Preface

The thesis entitled "**Electrochemical and Quantum Chemical Investigations of Carbon Steel Corrosion Inhibition by Organic Compounds**" deals with the synthesis/use of efficient corrosion inhibitors and their testing on mild steel, N80 steel and J55 steel in 20% H_2SO_4, 15% HCl and 3.5% NaCl saturated with CO_2 by using different techniques. Mild steel due to the excellent mechanical properties and low cost is commonly used as constructional material in many industries. In industry 20% sulfuric acid is used in pickling for the removal of oxide layer from the mild steel surface before undergoing other process like galvanizing etc. In petroleum industries, N80 steel is used for manufacturing tubing, casing, and transmission pipelines. 15% HCl is generally passed through N80 steel during acidization process in order to enhance the oil flow by enlarging the microscopic flow channels. In most of the oil and gas production industry J55 steel is used, which in presence of CO_2 undergoes corrosion by forming carbonic acid after reacting with high chloride containing water. Because of the aggressiveness of these acidic solutions, metals corrode severely, which results in terrible waste of both money and resources. A corrosion inhibitor is often added to the acid solutions to minimize the corrosion of metal during these processes. The selection of inhibitors is based on their cost, easily availability, efficiency to inhibit the corrosion of substrate material and effects over the environment. Most commonly in acidic media nitrogen, oxygen and/or sulfur containing organic compounds are used as corrosion inhibitors. The inhibition mechanism of these organic compounds is due to the adsorption onto the metal/solution interface. The adsorption process of inhibitors depends upon the surface charge and nature of the metal, type of aggressive media, inhibitor structure and nature of their interaction with the metal surface. Most of the effective inhibitors that are commonly used are either very costly, effective only at higher concentrations and are toxic for the environment. Therefore it is necessary to search corrosion inhibitors having high effectiveness and efficiency. The purpose of the present study is to investigate the corrosion behavior of mild steel, N80 steel and J55 steel in 20% H_2SO_4, 15% HCl

and 3.5% NaCl saturated with CO_2 in absence and presence of organic compounds at different experimental conditions (at different concentration and at different temperature).

To understand the inhibition mechanism, best fitted adsorption isotherm and energy of activation for tested inhibitors were evaluated on the basis of weight loss measurements. Electrochemical impedance measurements and potentiodynamic polarization experiments were also studied to investigate the preferential activeness of the inhibitors towards cathodic and anodic areas of the metal surface. Surface morphology of the metal surface in the absence and presence of inhibitors was analyzed by scanning electron microscopy (SEM), energy dispersive X- ray spectroscopy (EDX) and scanning electrochemical microscopy (SECM) techniques. The hydrophilic and hydrophobic nature of metal was studied by contact angle measurement. Density functional theory (DFT) was employed for quantum calculations. Molecular dynamic simulation study was done in order to calculate the adsorption energy.

The work done in the thesis has been published in Corrosion Science 95 (2015) 62-70, Applied Surface Science 359 (2015) 331-339, Physica E 69 (2015) 322-331 and Measurement 76 (2015) 136-147.