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Multiphasic inhibition of mild steel corrosion in H₂S gas environment

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Abstract Compounds like Octylpalmamide (OTP), Octylsteramide (OTS), Octylcaprylamide (OTC), Octylbenzamide (OTB) and one complex compound Dicyclohexylaminebenzotriazole (DCHAB) were synthesized and characterized by Fourier Transform infrared spectroscopy (FT-IR). These synthesized compounds were drawn as volatile corrosion inhibitor (VCI) in H₂S gas environment on mild steel (MS) at 323 K. Surface morphology and elemental analysis have been examined by Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDX) respectively. Various studies like weight loss, potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) were used for evaluating corrosion rate, inhibitor behaviour and change in charge transfer resistance (R_{ct}) value, respectively. All the above experiments proved that DCHAB was the most efficacious corrosion inhibitor. Adsorption behaviour of the inhibitor was evaluated and it obeys Langmuir adsorption isotherm.

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1. Introduction

Metals are more prone to atmospheric corrosion due to the variation of temperature and humidity during transport and

storage. Most of the industrial parts like vessels, pipeline, cooling tanks, boilers, etc. will easily get corroded. These materials are very sensitive to some corrosive like acid, base and corrosive gas. Many organic and inorganic plant extracts (Green inhibitors), dyes and drugs were used as inhibitors to make these materials passive in those media. Recently, VCIs are used for making the material more protective to corrosion. Inhibitor forms the primary adsorptive layer on the metal surface which separates the metal from the environment. Frequent condensation and deposition of vapours increase the thickness of the layer. The inhibition is transmitted as vapours and the vapour phase is controlled by the structure of the crystal lattice and the characteristic atomic bond present in the molecule. The protective vapours expand within the enclosed space until the equilibrium determined by the practical pressure of the

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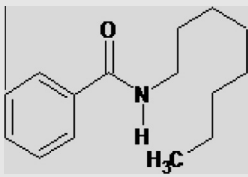
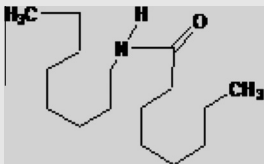
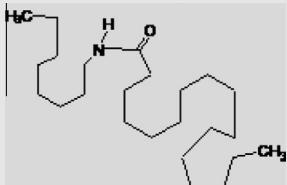
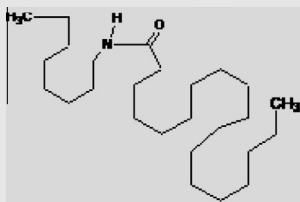
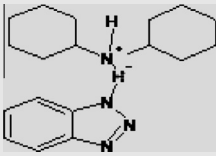
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vapour is reached (Subramanian et al., 2000). So many VCIs have been employed for protective efficiency in corrosion environment. These are used to protect the metallic instruments and auto mobile equipments (Sastri, 1998). VCIs are transported to the metal surface and then adsorbed; thereby it prevents corrosion (Furman et al., 2004). Bis-piperidiniummethylurea was used for the inhibition of corrosion on carbon steel in the atmosphere for temporary protection (Zhang et al., 2006). β -Naphthol and m-dinitrobenzene were used as VCIs in SO_2 (Rajagopalan and Ramaseshan, 1960). Dicyclohexylamine and cyclohexylamine salts were used as volatile nature compounds for mild steel, copper and zinc in SO_2 . Dicyclohexylamine exhibited maximum inhibition on those metals (Rosenfeld, 1978). In some cases like alkaline medium of sodium sulphate, mild steel was protected using piperazine

derivatives (Quraishi et al., 2009). On the other hand, more humid environment like NaCl which may cause corrosion on mild steel is greatly influenced by menthol as a VCI (Premkumar et al., 2009). Menthol is also used for the protection of copper in Hydrochloric acid environment which exhibits up to 78% efficiency (Premkumar et al., 2010). Thyme is also used as a VCI for mild steel which exhibits 77% efficiency in HCl (Premkumar et al., 2008). The extract of wood bark oil has been used as a VPI for NaCl and SO_2 environment. The inhibitor efficiency of trychnos-nux-vomica was higher even at lower concentration on mild steel and copper (Poongothai et al., 2005). Benzoichydrazide salts were employed as VCI for different metals (Quraishi et al., 2005). The vapour phase inhibition effect of morpholine carbonate, borate and phosphate derivatives on mild steel has been examined

Table 1 Structures of VCIs.

Sl.No	Structure	Molecular formula & weight	Vapour pressure (mmHg)	Name of VCIs
1		$\text{C}_{15} \text{H}_{23} \text{NO}$ & 233.3492	2.4853×10^{-3}	Octylbenzamide
2		$\text{C}_{16} \text{H}_{33}$ & 255.4393	2.5653×10^{-3}	Octylcaprylamide
3		$\text{C}_{24} \text{H}_{49} \text{NO}$ & 367.652	1.9667×10^{-3}	Octylpalmamide
4		$\text{C}_{26} \text{H}_{53} \text{NO}$ & 395.7051	1.2740×10^{-3}	Octylsteramide
5		$\text{C}_{18} \text{H}_{29} \text{N}_4$ & 301.4498	1.253×10^{-3}	Dicyclohexylaminebenzotriazole

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