New 3,3'-((4-Aryl) methylene)bis(4-hydroxy-2H chromen 2- one) (MHO) derivatives as Corrosion Inhibitor

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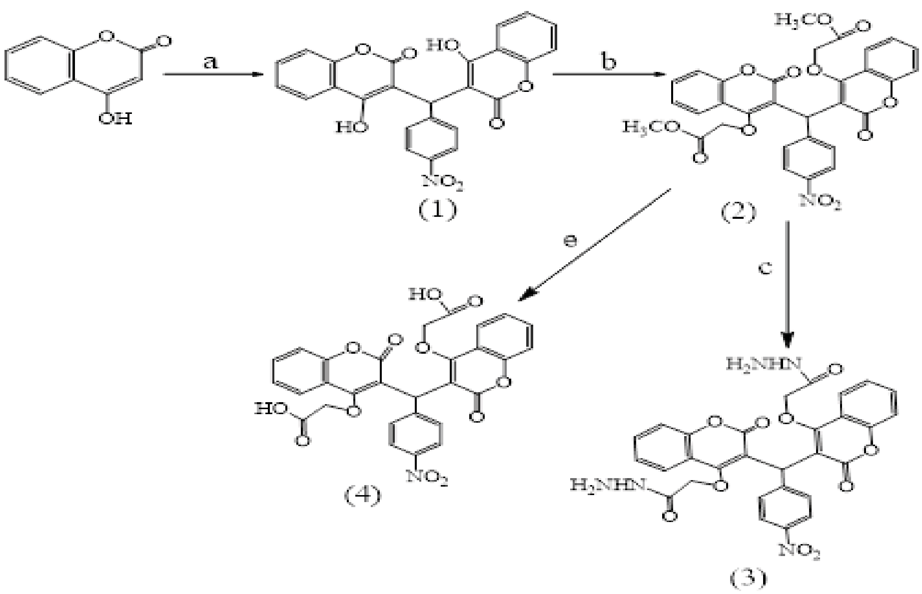
Abstract:

New green natural particles as corrosion inhibitor namely, macromolecules were incorporated beginning from 4-hydroxycoumarin with 4-nitrobenzaldehyde in the presence of glacial acid **(1)** then synthesis with methyl bromoacetate after that this compound **(2)** used to synthesis of 2,2'-(3,3'-((4-nitrophenyl)methylene)bis(2-oxo-2H-chromene-4,3 diyl))bis(oxy)diacetohydrazide **(3)** when was refluxed with hydrazine hydrate when compound(2) refluxed with HCl to obtain compound **(4)** and tested all the synthesis compounds on mild steel (MS) in 1 M HCl, 1M H_2SO_4 media by a weight loss method and identification of the surface technique employee scanning/electron/microscope (SEM) studies. The weight loss investigation demonstrated that inhibition performances have been improved via concentration raising of inhibitor. To support our results scanning electron microscopy was employed to clarify the surface of the MS with and without synthesis compounds in 1.0 M HCl and1.0M H_2SO_4 media.

1. Introduction:

Organic substances have been used extensively as corrosion inhibitors during the last four decades. Of these, heterocyclic compounds containing one or more N, O and S atoms can affect the inhibition of corrosion, in aqueous acid solutions, of metals [1–7]. A few unique strategies can be utilized to moderate or avert erosion of metallic structures. The most generally utilized techniques are defensive coatings on metals utilizing natural atoms, plastics, polymers; and cathodic or potentially anodic assurance utilizing natural or inorganic inhibitors.

Corrosion products are formed when a metal give its electrons to the oxidizing substances. This can be postponed by painting the metal, or other method for shielding these metals from erosion is to utilize consumption inhibitors. The adsorption of corrosion inhibitor depends mainly on physico-chemical properties of the molecule such as functional groups, steric factor, molecular size, molecular weight, molecular structure, aromaticity, electron density at the donor atoms and π- orbital character of donating electrons [8-10] and also on the electronic structure of the molecules [11,12]. Numerous studies have been made on the consumption and the restraint of steel in corrosive media [13-19]. The point of the present examination is to decide the restraint effectiveness of amalgamation mixes for the consumption of gentle steel in various destructive medium.. The proposed structure of the synthesized compounds as corrosion inhibitor is appeared in scheme (1).



Reagents and Conditions: a = 4-nitrobenzaldehyde, glacial acetic acid /refluxed; b = methyl bromoacetate / refluxed; c = hydrazine hydrate / refluxed; e = HCl / refluxed

Scheme (1) Reaction of the new coumarin compounds

2. Experimental:

2.1 Synthesis of (MHO) derivatives

All compounds (1-4) were synthesized according to Al-Amiery 2015 [20]

Compound (1) -3,3'-((4-nitrophenyl)methylene)bis(4-hydroxy-2H-chromen-2-one), Compound (2) –dimethyl 2,2'-(3,3'-((4-nitrophenyl)methylene)bis(2-oxo-2H-chromene-4,3-diyl))bis(oxy)diacetate.

Compund (3) -2,2'-(3,3'-((4-nitrophenyl)methylene)bis(2-oxo-2H-chromene-4,3diyl)) bis(oxy) diacetohydrazide,

Compound (4) -2,2'-(3,3'-((4-nitrophenyl)methylene)bis(2-oxo-2H-chromen-4,3-diyl))bis(oxy)diacetic acid.

2.2 Gravimetric Approach:

2.2.1 MS specimens.

MS specimens got by the Metal Samples Company were employed all through this investigation. The composition (wt %) of the mild steel was as follows: Fe, 99.21; C, 0.21; 0.38; 0.09; 0.05; 0.05; and 0.01 for Fe, Si, P, S, Mn, Al respectively. The measurements were conducted in aerated, non-stirred 1.0 M HCl and1.0M H_2SO_4 solutions containing different concentrations of MHO derivatives.

2.2.2 Weight-loss measurements

The specimens in duplicate were suspended in the test solution (200 mL), with the three compounds of MHO derivatives and without the three compounds in 1.0M HCl and 1.0M H_2SO_4. Corrosion Inhibitor of different concentration ($0x10^{-2}$ mM, $5x10^{-2}$ mM, $10x10^{-2}$ mM, $15x10^{-2}$ mM, $20x10^{-2}$ mM, $25x10^{-2}$ mM and $50x10^{-2}$ mM),for 24, 48,72,96 and 168 hr. at room temperature,The weight of the specimens before and after immersion was determined. Inhibition efficiency of the mild steel was determined using the average of the duplicate value using the equation:

Inhibition Efficiency (IE %) = $(1-W_2/W_1)$ X100

Where, $W_1$and W_2 is weight loss of the mild steel without and with the MHO derivatives as Inhibitor respectively [21-23].

3. Results And Discussion:

3.1 Weight Loss Method

Figures (1, 2, 3) demonstrates the chart of rate inhibitor proficiency against inhibitor focus for different time for compound 2, 3, 4 respectively in1.0 M HCl, The results of the experiment have shown that compounds 3and 4 decreased the corrosion rate as high as around 92.3 %, 90.5 for this specific investigation. The inhibitor proficiency is enabling and this can be used in the ventures as a substitute for the imported synthetic inhibitors, Figure (4) show the results of inhibition for MHO derivatives in 1.0 M H_2SO_4.

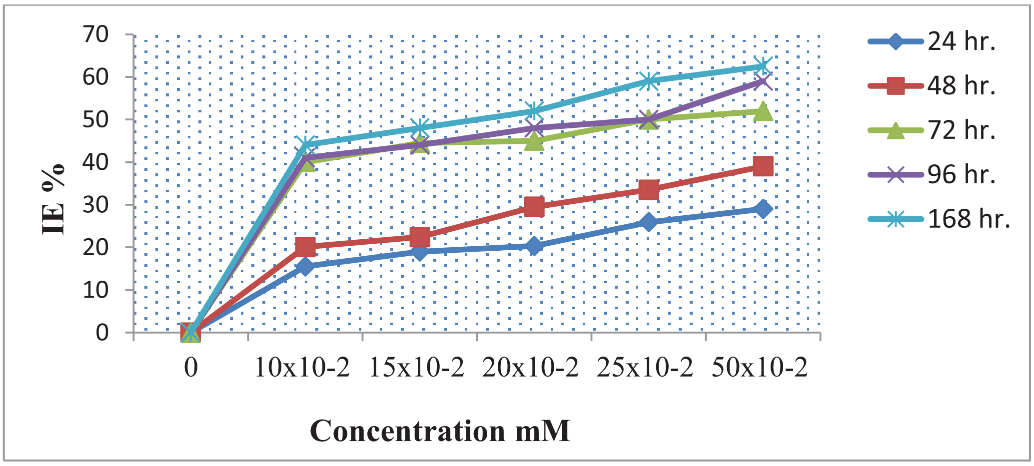


Fig. (1) Chart of % IE for compound (2) against concentration at different time in1.0 M HCl

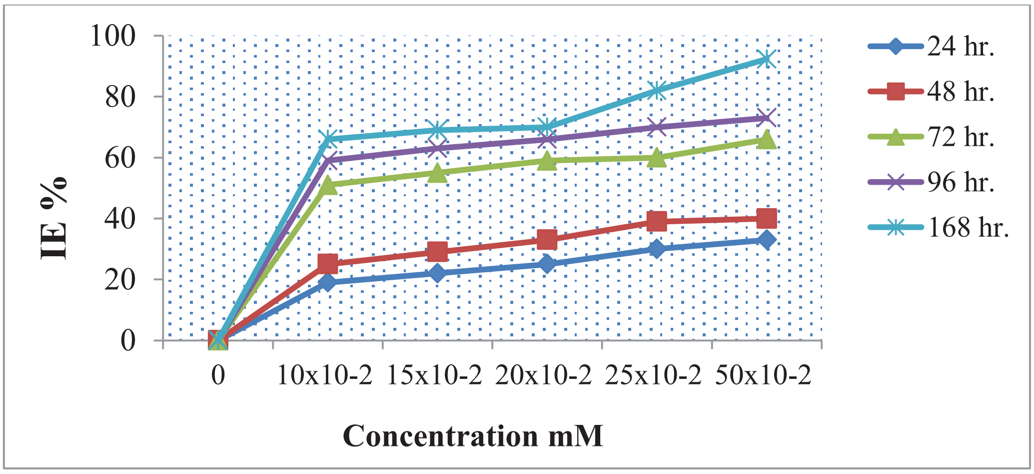


Fig. (2) Chart of % IE for compound (3) against concentration at different time in1.0 M HCl

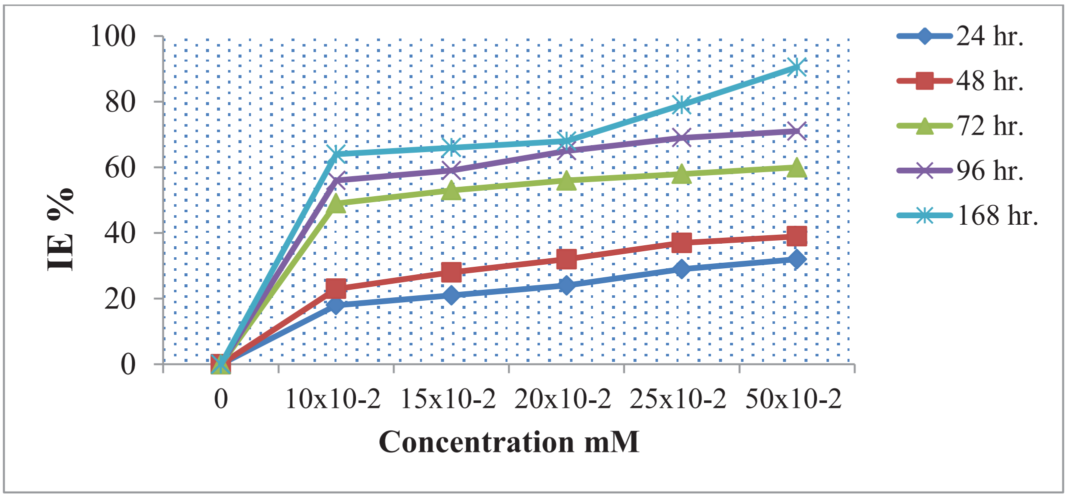


Fig. (3) Chart of % IE for compound (4) against concentration at different time in1.0 M HCl

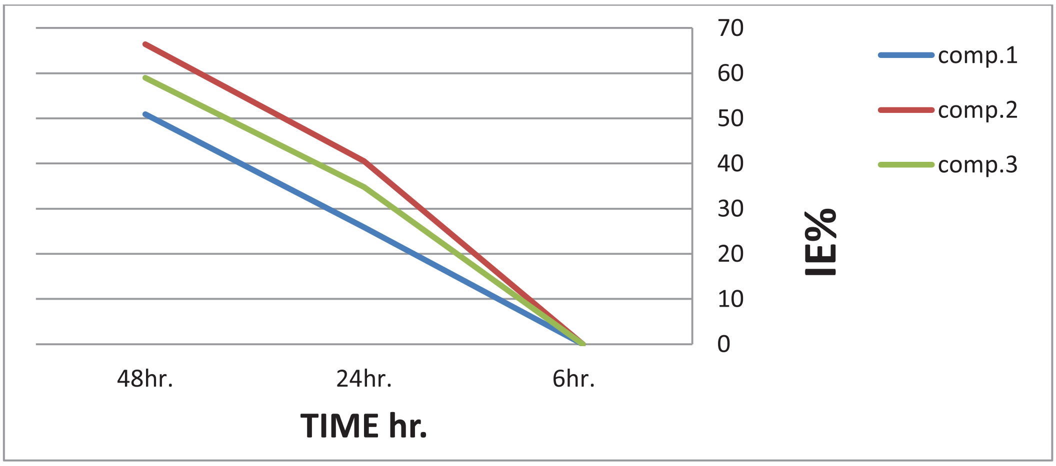


Fig. (4) Chart of % IE for MHO derivatives against concentration at different time 1.0M H_2SO_4

3.2 Scanning Electron Microscopy (SEM) Analysis

The SEM test was directed at the Electron Microscopy Unit of applied science department. Figure (5) shows the mild steel without corrosion inhibitor and Figure (6) shows that the corrosion inhibitor (compound 3) given security to the mellow steel from the erosion assault brought about by HCl.

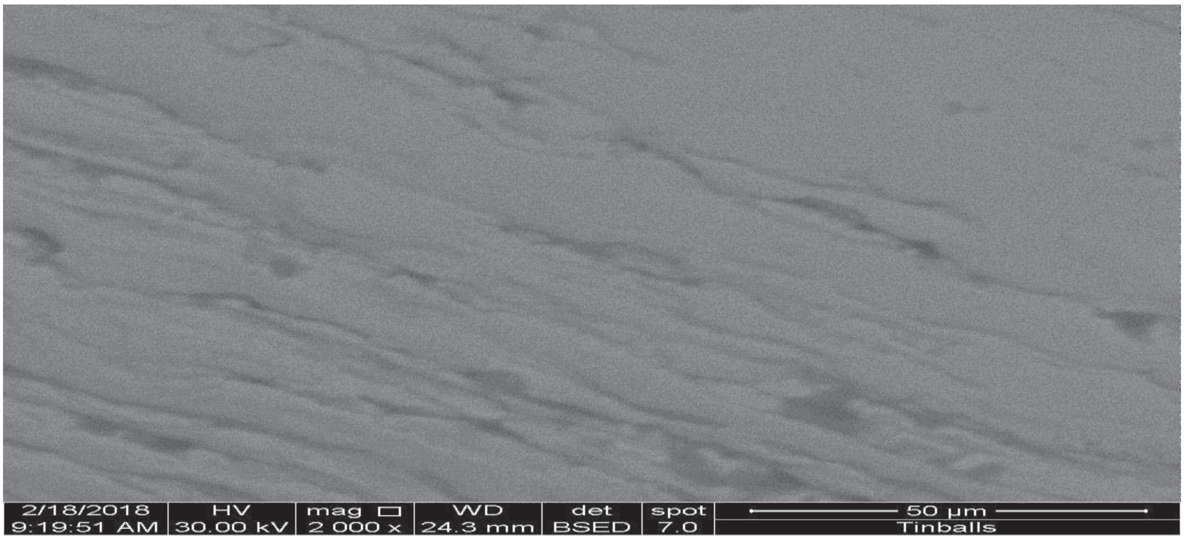


Fig. (5) The SEM micrographs 5000X, for MS in 1.0 M HCl

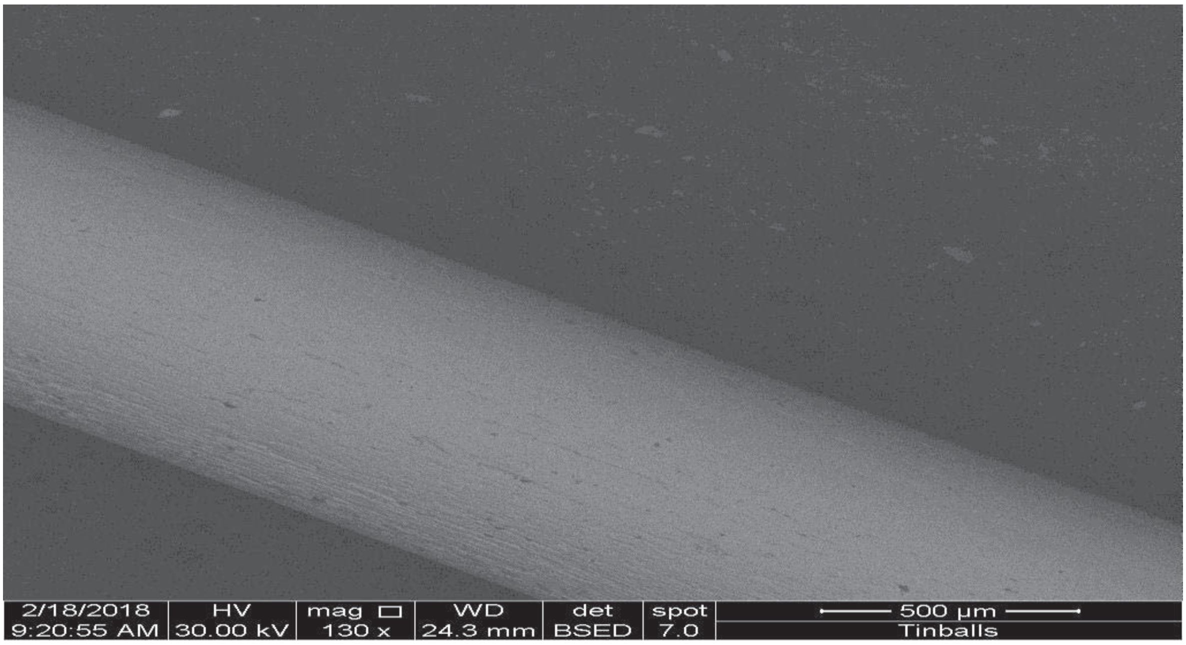


Fig. (6) The SEM micrographs 5000X, for MS in 1.0 M HCl with 0.5 mM of the compound (3)

3.3 Mechanism of corrosion inhibition

The organic compounds containing S, N and O are known to be effective inhibitors. Its effectiveness depends on the electron density at the functional groups. The electron density can be varied with the help of suitable substituents and thus the inhibition action of an inhibitor [24]. The corrosion inhibition property of the MHO derivatives can be attributed to the presence of heteroatoms and π electrons on benzene ring. These factors play the vital role in the adsorption of the inhibitor and the formation of co-ordinate bond with metal. The adsorption of inhibitor on the steel surface can occur either directly by the interactions between the π electrons of the inhibitor and the vacant d-orbitals of metal surface atoms. Also there may be an interaction of inhibitor with adsorbed sulphate ions leads to the adsorption of inhibitor [25,26]. As inhibitor concentration increases, it covers more and more surface area and results in the reduction of corrosion rate.

4. Conclusion:

The MHO derivatives were a good corrosion inhibitors for steel in aqueous corrosive media. The inhibition efficiency indicates strong interaction between the metal surface and inhibitor. It acts as mixed type of inhibitor. The amount of MHO derivatives required for inhibition is very small and this make MHO derivatives to be an attractive corrosion inhibitors.

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