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The Possibilities for the Inhibition of Corrosion formed in Salt Solutions for the Cast Iron Alloys Surface by Testing with Various Chemical Compounds.

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Abstract:

The Inhibition of corrosion of cast iron by addition aniline or hexamine in one of three solutions 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30^oC and different time intervals was studied.

It was found The inhibition of corrosion of cast iron by addition of 150 ppm Hexamine and 150 ppm Aniline was done efficiently, but the Aniline had more inhibition efficiency than the Hexamine.

Introductions:-

The chemical inhibition program is implemented to make the metal (cast iron) for more effective operation by using corrosion inhibitors that protect the metal from ongoing corrosion inhibitors that occurs in this research for salt solutions.

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Cast iron is very widely used for water carrying purposes besides mild steel and other metals. The extent and cost of damage caused by leakage in domestic water pipes has been rising during recent years [1].

The use of cast iron in potable water supplies in building is now essentially limited to to the incoming main water supplies [2].

Corrosion inhibitors are of great practical importance, being extensively employed in minimizing metallic waste in engineering materials [3]. Several N- and S- containing organic compounds have been used as inhibitors [4], [5] and [6].

The corrosion inhibition in a surface process which involve the adsorption of the organic compounds on the metal surface [5], [6]. The inhibition efficiency of organic compounds on molecular size, mode of interaction with the metal surface [4], [6].

The inhibitors used in this work are Hexamine (hexamethylenetetramine) and aniline, inhibition properties were studied to protect metals [7], [8].

Experimental Procedure:

Material Preparation:

The composition of the cast iron used was:-

Element:	C	S	Mn	Si	P	Fe
Wt. %:	3.26	0.1	0.59	2.25	0.06	balance

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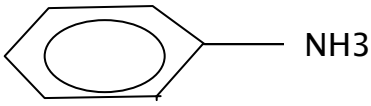
Every coupon specimen was (2x2) cm^2 and thickness (0.5) cm was used. After casting the surface was smoothened and a hole was drilled (diameter 0.015 cm) near the upper edge. The specimens were cleaned by buffing, degreased in benzene, washed using 50% acetone, dried, marked and weighed to a constant weight before exposing to the corrosive medium. These were suspended by a glass hook in a beaker filled with test solution, for different duration of immersion, 24, 72, 120, 192, 240 and 360 hr. After definite period of exposure, specimens were removed, cleaned, dried and weighed [1].

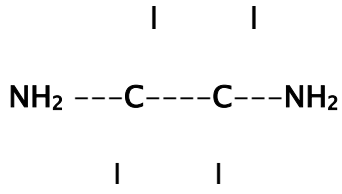
All test solutions were prepared from analytical grade reagents and double – distilled water. The chemicals aniline and hexamine was used as corrosion inhibitors for this investigation. The inhibitors concentration was 150 ppm were prepared in 600ppm– NaCl, 400ppm–Na_2SO_4 and 400ppm–$CaCO_3$ salt solutions (corrodent) at 30°C.

Weight Loss Measurement:

The molecular structures of the inhibitors used.

Aniline 

Hexa methyl tetra amine



The inhibition efficiency (I %) was determined [9].

$$(I\,\%) = \frac{Wb - Wi}{Wb} \times 100\%$$

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The Wb and Wi are the weight loss of cast iron per unit area (mg / cm^2) of coupons in the corrodent (blank) and corrodent – inhibitor system.

Results and Discussions:

The corrosion rate of cast iron in the test solutions was calculated from decrease in weight observed in coupons in weight loss tests with the units (gm / m^2. hr).

Table (1) : The Weight Loss (mg / cm^2) of the Cast Iron Coupons in Different Salt Solutions(corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	13.786	42.227	77.415	118.136	159.483
Na_2SO_4	5.874	24.847	49.280	73.131	96.471
$CaCO_3$	5.681	21.133	34.113	42.887	51.280

Table(2): The Corrosion Rate (mg/m^2.hr) of the Cast Iron Coupons in Different Salt Solutions(corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	478.681	488.733	537.606	585.991	615.291
Na_2SO_4	203.958	287.581	342.221	362.754	372.186
$CaCO_3$	197.257	244.599	236.894	212.731	197.840

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Table (3): The Weight Loss (mg / cm^2) of the Cast Iron Coupons in Different Salt Solutions (corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C,150 ppm Hexamine Inhibitor Conc. and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	9.805	29.618	53.787	81.566	113.073
Na_2SO_4	4.398	18.602	36.616	53.889	70.861
$CaCO_3$	4.126	14.739	22.972	29.163	35.229

Table (4): The Corrosion Rate (mg/m^2.hr) of the Cast Iron Coupons in Different Salt Solutions (corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C,150 ppm Hexamine Inhibitor Conc. and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	340.457	342.797	373.523	404.592	513.399
Na_2SO_4	152.724	215.300	254.276	267.305	273.382
$CaCO_3$	143.272	170.593	159.530	144.658	135.914

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Table (5): The Weight Loss (mg / cm^2) of the Cast Iron Coupons in Different Salt Solutions (corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C,150 ppm Aniline Inhibitor Conc. and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	6.693	20.269	36.230	54.106	74.957
Na_2SO_4	2.886	10.635	19.960	29.472	40.807
$CaCO_3$	2.909	10.494	16.968	22.207	27.178

Table (4): The Corrosion Rate (mg/m^2.hr) of the Cast Iron Coupons in Different Salt Solutions (corrodent) in 600ppm- NaCl, 400ppm-Na_2SO_4 and 400ppm-$CaCO_3$ at 30°C,150 ppm Aniline Inhibitor Conc. and for Different Time Intervals.

Time (hr)	24	72	120	168	216
NaCl	232.396	234.595	251.297	268.383	289.186
Na_2SO_4	100.205	123.090	138.611	146.190	157.434
$CaCO_3$	101.007	121.461	117.833	110.152	104.853

The two anions are reported to have a significant influence on the corrosion characteristics of cast iron are chloride and sulphate ions[ ].

The corrosion rate remains increasing with time for time interval from 24 hr to 216 hr for NaCl (from 478.681 to 615.291), for Na_2SO_4 (from 203.681 to 372.186) , and for $CaCO_3$ from 24 hr to 168hr (from 197.257 to 212.731) .

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The corrosion rate increases so high due to the adsorption behavior of anions of the electrolyte at the electrode surface [1].

From the results it was found the weight loss increases with time for all three solutions and the corrosion rate increases with time for NaCl and Na_2SO_4 solutions but for $CaCO_3$ the corrosion rate increase at the beginning but it followed by decreasing especially after 72 hr, that because of the stability of ferric oxide film forms after corrosion reaction that known as inhibitor behavior and anions accelerator for the solution.

The corrosion rate was highly decreased in the solutions contains inhibitors (Hexamine and Aniline) that may occur due to the inhibitor protection for the metals by preventing the direct contact between metals surface and corrodents and corrosives anions and also by reducing plenty of cations on the metal surface.

The corrosion rate for NaCl was lessened from (615.291) to (513.399) , while the corrosion rate for Na_2SO_4 was decreased from (372.186) to (273.382), for $CaCO_3$ the corrosion rate is decreased from (197.84) to (135.914) in the presence 150 ppm Hexamine at 30 $^0C \pm 1$ and 216 hr.

The corrosion rate for NaCl was lessened from (615.291) to (289.186) , while the corrosion rate for Na_2SO_4 was decreased from (372.186) to (157.434), for $CaCO_3$ the corrosion rate is decreased from (197.84) to (104.853) in the presence 150 ppm Aniline at 30 $^0C \pm 1$ and 216 hr.

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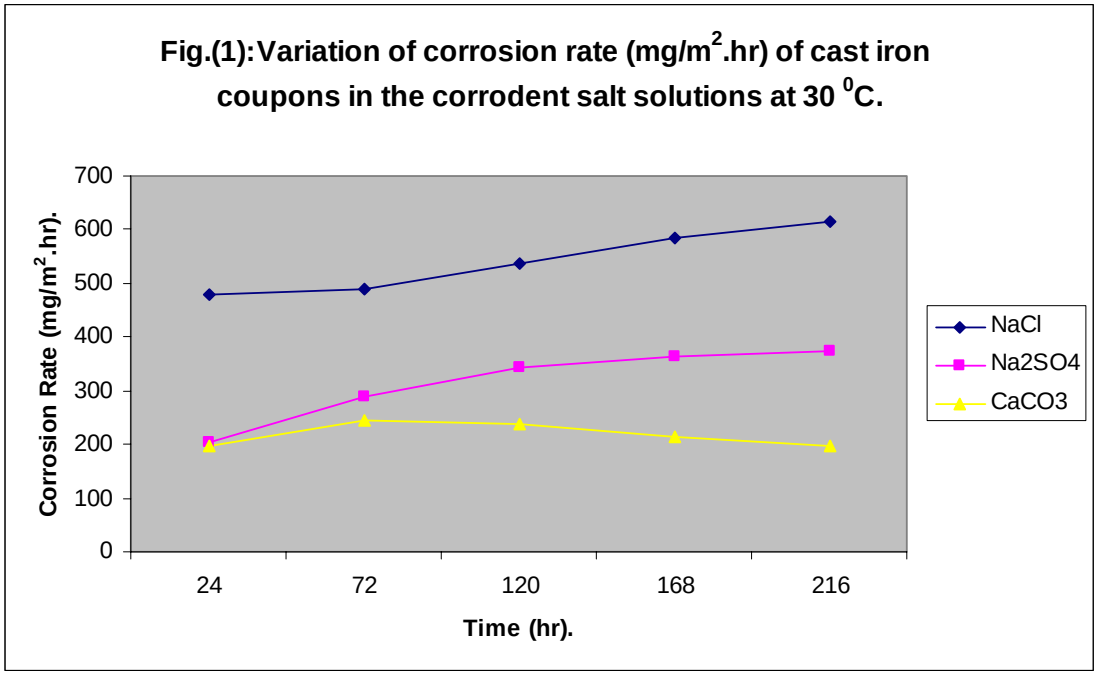

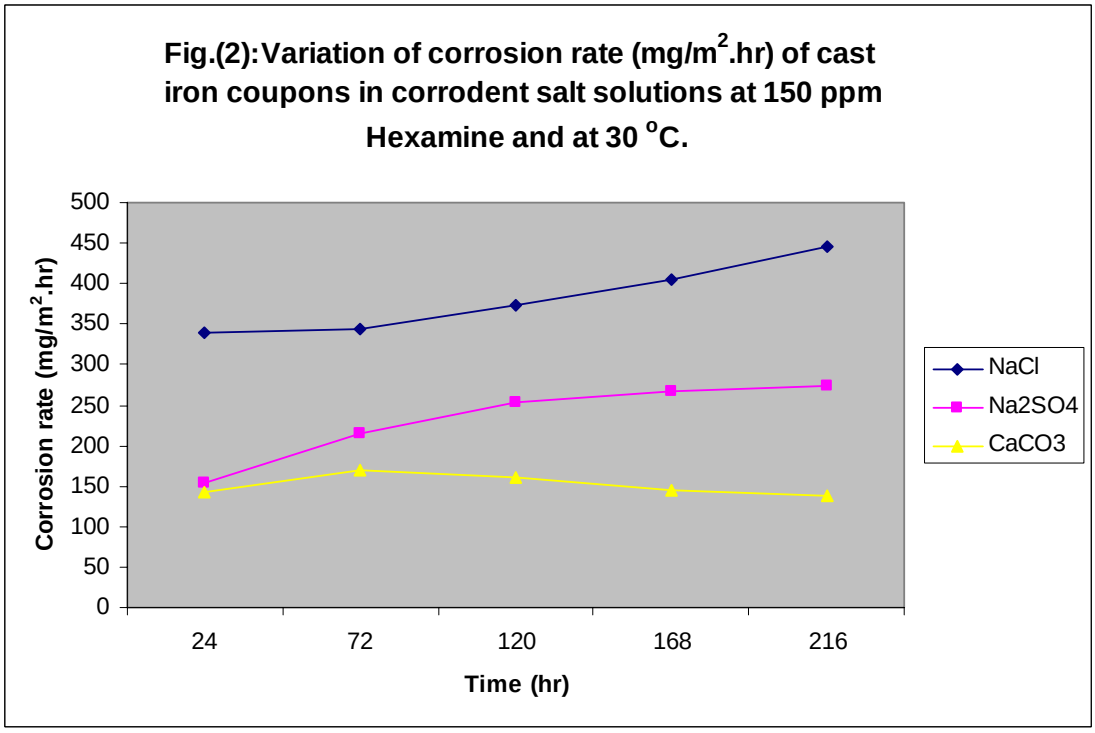

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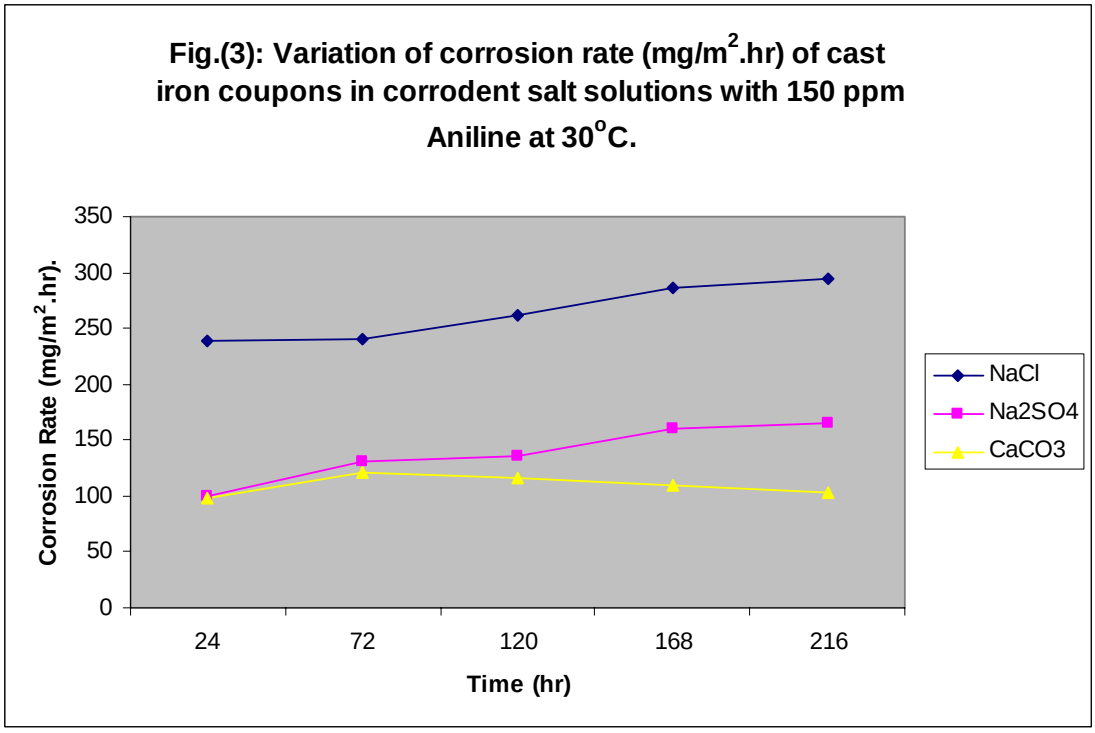

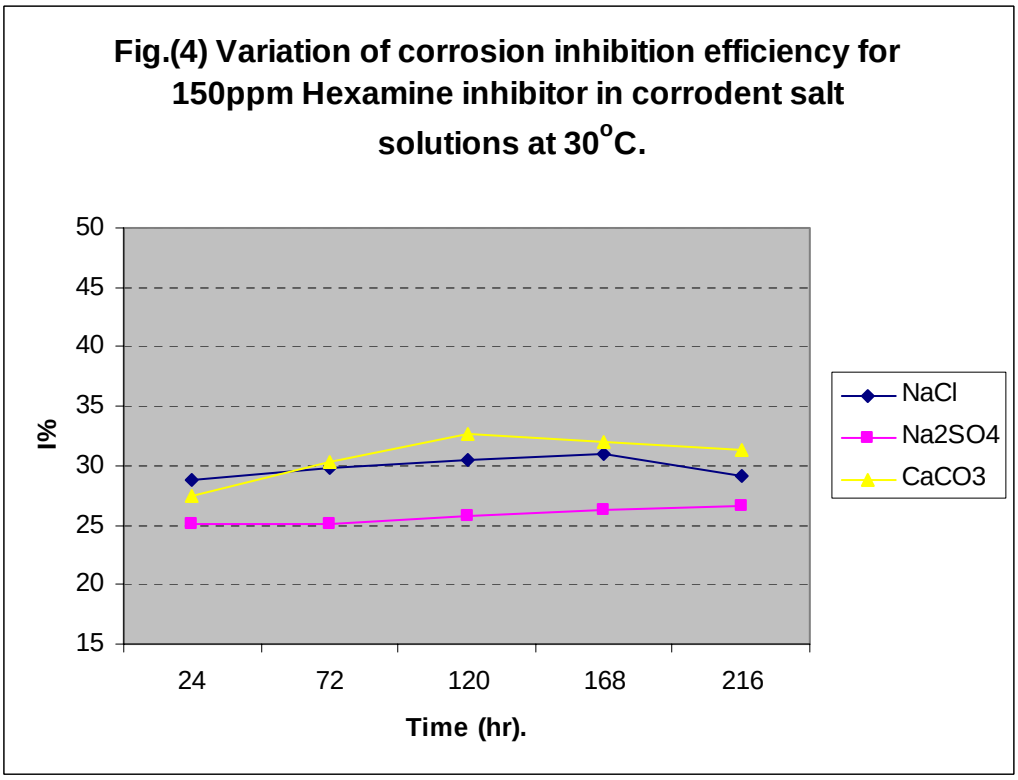

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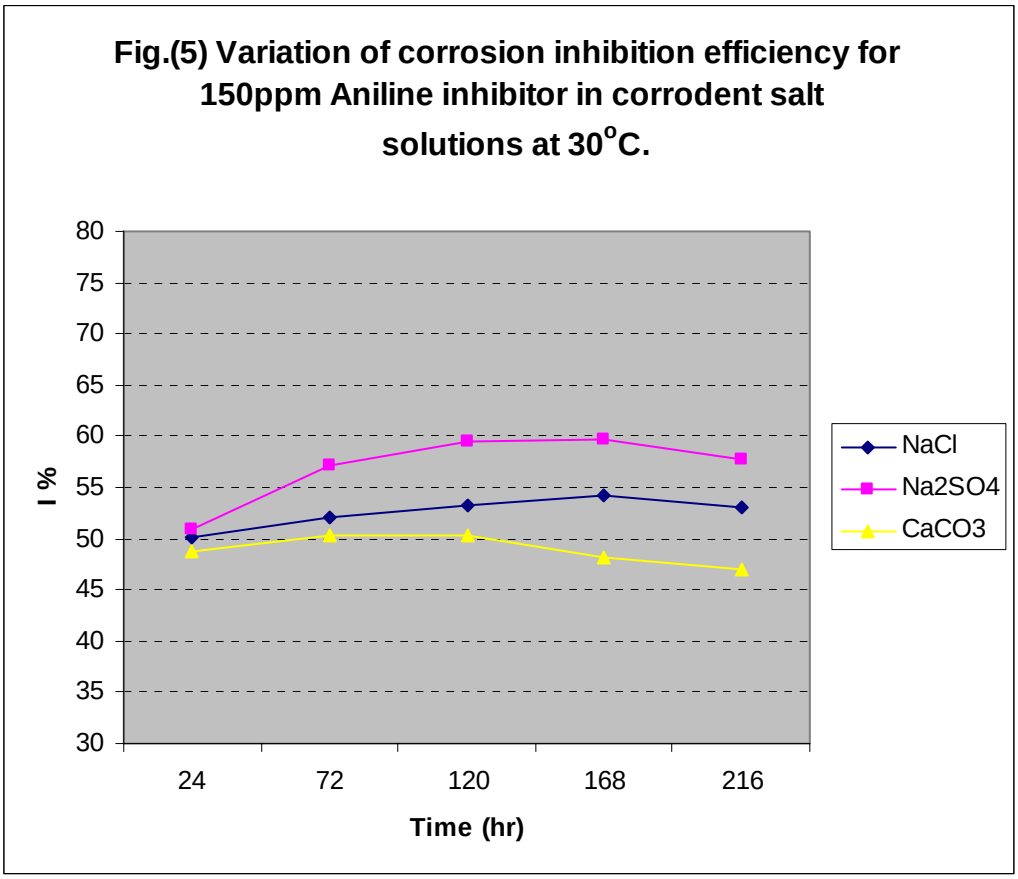

Conclusions:-

1. The inhibition of corrosion of cast iron by addition of 150 ppm Hexamine and 150 ppm Aniline was done efficiently, but the Aniline was more inhibition efficiency than the Hexamine.

2. The corrosion rate of cast iron in 400ppm NaCl was higher than 400 ppm Na_2SO_4 and 600ppm CaCO3.

3. The corrosion rate of cast iron in the salt solutions is a function of salt type, inhibitor type and inhibitor concentration.

4. It was expected to use Aniline as corrosion inhibitor rather than Hexamine in prevention the cast iron corrosion.

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