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# Review of metal protection techniques and application of drugs as corrosion inhibitors on metals

R.C. Nduma<sup>1\*</sup>, O.S.I. Fayomi<sup>1, 2</sup>, M.O. Nkiko<sup>3</sup>, A.O. Inegbenebor<sup>1</sup>, N. E. Udoye<sup>1</sup>, O. Onyisi<sup>1</sup>, O. Sanni<sup>2</sup>, J. Fayomi<sup>2</sup>

<sup>1</sup>Department of Mechanical Engineering, Covenant University, P.M.B 1023, Ota, Nigeria

<sup>2</sup>Department of Chemical, Metallurgical and Materials Engineering, Tshwane University of Technology, P.M.B. X680, Pretoria, South Africa.

<sup>3</sup>Department of Physical and Chemical Sciences, Elizade University, Ilara-Mokin Nigeria

[ojo.fayomi@covenantuniversity.edu.ng](mailto:ojo.fayomi@covenantuniversity.edu.ng), [Ojosundayfayomi3@gmail.com](mailto:Ojosundayfayomi3@gmail.com) +2348036886783  
[uduma62@gmail.com](mailto:uduma62@gmail.com)

## Abstract

The inability of metals to resist degradation as a result of corrosion remains a unique global problem that depend on different metals for daily operations. Therefore, knowing the appropriate method to use is a key to ameliorate corrosion effect on metals. Green inhibitors serve as a modern, cheaper and environmentally favorable method to retard the effects of corrosion. Drugs are corrosion inhibitors which can reduce the action of corrosion without being hazardous to the environment as they are synthesized from natural products. The review studies the metal protection techniques and the use of drug as corrosion inhibitors. The importance of copper as a useful metal as good corrosion resistance due to inherent properties alongside its malleability was also discussed.

**Keywords:** Corrosion, inhibitors, drugs, copper, coating.

## 1. Introduction

Metal corrosion is a phenomenon which affects the entire metallurgical world, a major issue which society makes substantial effort to nib in the bud to a reasonable extent. It is a huge flaw to engineers as bulk of the engineering work involves the use of metals and their respective alloys, which are the materials that are attacked by corrosion [1]. Corrosion can be viewed as the destructive diminution of metals and its alloys because of different chemical and physical reactions with its environment. The chemical reactions that cause this phenomenon are the anodic and cathodic reaction [2]. Most agents of corrosion include water, some solids, oppressive metal polishes, some gaseous materials containing ammonia, sulphur, liquid chemicals, base salts, oils, humidity in air [3]. Material deterioration can sometimes occur in air, water, different acidic and alkaline mediums. Corrosion is very harmful to the life-span of metals, hence detrimental to tools, structures and equipment which are fabricated from metals. The fact that these metals are of extreme value to daily living, makes the effect of deterioration a concern, hence, every metal is no alien to gradual deterioration and destruction. Corrosion has to be controlled and inhibited, in order to control this natural deterioration process, the mode of activation and propagation should be understood [4]. The mechanisms that enable the phenomenon must be known so as to prevent their activity or their effects. These studies lead to various methods of corrosion control. These methods include: material selection, surface coating, electrical protection; inhibitors and equipment design [5]. The various methods used to control corrosion mentioned above, in various conditions have a manifold of occurrences for applications. Material selection is sufficient where the characteristics of the metal are most important to its application, several selections can be dependent on the metals connection to corrosion inhibition techniques or based on the natural corrosion resistivity of the metal; we have surface coatings, which can be seen as the



application of various substances to the surface of materials such as metals in order to enhance surface properties of the metal such a corrosion resistance and wear resistance [6]. Thus, this study explore the review of metal protection techniques and application of drugs as corrosion inhibitors on metals

## **2. Copper and its corrosive activities in application**

Copper is a metal known for its high thermal and electrical conductivity alongside its malleability, ductility. It has a pinkish-orange color when it is freshly exposed. Due to the unique properties of copper, it is relied upon prominently and it is a utilized essence of different expanding and rising industrial economy. From electrical wiring to domestic and industrial plumbing, from radiators to air conditioners, from different transportation equipment to machinery, the uses of copper cannot be overemphasized. Over the past 1000 years, the industrial call for processed copper has gone up from 500,000 metric tons to over 19 million metric tons. The outstanding properties of copper are its high electrical and thermal conductivities which makes it the first choice material when producing heat exchangers. The ability of copper to withstand and conduct heat is of high value to electrical and electronics industry as it involves a lot of applications with heat. It is the best non precious metal electric conductor. Outside the usual wiring and other cable products, other huge application of copper is in the production of copper tubing which have various applications which include heating systems, refrigeration and air conditioning units and plumbing.

As of 2016, the global copper consumption rate sits at 31% for construction, 24% for electrical work and industrial work respectively, 11% for transportation and 10% for general and consumer needs (Wood, 2017). The demand of copper has increased largely over the past years and an estimated increase in the price of copper has been predicted from summer of 2020-2025 which is one great disadvantage of copper [19]. A huge drawback in copper is its susceptibility to corrosion (oxidation) which is a major problem to the industries which have copper as a major product for profit maximization and daily activities. Seeing that copper is not cheap to acquire, the different industries which utilize copper need to find different means of reducing the corrosion rate of the copper is service. The most common engineering applications of copper comprise of pumps, heat exchangers, valves, large vessels, large aircrafts and off road vehicles, bearings for millions of mechanical products, plastic injection molding dies and ship propellers. Copper has seen various advancement in her applications over the years as semiconductor technology has embraced the use of copper to help increase its efficiency and performance by 30% [20]. This investigation aims to compare and contrast the behaviors of copper thermodynamically using inhibitive drugs in an acid chloride media.

## **3. Metal protection techniques**

Equipment design follows the same route of selection and appropriate planning before application. Electrical protection techniques involve cathodic protection, which is a method used for preventing structures in electrolytes from corroding by connecting the metal structure to an anode in an electrical circuit, thereby making it a cathode and not able to corrode [7]. Finally, Corrosion inhibitors are different contents which are applied to a corrosive media like acid or salt water, impede the corrosive action of the medium on substrates [8]. The process of controlling corrosion of different metals is a very important activity which is of economical, aesthetic, technical and environmental importance. Hence,

the use of inhibitors poses to be one of the best options of protecting metals and metal alloys from deterioration [9]. The use of inorganic corrosion inhibitors has increased the cost and environmental hazard in the world. The toxicity of inorganic and organic inhibitors to the environment has given rise to riskless corrosion inhibitors like green inhibitors as they are to a greater extent, environmentally favorable inhibitors of corrosion, of which most of them are biodegradable and do not constitute of toxic compounds or heavy metals [10]. Green inhibitors, not also being environmentally safe and ecologically acceptable, they offer economic advantages as green inhibitors are readily available, inexpensive and renewable sources of materials.

Green inhibitors serve as a modern, cheaper and environmentally favorable method to retard the effects of corrosion. Gopiraman & Sulochana, (2012) expressed that there two types of green inhibitors; organic green inhibitor which is mostly extracts of plants and inorganic green inhibitors, like antibacterial drugs [11]. According to [12], the application of chemical inhibitors is on a large decrease because of environmental regulations due to its ecological threats making plant extracts and antibacterial drugs become acceptable due its environmental friendliness and availability for a wide-ranging variation of required inhibitors. The use of green eco-friendly natural polymeric structures is having a large preference, due to its practical use, renewable sources of materials, low cost and safe effect and can also be easily extracted from leaves or seeds [13]. The use of natural corrosion inhibitor is a solution for Nigeria oil and gas firm. According to [14] Figure 1 shows the research work distribution in the last two decades on the various sector. It reveals that most of publications are focused on the study of plant extracts followed by both drugs and gums at the same 11%.

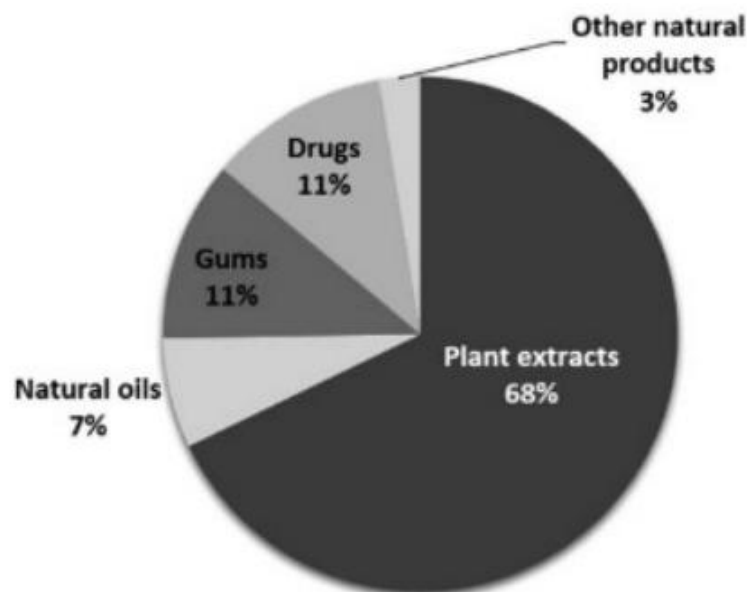


Figure 1: The distribution of the research work done on natural products as corrosion inhibitors [14].

In recent years, there have been concerns about biodegradability, accumulation and toxicity of corrosion inhibitors. Major challenges faced are safety of researchers, environmental pollution and economics as researchers yearn for safe, non-polluting and cost effective inhibitors [15]. Worldwide search for non-polluting inhibitors have lead to the use of inhibitive drugs [16]. Many researchers in the corrosion field are of the opinion that drugs are

corrosion inhibitors which can reduce the action of corrosion without being hazardous to the environment as they are synthesized from natural products [16]. According to Fayomi, Anawe & Ayodele (2017), the employment of drugs as corrosion inhibitors has been regarded as an appropriate substitution for very harmful organic and inorganic inhibitors since they generally have the adsorption effect on the metal. These drugs are very good examples of green inhibitors [17]. Drugs as inhibitors are economically advantageous for research purposes, and these drugs are commercially available [18]. The choice of some drugs are based on the fact that some drugs are easily produced and purified, molecules of the drug comprise nitrogen, sulphur and oxygen as active centers and environmentally friendly to biological reactions [19]. Drugs such as ampiclox, tetracycline, ampicillin, cloxacillin, amoxicillin and flucloxacillin have been established to be proficient inhibitors for the deterioration of metals.

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### Conclusion

Corrosion is a challenge to engineers as bulk of the engineering work involves the use of metals and their respective alloys, which are the materials that are attacked by corrosion processes. Several procedure have been designed to retard the corrosion of metals after studying the different types of corrosion. Drugs are corrosion inhibitors which can reduce the action of corrosion without being hazardous to the environment as they are synthesized from natural products. The studies on the metal protection techniques and the use of drug as corrosion inhibitors were greatly confirmed in this study.

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