deposition. Paunovic, [14, 16] attested that electroless plating are used worldwide in industrial applications to meet functional requirements.

3.1.2. Hot Dip Galvanizing
This is a special coating process that involves submerging the substrate in a bath of molten metal with low melting points (mainly zinc). The galvanization process has its main applications in the automotive industry, manufacturing plants and also in industries that use iron or mild steel. The hot dip coating formation is by a chemical reaction between the substrate and the molten zinc. The thickness of the coating depends on the temperature of the zinc and its immersion time. The chemical protection afforded to the substrate by zinc coatings is an important factor in determining the effectiveness of galvanized coatings, as it protects the material against corrosion. The galvanization process is a particular advantage over other methods of resistance to metal corrosion. Most of the pieces produced depend solely on cathodic protection to avoid corrosion of the steel at the edges of the cut [15].

3.1.3 Flame Spraying
Flame spraying makes use of powder or wire which is been put into a melting flame. The finely liquid particles are then blown to the metal surface to be protected. To get a desired result, the surface of the metal must be roughened or sandblasted. Applications of flame spraying can be observed in marine industries with ship hulls, structural bodies like bridges [16].

Conclusion
The drive for the correction and mitigation of the problems associated with corrosion is still ongoing. However, this study covers the general overview the various techniques that are currently in active use by most researcher to properly address this corrosion challenge in terms material degradation. Thus, corrosion cannot be totally eliminated, but its effect and attack can be controlled and reduced drastically.

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