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CHLORELLA SP. AS GREEN CORROSION INHIBITOR FOR ALUMINIUM IN HCL SOLUTION

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ABSTRACT

Metal corrosion prevention is of technical, economic, environmental, and aesthetic value. The environmental toxicity of organic corrosion inhibitors has led to the quest for green corrosion inhibitors, which are biodegradable, do not include heavy metals or other hazardous chemicals, and are biodegradable. The utility of Chlorella sp. as an aluminium alloy corrosion inhibitor in 0.5M HCl solution was evaluated by weight loss and thermodynamic studies, as well as Fourier transform infrared spectroscopy (FTIR). The findings obtained from weight loss and thermodynamic studies indicate that the value of inhibition efficiency (% IE) is proportional to the concentration of administered inhibitor. According to FTIR constants, Chlorella sp. contains more than one polar group (with atoms of O, N), π electron and protein functional group in FTIR spectra which is a functional group used as an inhibitor. Activation energy for this experiment is 106.72 kJ mol-1 greater than 80 kJ mol-1, suggested mechanism for corrosion inhibitor of Chlorella biomass is chemisorption. Chlorella sp. derived from a renewable resource with minimal health and safety issues has the potential to be a cost-effective alternative to synthetic corrosion inhibitors, according to the experimental results.

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1.1 Introduction

Corrosion is the degradation of metal caused by chemical attack or reaction with its surroundings. It is an ongoing issue that is often difficult to completely eliminate. Prevention would be more practical and feasible than total eradication. Corrosion processes develop quickly after the protective barrier is breached and are accompanied by a number of reactions that alter the composition and properties of both the metal surface and the local environment, such as oxide formation, metal cation diffusion into the coating matrix, local pH changes, and electrochemical potential. The study of corrosion of mild steel and iron is a huge theoretical and practical concern, and as such has sparked a lot of interest. Acid solutions, which are widely used in industrial acid cleaning, acid descaling, acid pickling, and oil well acidizing, necessitate the addition of corrosion inhibitors to prevent corrosion attack on metallic materials.

Several methods, including corrosion inhibitors, protective coatings, and cathodic and anodic protection, are currently being researched and applied to prevent corrosion. Corrosion inhibitors have been the most widely used method, with widespread industrial application. Corrosion inhibitors are classified into two types: organic and inorganic. Organic inhibitors, which are compounds containing one or more polar groups (with atoms of O, N, P, S, and π electrons), work by a physical or chemical adsorption mechanism, whereas inorganic inhibitors, such as nitrite, nitrate, chromate, dichromate, and phosphate salts, work by mitigating the cathodic or anodic reactions.

Although many of these compounds have high inhibition efficiency, they can have negative side effects such as toxicity and are expensive. As a result, demand for natural corrosion inhibitors (such as plants and algae) is increasing because they are biodegradable, do not contain heavy metals, are simple to extract or produce, and are inexpensive. Plant extracts are a rich source of natural organic compounds such as heterocyclic alkaloids and flavonoids, polycyclic compounds, and cellulose, among others, which can help to form a film on the metal surface, preventing corrosion and providing environmental benefits.

Algae extracts are widely used in both medical and cosmetic applications. Microalgae have significant biotechnological potential, and their biomass can be used to make food, animal feed, bioactive compounds, biofuels, and biofertilizers. However, there are few reports in the literature about their use as corrosion inhibitors.

Green microalgae of the Chlorella genus are spherical unicellular organisms with no flagella. Chlorella sp. is a green microalga that can grow in fresh or salt water and consumes both inorganic carbon and organic carbon through photosynthesis. As a result, it is a species that is resistant to environmental changes and grows quickly. Microalgae produce a wide range of primary biomolecules with potential industrial applications, including proteins, carbohydrates, and lipids, as well as a number of intermediate compounds such as carotenoids and phycobilin.

1.2 Literature Review

1.2.1 Introduction of Corrosion

Since the dawn of civilization, humanity have experienced natural disasters all across the world. Corrosion is one of the natural disasters that still occurs today. Rust, also known as corrosion, is a by-product of the Latin verbs ‘rodere’, which means to gnaw, and ‘corrodere’, which means to nibble into pieces (Sastri et al., 2012). Even if there are numerous labels used to describe this occurrence, the truth is that corrosion shortens the lifespan of an object by causing physical damage and destroying its lustre and attractiveness. It is highly electropositive and resistant to corrosion because a hard, tough film of oxide is formed on the surface(Rougier et al., 2020).

Faraday's first and second laws are the basis for calculation of corrosion rates in metal(Sugie et al., 1991). Protection from corrosion is one of the primary concerns in the recreational boating industry. To guarantee appropriate operation and a long service life, material selection and design must adhere to exacting standards, especially in salt water settings. In the case of a failure or human mistake, the mixing of electricity and seawater can have potentially catastrophic results (leakage current, incorrect earthing).