Electronic Supplementary Material (ESI) for RSC Advances.

Table (4) Data obtained from potentiodynamic polarization measurements of carbon steel in sea water solution in the absence and presence of various concentrations of compounds I, II,and III at 298 K.

Inhibitor	Conc., ppm	$-E_{corr}$, mV vs. SCE	Icorr, µA/cm²					β_a, mV dec^{-1}	β_c, mV dec^{-1}	IE%				
			Run 1	Run 2	Run 3	STD DEV	Average			Run 1	Run 2	Run 3	STD DEV	Average
Blank	0	760	24.04	26.62	26.20	1.39	25.62	119.1	301.4	-	-	-	-	-
(I)	50	776.1	13.51	14.09	14.81	0.65	14.14	115.1	229.6	43.80	47.08	43.47	1.99	44.78
	100	738	12.90	12.35	11.60	0.65	12.28	112.3	149.7	46.34	53.61	55.73	4.92	51.89
	150	807.6	10.25	11.50	11.16	0.65	10.97	133.2	206.8	57.36	56.79	57.40	0.34	57.18
	200	737.1	9.56	10.72	11.25	0.86	10.51	129.6	162.8	60.22	59.73	57.08	1.69	59.01
	250	734.4	8.50	9.95	9.00	0.74	9.15	125.2	138.4	64.64	62.63	65.65	1.54	64.31
	300	699.8	5.48	6.89	6.96	0.83	6.44	127.7	157.2	77.20	74.12	73.45	2.00	74.93
(II)	50	788.6	12.05	14.30	12.70	1.16	13.02	125.2	211.7	49.88	46.29	51.53	2.68	49.23
	100	735.7	11.30	12.10	12.48	0.60	11.96	120.9	190.8	53.00	54.55	52.37	1.13	53.30
	150	796.4	10.20	10.22	11.85	0.95	10.76	135.4	216.7	57.57	61.61	54.77	3.44	57.98
	200	714.1	8.60	9.20	9.80	0.60	9.20	135.2	195.3	64.23	65.44	62.60	1.43	64.09
	250	695.5	7.51	7.76	8.70	0.63	7.99	130.7	188.1	68.76	70.85	66.79	2.03	68.80
	300	651.7	5.28	6.66	5.11	0.85	5.68	131.6	144.5	78.03	74.98	80.49	2.76	77.83
(III)	50	689.1	8.29	9.00	9.73	0.72	9.01	247.8	168.7	65.52	66.20	62.86	1.76	64.86
	100	682.9	7.62	7.10	8.05	0.48	7.59	206.5	173.2	68.30	73.33	69.27	2.67	70.30
	150	682.1	6.10	6.90	7.10	0.53	6.70	199.4	171.3	74.63	74.08	72.90	0.88	73.87
	200	679.9	4.80	5.78	4.54	0.66	5.04	187.5	171.2	80.03	78.29	82.69	2.21	80.34
	250	672.6	3.40	3.65	4.50	0.58	3.85	195.1	160.7	85.86	86.29	82.82	1.89	84.99
	300	610.8	1.80	2.16	2.10	0.19	2.02	192.6	166.1	92.51	91.88	91.98	0.34	92.13

Table (5) Data obtained from electrochemical impedance spectroscopy (EIS) measurements of carbon steel in sea water solution in the absence and presence of various concentrations of compounds I, II and III.

Inhibitor	Conc., ppm	Coefficient	R_s, ($\Omega.cm^2$)	C_s ($\mu F.cm^2$)	R_t ($\Omega.cm^2$)					Cdl ($\mu F.cm^2$)	IE%				
					Run 1	Run 2	Run 3	STD DEV	Average		Run 1	Run 2	Run 3	STD DEV	Average
Blank	0	0.99	-	-	354.6	358.1	361.7	3.5	358.13	1302	-				
(I)	50	0.99	230	48.1	634.0	650.0	642.0	8.0	642.00	1217	44.07	44.91	43.66	0.63	44.21
	100	0.99	270	43.4	750.0	754.0	735.0	10.0	746.33	1104	52.72	52.51	50.79	1.06	52.01
	150	0.99	320	37.2	798.0	806.0	790.0	8.0	798.00	989.3	55.56	55.57	54.22	0.78	55.12
	200	0.99	350	32.5	871.0	875.0	865.0	5.0	870.33	930.1	59.29	59.07	58.19	0.58	58.85
	250	0.99	380	29.3	1011.0	991.0	1001.0	10.0	1001.00	902.5	64.93	63.86	63.87	0.61	64.22
	300	0.99	390	28.7	1420.0	1385.0	1398.0	17.7	1401.00	887.4	75.03	74.14	74.13	0.51	74.43
(II)	50	0.99	250	46.2	706.0	690.0	713.0	11.8	703.00	1159	49.77	48.10	49.27	0.86	49.05
	100	0.99	290	42.4	764.0	748.7	771.6	11.7	761.45	1090	53.59	52.17	53.13	0.72	52.96
	150	0.99	350	36.7	829.6	839.0	846.4	8.4	838.33	970.6	57.26	57.32	57.27	0.03	57.28
	200	0.99	370	31.1	996.0	999.0	993.0	3.0	996.00	911.8	64.40	64.15	63.58	0.42	64.04
	250	0.99	410	28.8	1129.0	1134.0	1143.0	7.1	1135.33	873.1	68.59	68.42	68.36	0.12	68.46
	300	0.99	420	27.6	1585.0	1576.0	1615.0	20.4	1592.00	855.7	77.63	77.28	77.60	0.20	77.50
(III)	50	0.99	280	43.2	1016.0	1004.9	1025.2	10.2	1015.33	1004	65.10	64.36	64.72	0.37	64.73
	100	0.99	330	40.5	1203.0	1215.0	1191.0	12.0	1203.00	978.1	70.52	70.53	69.63	0.52	70.23
	150	0.99	390	35.2	1366.0	1360.0	1342.4	12.2	1356.15	914.4	74.04	73.67	73.06	0.50	73.59
	200	0.99	420	29.1	1805.0	1801.0	1792.0	6.7	1799.33	877.5	80.35	80.12	79.82	0.27	80.10
	250	0.99	430	27.9	2367.0	2355.0	2371.0	8.3	2364.33	822.3	85.02	84.79	84.75	0.15	84.85
	300	0.99	440	26.4	3978.0	3996.0	3988.0	9.0	3987.33	786.9	91.09	91.04	90.93	0.08	91.02

Table (6) Efficiency of the selected amine derivatives (I, II and III) as calcium sulfate scale inhibitors at various concentrations as calculated from ASTM G 3-89 Re-approved 1994

Conc., ppm	Percentage Inhibition Efficiency (IE%) of Inhibitor I					Percentage Inhibition Efficiency (IE%) of Inhibitor II					Percentage Inhibition Efficiency (IE%) of Inhibitor III				
	Run 1	Run 2	Run 3	STD DEV	Average	Run 1	Run 2	Run 3	STD DEV	Average	Run 1	Run 2	Run 3	STD DEV	Average
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	30.393	31.35	30.393	0.55	30.71	38.5	38.1	38.7	0.31	38.43	52.5	51.48	52.1	0.51	52.03
50	45.5	46	44.45	0.79	45.32	52.015	51.5	50.985	0.52	51.50	62.132	64.034	64.034	1.10	63.40
75	55.9	57.2	55.8	0.78	56.30	63.226	61.348	63.226	1.08	62.60	75.548	75.548	73.304	1.30	74.80
100	63.261	65.2	63.261	1.12	63.91	68.6	69.5	69.9	0.67	69.33	79.2	78.9	79.8	0.46	79.30
125	65.751	63.798	65.751	1.13	65.10	75.7	75.1	74.8	0.46	75.20	85.6	87.1	87.4	0.96	86.70

Polarization curves for compounds I and II

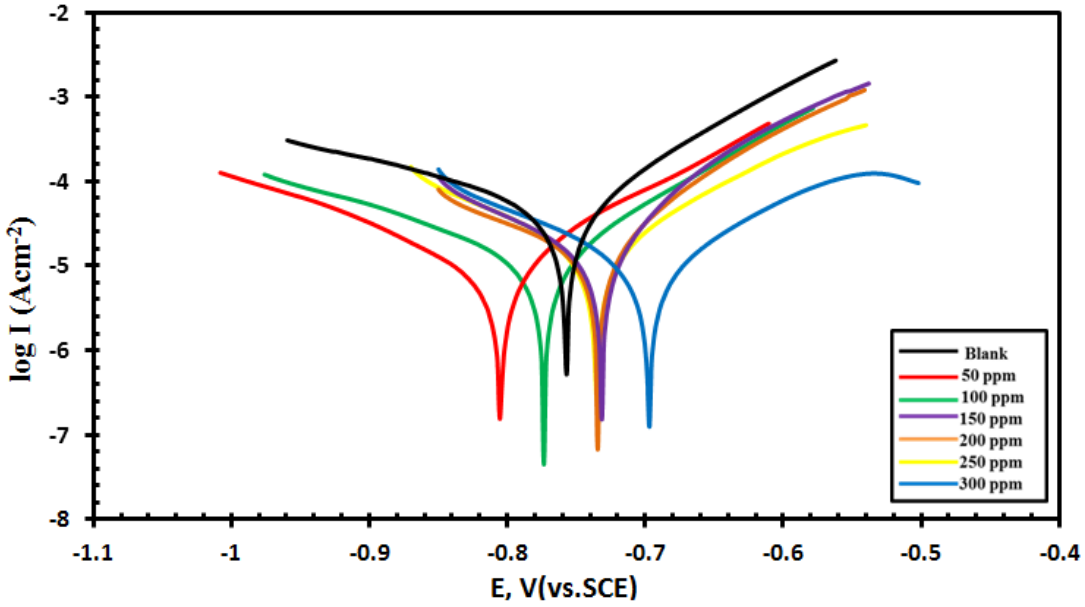


Figure (I): Potentiodynamic polarization curves (E – log I relationship) of carbon steel in sea water in the absence and presence of different concentrations of compound I.

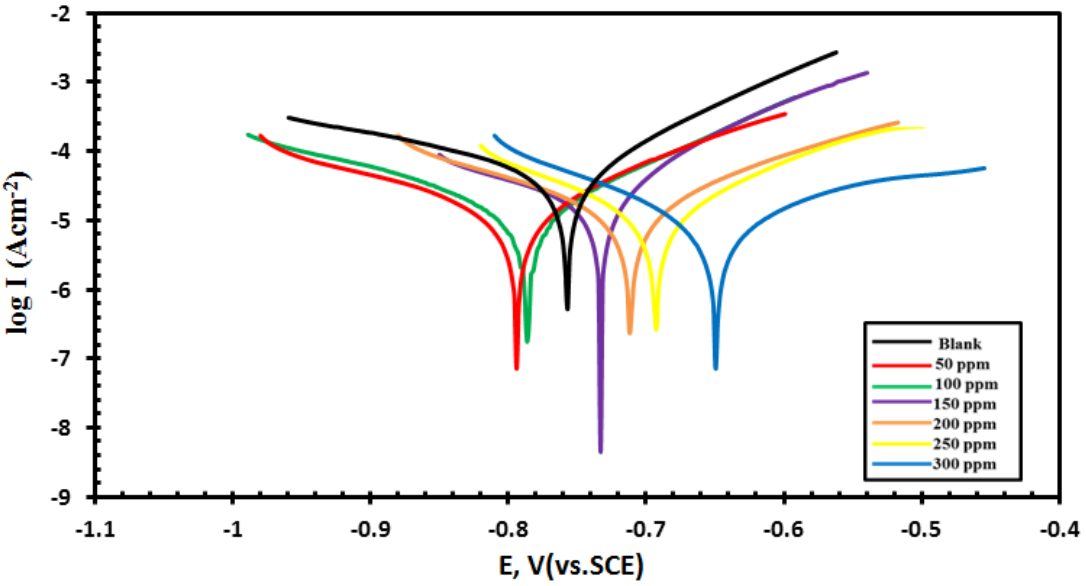


Figure (II): Potentiodynamic polarization curves (E – log I relationship) of carbon steel in sea water in the absence and presence of different concentrations of compound II.

Nyquist plots for compounds I and II

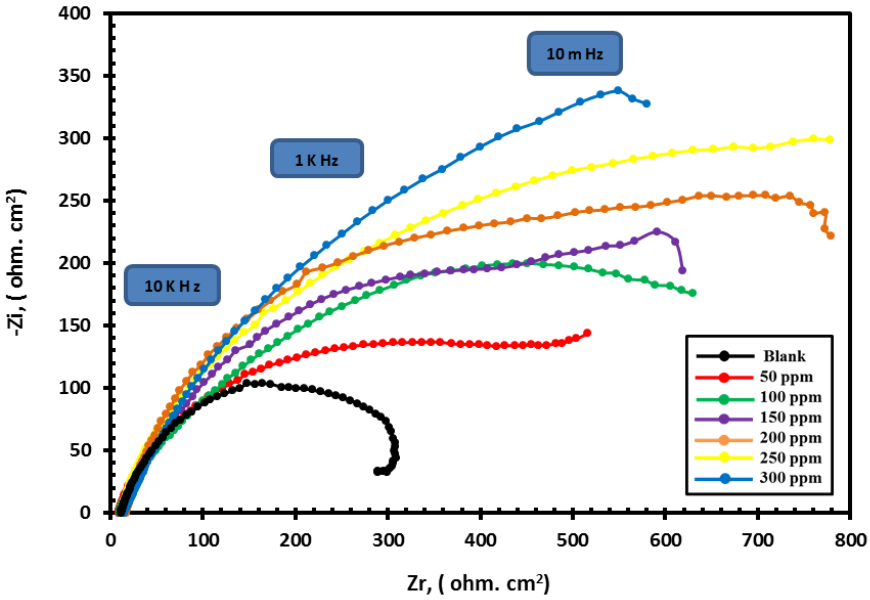


Figure (III). Nyquist plots for carbon steel in sea water in the absence and presence of different concentrations of compound I.

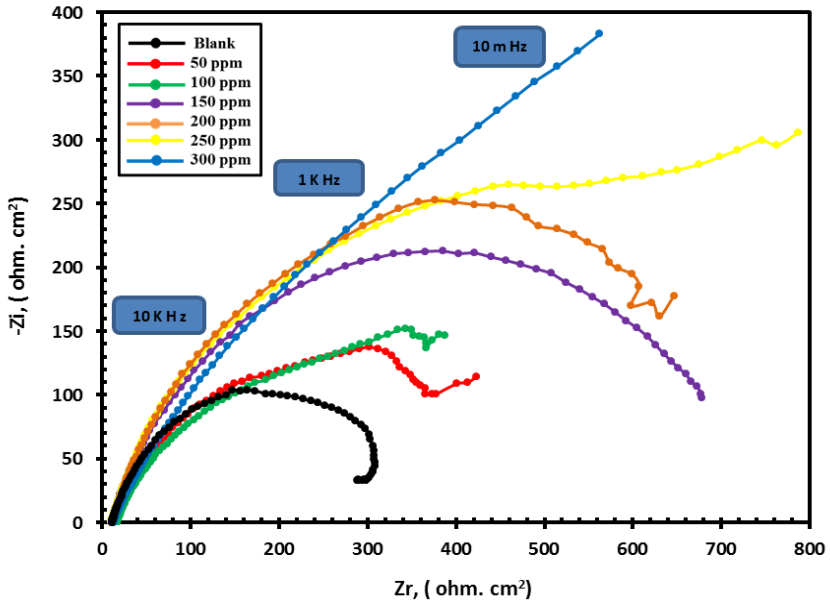
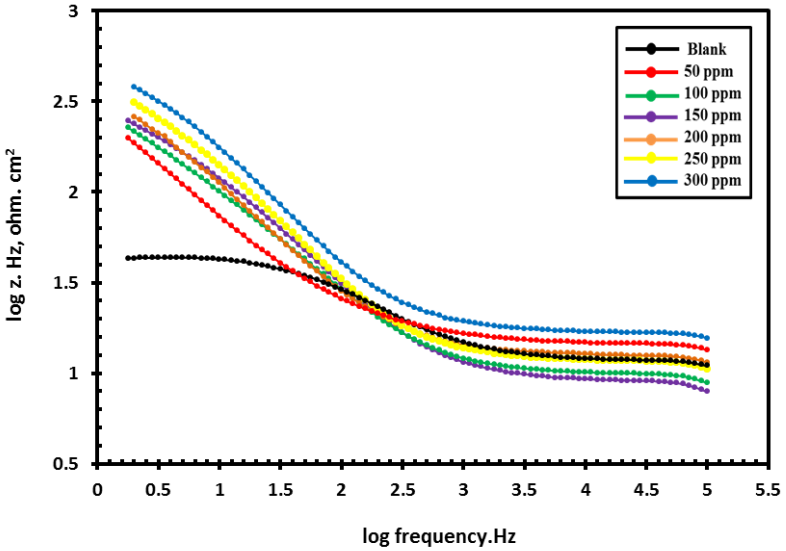
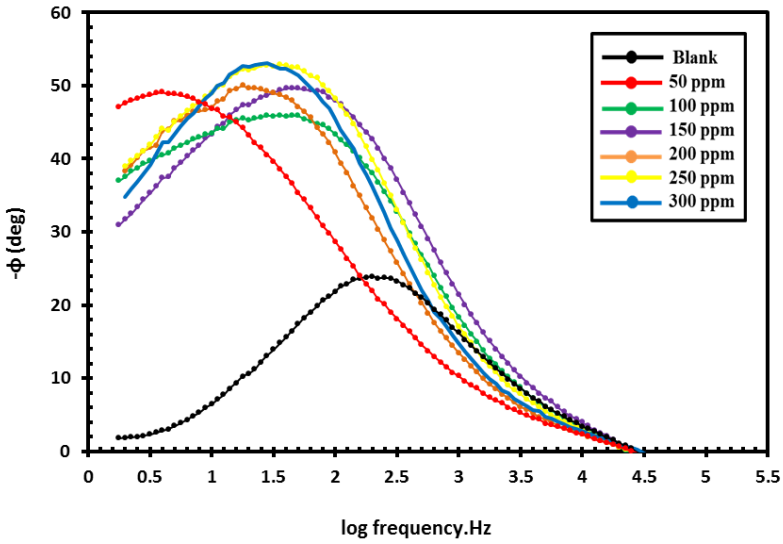


Figure (IV). Nyquist plots for carbon steel in sea water in the absence and presence of different concentrations of compound II.

Bode plots for compounds I and II

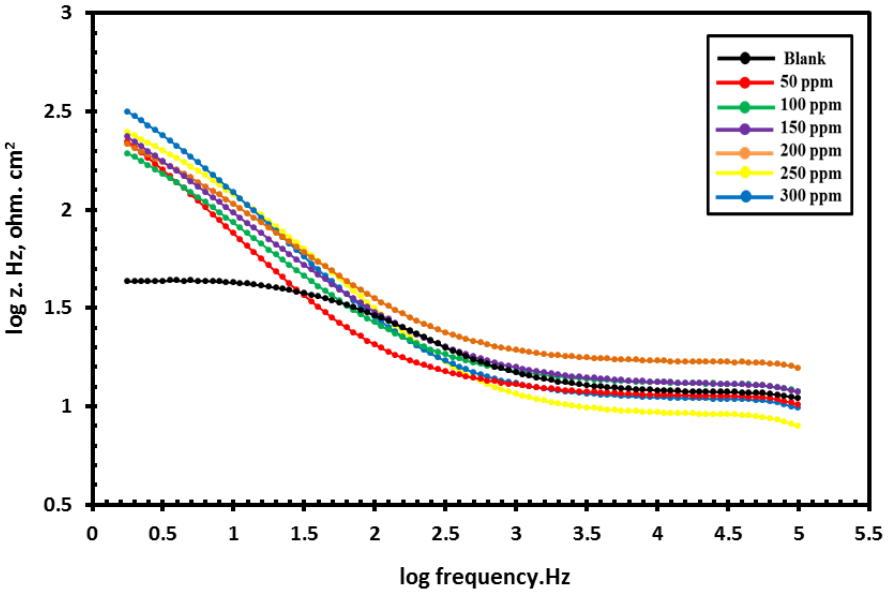


(a)

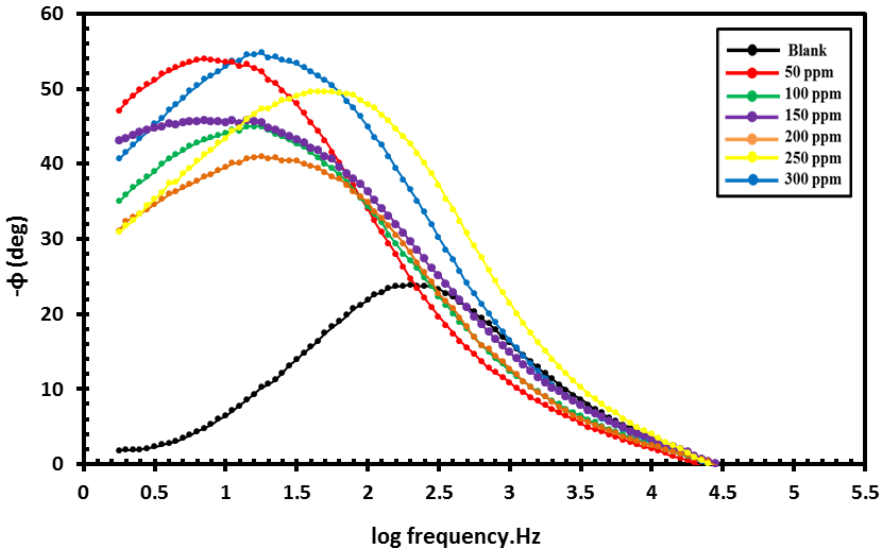


(b)

Figure **(V). (a)** Log frequency vs log Z (b) Log frequency vs Phase angle Bode plots for carbon steel in sea water in the absence and presence of different concentrations of compound I.



(a)



(b)

Figure **(VI). (a)** Log frequency vs log Z (b) Log frequency vs Phase angle Bode plots for carbon steel in sea water in the absence and presence of different concentrations of compound II.

Inhibition mechanism of compounds I and II

Corrosion inhibition mechanism

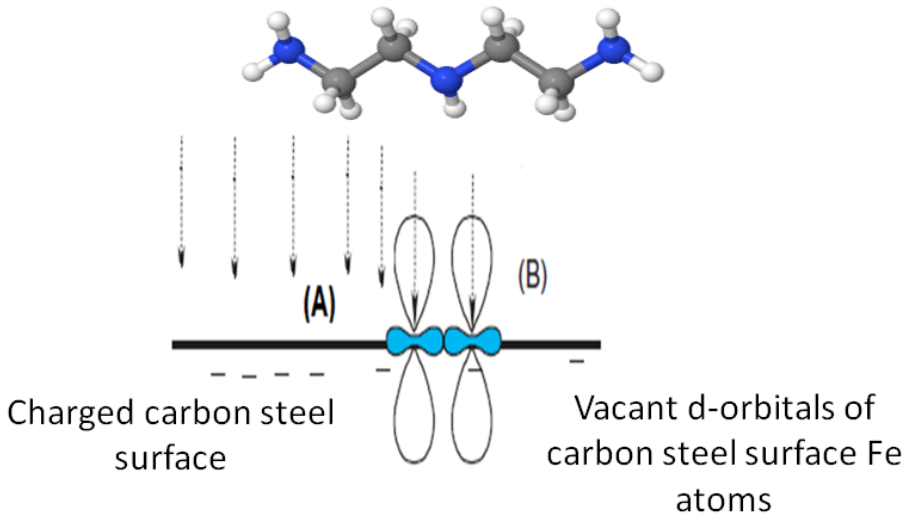


Figure (VII): Interaction between diethylenetriamine and carbon steel surface through chemical adsorption process

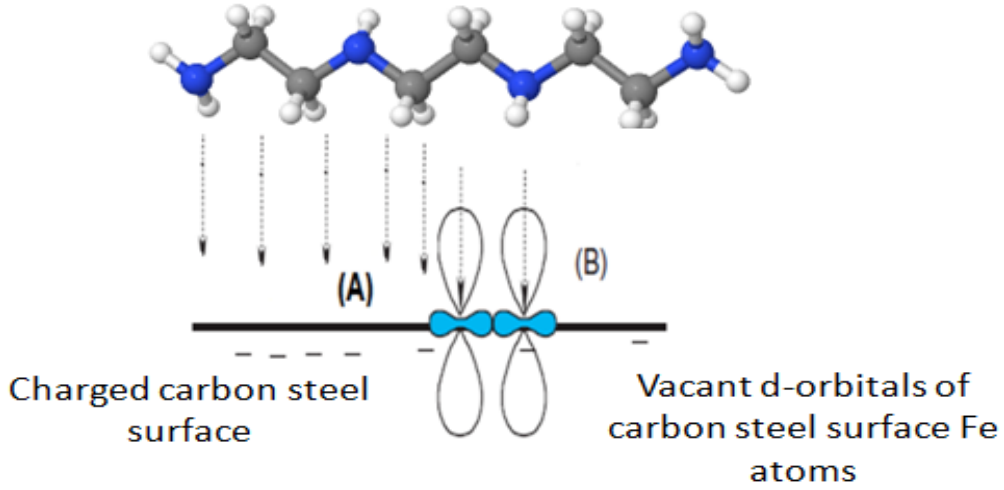


Figure (VIII): Interaction between triethylenetetramine and carbon steel surface through chemical adsorption process

SEM and EDX of compound II

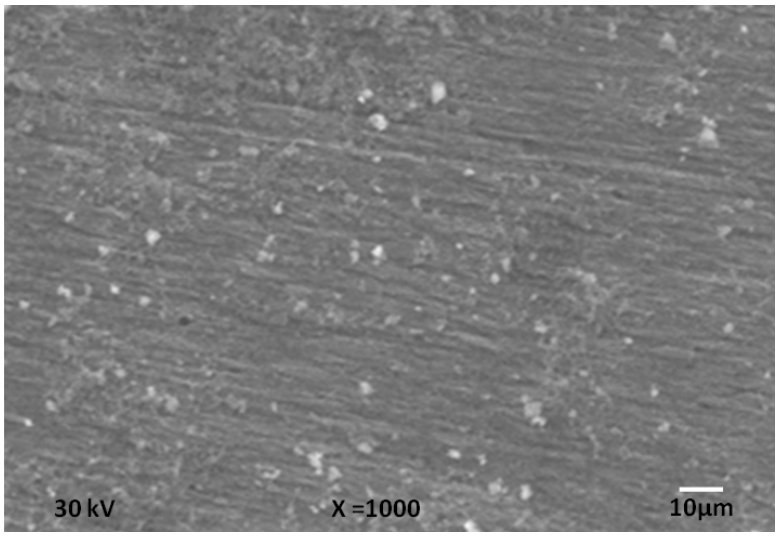


Figure (IX). SEM of the carbon steel surface: after immersion in the sea water in the presence of 300 ppm of compound II.

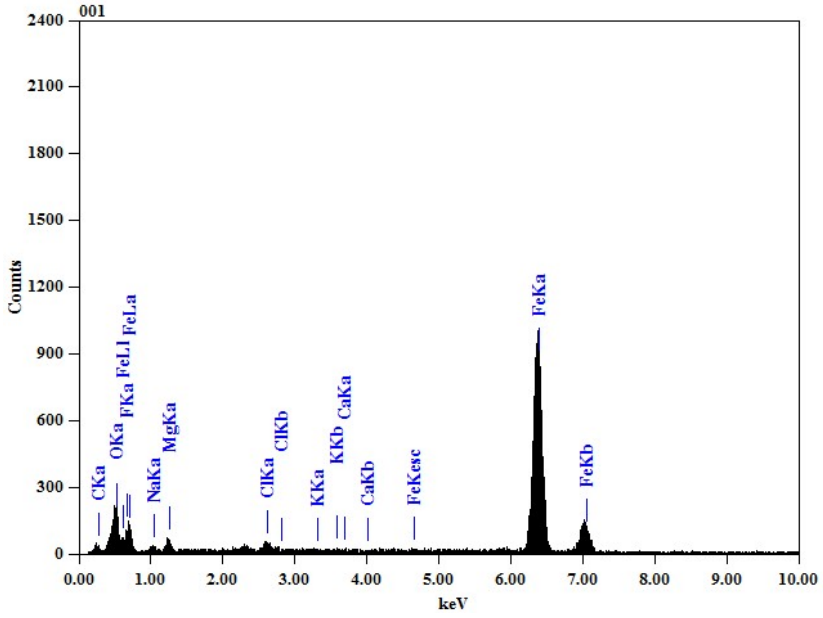


Figure (X). EDX of the carbon steel surface: after immersion in the sea water in the presence of 300 ppm of compound II.