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Kinetic-Thermodynamic and Adsorption Isotherms Analyses for the Inhibition of the Acid Corrosion of Steel by Cyclic and Open-Chain Amines

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ABSTRACT | CITING ARTICLES

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The corrosion inhibition characteristics of the quadridentate macrocycle 1, 4, 8, 11 tetra-azacyclotetradecane (cyclam)on steel in sulfuric acid media are investigated at 25, 35, 45, and 55°C, and the thermodynamic energy parameters calculated.In addition the inhibition characteristics of the open-chain polydentate amines, ethylenediamine (en), diethylenetriamine(dien), triethylenetetraamine (trien), and tetraethylenepentamine (tetren) were investigated at 25°C. Activation-freeenergies, enthalpies, and entropies for the inhibition process of both cyclam and tetren were determined from therate constants data measured at four temperatures *viz.*, 25, 35, 45, and 55°C at one or two fixed inhibitor concentrations. Alldata were compared and fitted to a previously published kinetic-thermoydnamic model in terms of an active site occupancyparameter *y* and a binding constant *K* of the inhibitor to the active site. The results obtained are compared with fitsobtained from the application of Fumkin and Flory-Huggins adsorption isotherms. The first isotherm attempts to treat thedeviations from the ideal Langmuir isotherm by the use of a lateral interaction parameter *a* while the second uses a relative-sizeparameter *x* which is a measure of the relative size of the inhibitor molecule to the surface-adsorbed water molecule.Good agreement was obtained between the kinetic-thermodynamic and Flory-Huggins models. The Frumkin isothermmodel, however, agreed only in cases where the active site occupancy, or the relative-size parameters were equal toor close to unity. A discussion of the strengths and weaknesses of each treatment is given. In addition, the results obtainedare correlated to the chemical structure of the inhibitors, the number of donor atoms, and the macrocyclic effect.

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