

# Application of Electrochemical Studies in Corrosion Inhibition of Mild Steel in Oil Well Water Using Aqueous Extracts as Inhibitor

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**ABSTRACT** :Corrosion resistance performance of mild steel be evaluated in the absence and presence of aqueous extracts of three natural products namely Neem, Tulasi and Hibiscus in simulated petroleum oil well water AC impedance spectra reveals that in presence of inhibitors (aq. Extracts of natural products) corrosion resistance of mild steel increases. Nyquist plot and AC impedance techniques were used to estimate the corrosion rate, the corrosion resistance and inhibition of the alloy samples. Effective corrosion inhibition was also exhibited on the tested sample. AC impedance spectra reveals by increases in charge transfer resistance ( $R_t$ ) and decreases in  $C_{dl}$  (double layer capacitance) value. The anodic reactions are controlled predominantly, as revealed by shift of corrosion potential to the anodic cell in presence of inhibitors due to the formation of passive film (ion inhibitor complex). The study reveal that the corrosion resistance of various inhibitors decreases in the following order:

Tulasi > Neem > Hibiscus > Blank

Conclusion of this revise will be valuable in the corrosion protection of Mild steel pipe lines hauling oil well water.

**KEYWORDS:** corrosion, mild steel, oil well water, tulasi, neem, hibiscus, AC impedance spectra.

## I. MATERIALS AND METHODS

### 1.1 Metal specimens

TheMild steel specimen was used in the present study. (Composition (wt. %): 0.026 S, 0.06 P, 0.4 Mn, Si 0.168, Cu .0.9, Al 0.07 and 0.1 C and balance iron) [22].

### 1.2 Preparation of StimulatedOil well waterSolution

Asaturatedsolutionofsodiumchloride(NaCl)3.5gwasweighedand0.305g ofcalcium chloride solution( $\text{CaCl}_2$ ) and 0.186g ofmagnesium chloride( $\text{MgCl}_2$ ) make 500ml instandard measuringflask(SMF)andaddSodiumsulphite0.03gand2mlofconcentratedHClacid solutionwasdiversewithafractionofaseconds.ProgresstheH<sub>2</sub>Stoformoil wellwater.

### 1.3 Preparation of aqueous extract

Aqueous extort of three natural products were use second-hand as corrosion inhibitors in the present study. 100gm of the natural products desiccated in the gloominess and boiled with distilled water. And prepared up to 100ml after removing the suspended impurities by filtration.

**Table1 : Stimulated Petrol Oil Solution composition:**

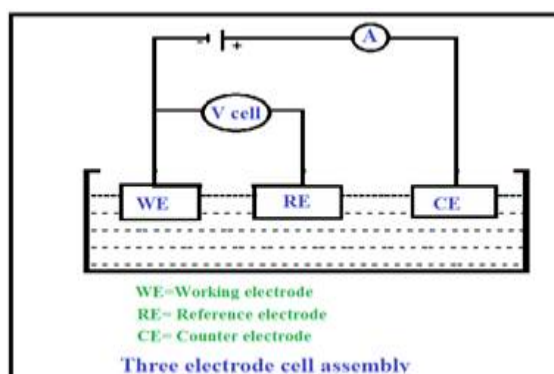
S.No	Name of the chemicals	Wt/litre(ml)
1	NaCl	17.5
2	CaCl <sub>2</sub>	1.525
3	MgCl <sub>2</sub>	0.930
4	Con.HCl	2drops
5	H <sub>2</sub> S	

**Table 2 :Composition of Mild Steel Electrode:**

S.No	Element	Composition(Wt%)
1.	C	0.16
2.	Al	0.07
3.	S	0.026
4.	P	0.06
5.	Mn	0.4
6.	Si	0.168
7.	P	0.025
8.	Cu	0.09
9.	Fe	Balance

### 1.5 Electrochemical study AC impedance spectra

AC impedance spectra were carried out in a CHI-Electrical workstation, Model 660A. A three electrode cell assembly was used. The working electrode was MSe electrode. A saturated calomel electrode (SCE) was the reference electrode and platinum was the counter electrode. The real part of ( $Z'$ ) and imaginary part ( $Z''$ ) of the cell impedance were measured in ohms at various frequencies. Values of the charge transfer resistance ( $R_t$ ) and the double layer capacitance ( $C_{dl}$ ) were calculated.



**Figure.1.Three electrode system**

## II. RESULT AND DISCUSSION

### Analysis of AC Impedance Spectra

AC Impedance Spectra has been used to investigate the information of protective film on the metal surface. When a protective film is formed the Charge Transfer Resistant ( $R_t$ ) increases; Double Layer Capacitance ( $C_{dl}$ ) value decreases. The impedance value ( $\log(Z/\text{ohm})$ ) increases [23-27]. Corrosion resistance of MS immersed in simulated oil well water in the lack and presence of aqueous extract of three natural yield namely Hibiscus, Neem, Tulasi has been evaluated as a result of electrochemical study such as AC Impedance Spectra.

The AC Impedance Spectra curves of MS engrossed in simulated oil well water in the absence and presence of aqueous extract of three natural products are shown in figures (2-5). The corrosion parameters such Charge Transfer Resistant ( $R_t$ ); Double Layer Capacitance ( $C_{dl}$ ) value, impedance value ( $\log(Z/\text{ohm})$ ) are given in table 3.

Table.3. Electrochemical AC Impedance Spectra of Mild Steel in the presence of Natural inhibitors

Metal	System	Nyquist plots		Bode plot
		$R_t$ ohm cm <sup>2</sup>	$C_{dl}$ F/cm <sup>2</sup>	Impedance log (z/ohm)
Mild Steel	Blank	69.09	$7.381676 \times 10^{-9}$	2.130
	Neem	111.31	$4.581799 \times 10^{-9}$	2.064
	Tulasi	214.7	$2.110054 \times 10^{-9}$	2.544
	Hibiscus	85.49	$5.96561 \times 10^{-9}$	2.144

When corrosion resistance increases the Double Layer Capacitance ( $C_{dl}$ ) value decreases and Charge Transfer Resistant ( $R_t$ ) [28]. It is observed from the table that in presence of three extract corrosion protection of MS is observe. This is obvious from the fact that in presence of these inhibitors. There is increases in Charge Transfer Resistant ( $R_t$ ) value and decreases in Double Layer Capacitance ( $C_{dl}$ ) value. Protective films are initiate on the metal surface. The protective film consist of ion inhibitor complex. The inhibitors are the active principles of the extracts.

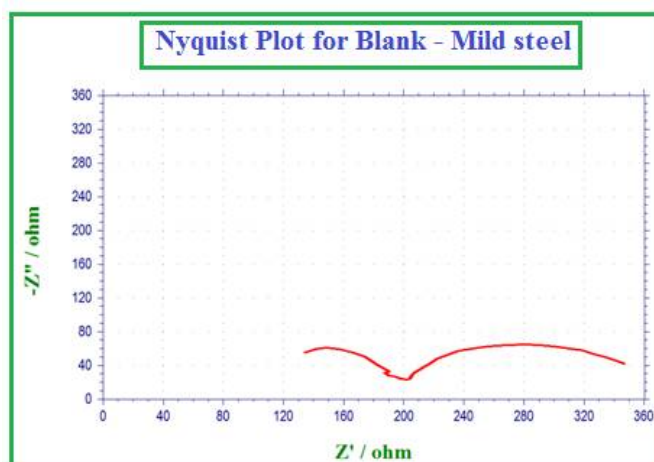


Fig 2: AC impedance spectra (Nyquist plot) of Mild steel immersed in Blank solution

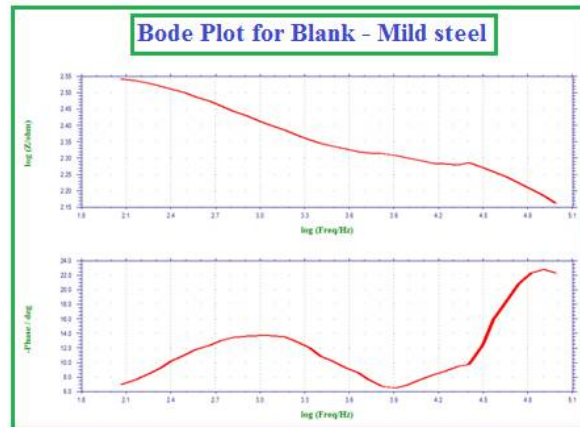


Fig 3: AC impedance spectra (Bode plot) of Mild steel immersed in Blank solution

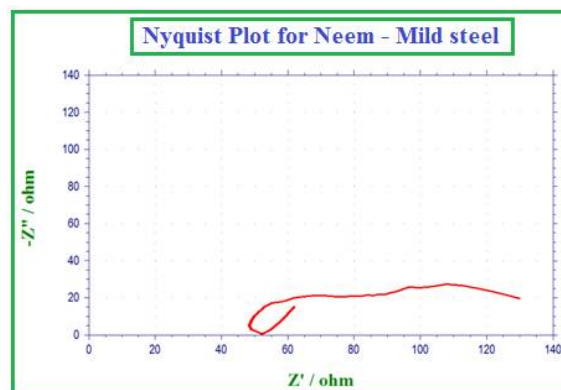


Fig 4: AC impedance spectra (Nyquist plot) of Mild steel immersed in Neem Extract

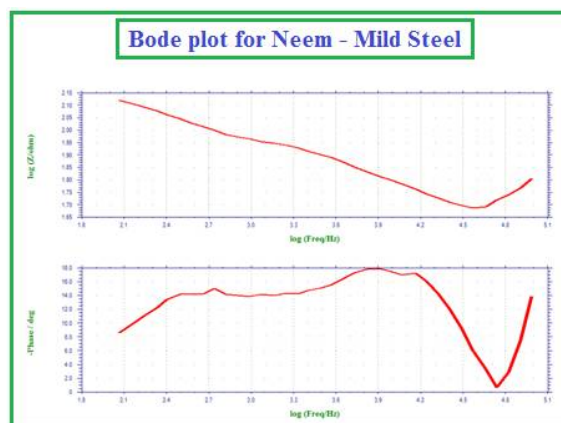


Fig 5: AC impedance spectra (Bode plot) of Mild steel immersed in Neem Extract

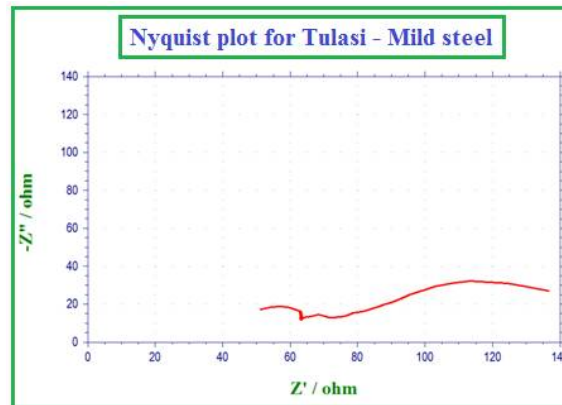


Fig 6: AC impedance spectra (Nyquist plot) of Mild steel immersed in Tulasi Extract



Fig 7: AC impedance spectra (Bode plot) of Mild steel immersed in Tulasi Extract

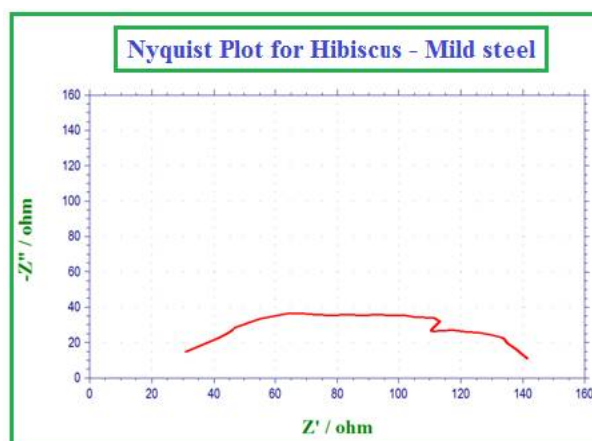


Fig 8: AC impedance spectra (Nyquist plot) of Mild steel immersed in Blank solution



**Fig 9: AC impedance spectra (Bode plot) of Mild steel immersed in Hibiscus Extract**

In presence of inhibitors, the Charge Transfer Resistant ( $R_t$ ) value is shifted to the anodic side (less negative). This indicates that in presence of inhibitors anodic reaction of metal dissolution is controlled for the most part resulting in the formation of ion inhibitor complex on the metal order surface. It is pragmatic from the table that the corrosion resistance of the inhibitors decreases in the following:

$$\text{Tulasi} > \text{Neem} > \text{Hibiscus} > \text{Blank}$$

### III. CONCLUSIONS

1. Corrosion resistance of MS immersed in simulated oil well water in the absence and presence of aqueous extract of three natural products namely Hibiscus, Neem, Tulasi has been evaluated by electrochemical study such as AC Impedance Spectra.
2. AC Impedance Spectra reveals that in presence of inhibitors (aq. Extract of natural products) corrosion resistance of MS increases. This is revealed by increases in Charge Transfer Resistant ( $R_t$ ) value and decreases in Double Layer Capacitance ( $C_{dl}$ ) value.
3. The anodic reactions are controlled predominantly, as revealed by shift of corrosion potential to the anodic side in presence of inhibitors due to the formation of passive film (ion inhibitor complex).
4. AC Impedance Spectra reveals that the corrosion resistance of various inhibitors decreases in the following order Tulasi > Neem > Hibiscus > Blank
5. Finding of this study will be useful in the corrosion protection of MS pipe lines carrying oil well water.

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