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Valorized chicken feather as corrosion inhibitor for mild steel in drilling mud

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ABSTRACT

Modified chicken feather reduced the corrosion rate of mild steel in drilling mud as deduced from electrochemical potentiodynamic polarization technique, albeit, with observed infestation of the test environment by microbes over protracted exposure period of 92 days. The corrosion rates with and without the addition of 0.3g of hydrolyzed feather per 100 ml of drilling mud were 1.70 and 1.95 mm/yr, respectively; which corresponded to inhibition efficiency of 13% over the immersion period. The corresponding charge transfer resistances, a measure of corrosion rates were 1480.4 and 1780.0 Ω, respectively; in the uninhibited and hydrolyzed-feather inhibited environments. The voltage over the double layer capacitor as obtained from the polarization studies numerically increased from −0.907 to −0.948 V which indicated adsorption of moieties in the inhibitor and probably some corrosion products on the surface of the mild steel specimen.

Introduction

Valorization of chicken feather has received major interests in recent times because of disposal of this patently obnoxious environmental pollutant [1]. Although poultry farmers have found some economical use for these environmental nuisance; conversion to feeds for pigs and birds are prominent among the end uses, however, valorization routes sometimes deny the end products of the inherent high protein content of the feather [1]. Recent experience in valorization revealed that after hydroxylation with sodium hydroxide and neutralization with organic or inorganic acids revealed that organic acids suppressed the identification of some amino acid moieties during runs with Fourier transform infrared spectroscopic analysis. However, such N–O groups become prominent on interacting with corroding metal surfaces. Other researchers have experimented on the use of hydrolyzed feather as corrosion inhibitor for Al in hydroxide solution [2] and for mild steel in 0.5 M H_2SO_4 [3] with good inhibitory performances over 1–5 hours of experimentation. Thus, this report, which covered experimentation with 0.3, 0.5–0.8g of the inhibitor over 92 days, witnessed infestation of the corrosion system with microbes within 7–8 days of exposure of specimens to the inhibited systems. These were more pronounced with higher concentrations of hydrolyzed chicken feather.

Methods

Keratin from chicken feather obtained from the teaching and research farm at Landmark University Omu-Aran, was valorized by the protocol established by Taskin et al. [4]. For corrosion study, 0.3, 0.5 and 0.8g of chicken feather extracts were dissolved in drilling mud made up in the usual manner [5]. Mild steel specimens, measuring 78 mm × 25 mm and 9 mm, abraded with emery paper were immersed in the inhibited and uninhibited drilling mud for 7–92 days. Weight loss measurements were undertaken at intervals to validate the electrochemical polarization technique carried out with Digi Ivy 2300 potentiostat. SHIMADZU Fourier transform infrared spectrophotometer (FTIR) was employed to analyze the hydrolyzed feather and the corrosion products.

Results and conclusions

The kinetic data derived from Fig. 1 are corrosion rates of 1.95 and 1.70 mm/yr for uninhibited and inhibited drilling mud respectively;

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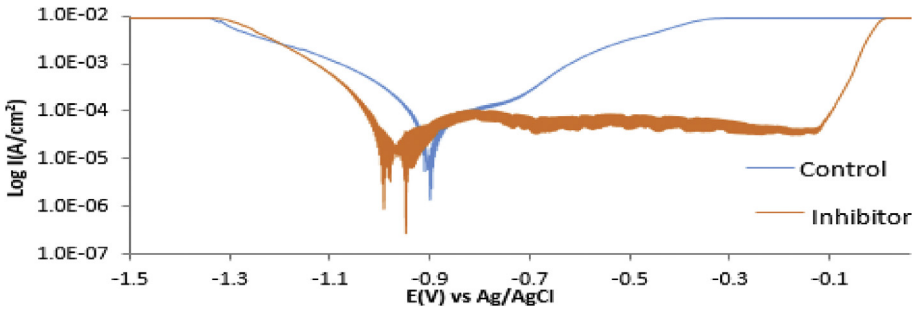

Fig. 1. Polarization plot for mild steel in 0.3g of hydrolyzed feather inhibited and uninhibited drilling mud.

Table 1
FTIR peaks for hydrolyzed feather and corrosion product on mild steel after exposure to inhibited drilling mud.

S/N	Peaks from FTIR spectra, (cm^{-1})		Possible groups
	Hydrolyzed feather	Corrosion product	
1	3320.3	3349 and 3518.1	O-H_{str}intermolecular bonded(phenol)
2	3041.7	3024.6 and 3259.8	C-H_{str} Alkene
	2988.1	2988.1	C-H_{str} Alkene
3	2823.1 and 2771.0	2729.6	C-H_{str}Aldehyde
4	2233.4	2254.7	C=N Nitriles
5	2401.6	2382.4	O=C=O Carbon dioxide
6	2052.9	2063.8	C=C Acetylenes
7	1774.4	1818.1	C=O_{str}Vinyl
8	1736	1734.9	C=O_{str} Aldehyde
9	1559.9 and 1230.1	1558.7	N-O_{str}Aliphatic
10	1349.3	1351	-NO_2 Nitro
11	1149.8	1152.1	C-O_{str}Alcohol
12	1006.1	1062.4	C–H Alkene out of plane

From FTIR studies, (see Table 1) the absorbance of the major peaks identified in the raw extract of chicken feather, notably –OH, C–O, N–O, C=O, C≡C shifted either downfield or upfield indicating interactions with the mild steel surface through their lone pairs of electrons. Others which were partially suppressed in the extract, such as C≡N, –NO_2, with electron–rich centers, became prominent after adsorbing on to Fe on the mild steel surface which indicated stronger bonds with shorter bond lengths as their peaks' wave numbers shifted to higher values.

corresponding to 13% inhibition efficiency at 92 days of immersion of mild steel specimens. Equally important are the voltages across the double layer capacitors which increased numerically from −0.907V for the un-inhibited mud to −0.948V for the inhibited environment which indicated the adsorption of inhibitor moieties on the specimens.

Conflict of interest

Authors declare no conflict of interest of interest.

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