Influence of *Aloe vera* Extract on Corrosion Inhibition of Mild Steel in Well Water

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1. Introduction

Plant extracts are viewed as an incredibly rich source of naturally synthesized chemical compounds that can be extracted by simple procedures with low cost and are biodegradable in the environment.Plant extracts have become important as environmentally acceptable, readily available and renewable source for wide range of inhibitors.[1] In general, the plant extracts are inhibitors with high inhibition efficiency and of non toxicant. Natural products are nontoxic, bio-degradable and readily available. They have been used widely as inhibitors. Several plant extracts[2-6] and eco-friendly inhibitors[7,8] attracted the researchers. Natural products such as caffeine[9,10] have been used as inhibitors. Corrosion inhibition of steel by plant extracts in acidic media has been reported[11,12].

Corrosion inhibition by beet root extract has been studied[13]. Aqueous extracts of Onion[14] and Andrographis panizulata[15] have been used as corrosion inhibitors. Opuntia extract[16] was investigated for the corrosion of Aluminium in acid medium and vanillin[17] for the corrosion of mild steel in acid media. Extracts of tobacco from twigs, stems, and leaves can protect steel and aluminium in saline solutions and strong pickling acids[18,19]. Extract of Hibiscus sabdariffa can be used as corrosion inhibitor for mild steel in 2M HCl and 1M H_2SO_4 solution[20]. Anthony et al. have studied the effect of caffeine against chloride corrosion of carbon steel.[21] Bo yong *et al*. Investigated the corrosion inhibition of mild steel in acidic media by garlic[22, 23], Eddy *et al*.[24] was studied the corrosion inhibition of ethanol extract of Aloe vera on mild steel in acid media. Sribharathy *et al.* investigated the corrosion of mild steel in sea water by *Aloe vera* extract[25]. Through these studies, it is agreed that the inhibition performance of plant extract is normally ascribed to the presence of their composition of complex organic species such as tannins, alkaloids and nitrogen bases, carbohydrates, amino acids and proteins as well as hydrolysis products. These organic compounds contain polar functions with N, S, O atoms as well as conjugated double bonds or aromatic rings in their molecular structures, which are the major adsorption centres.

Aloes have abundant organic components in which N, S, O atoms are the main constituent atoms. The present work investigated the inhibition efficiency of an aqueous extract of plant material, *Aloe vera* (L) Burm f. (Liliaceae) extract, in controlling corrosion of carbon steel immersed in well water in the absence and presence of inhibitor, using weight loss method, analyzed the protective film by

Fourier transform infrared (FTIR) spectroscopy and proposed a suitable mechanism of corrosion inhibition, based on the results of the above studies.

2. Experimental

2.1 Preparation of plant extract and specimens

An aqueous extract was prepared by grinding 10 g of fresh extract of aleo vera gel, filtering and making up to 100 ml using double distilled water. Carbon steel specimens (0.0267% S, 0.06% P, 0.4% Mn, 0.1% C and the rest iron) of dimensions 1.0 cm × 4.0 cm × 0.2 cm were polished to a mirror finish and degreased with trichloroethylene.

2.2 Weight loss method

Carbon steel specimens were immersed in 100 ml of the well water, containing various concentrations of the inhibitor in the absence and presence of Zn^{2+} for 3 days. The weights of the specimens before and after immersion were determined using a Digital Balance Model AY 62 SHIMADZU. The corrosion products were cleaned with Clarke's solution. It can be prepared by dissolving 20 g of Sb_2O_3 and 50 g of $SnCl_2$ in one litre of conc. HCl of specific gravity (1.9)[26]. The corrosion IE was then calculated using the equation.

$$IE = 100\ [1-(W_2/W_1)]\ \%$$

where W_1 is the corrosion rate in the absence of inhibitor and W_2 is the corrosion rate in the presence of inhibitor. Corrosion rate was calculated using the formula:

$$\text{Millimetre per year} = 87.6\ W / DAT$$

W = Weight loss in milligrams
D = Density of specimen g/cm^3 = 7.87 gm/cm^3
A = Area of specimen = 10 cm^2 and
T = Exposure in hours = 72 hr

2.3 Synergism Parameter

The synergism parameter can be calculated by using the equation indicates the synergistic effect existing between the inhibitors[27-29]. S_I value is found to be greater than one suggesting that the synergistic effect between the inhibitors is S_I=1-I_1+2 /1-I'_{1+2}. where I_1 = inhibition efficiency of substance 1, I_2 = inhibition efficiency of substance 2,I'_{1+2} = combined inhibition efficiency of substance 1 and 2. If synergistic effect exists between the inhibitors, S_1 value will be greater than one.

2.4 Analysis of Variance (F-Test)

An F-test was carried out to investigate whether the synergistic effect existing between inhibitor systems is statistically significant[30]. If F-value is greater than 5.32 for 1, 8 degrees of freedom, the synergistic effect proves to be statistically significant. If it is less than 5.32 for 1, 8 degrees of freedom, it was statistically insignificant at a 0.05 level of significance.