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Predicting CO_2 Corrosion in the Oil and Gas Industry

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Preface

In a climate of squeezed profit margins and low oil prices, the appropriate and cost effective choice of materials in oil and gas production is becoming increasingly essential. Carbon steel is the basic material used for the majority of facilities in this industry since it offers economy, availability and strength. However, the uncontrolled corrosion of carbon steel in oilfield facilities that is promoted by dissolved carbon dioxide is a potential major source of leaks and failures in the oil industry worldwide with serious financial, safety and environmental consequences. The financial impacts of unplanned shut downs through deferred production plus repair costs, make it imperative to develop a reliable model for the prediction of CO_2 corrosion in order that carbon steel can be used safely and economically.

CO_2 corrosion has been a recognised problem in oil and gas production facilities for many years. Despite systematic attempts to analyse it and develop predictive models, it is still not a fully understood phenomenon and there is ambiguity and argument on the engineering use of these models. Furthermore, the models do not provide adequate information to take into account the increasingly harsh environments seen in deep wells and take little account of hydrodynamic parameters, leading to conservative designs. The problem cannot be said to be a diminishing one since reliable prediction of the life of carbon steel components remains unclear. CO_2 corrosion is a multidisciplinary phenomenon, the understanding of which involves knowledge of fluid chemistry, hydrodynamics, metallurgy and inhibitor performance and partitioning. Mechanistic understanding of the phenomenon is essential to enable development of engineering criteria for accurate prediction of the rate and nature of corrosion attack.

Recognising the importance of the topic, a Working Group has been set up within the European Federation of Corrosion (EFC) Oil & Gas Working Party, to address aspects of CO_2 corrosion. The Working Party has become the focus and forum for quality work in all areas of oilfield corrosion engineering activities in Europe.

This monograph incorporates technical papers presented at the CO_2 Session of the 1993 EFC Conference in Barcelona together with a number of additional invited key papers. The papers are from experts in the field and major research organisations and they represent a cross-section of the current understanding of CO_2 corrosion. This volume covers the practical aspects of CO_2 corrosion and includes papers providing new data on mechanisms and test methods and will assist the corrosion engineer in evaluating the possible risk and rate of CO_2 corrosion. The volume will also provide a useful source of reference to all those involved in the corrosion problems of the oil industry, in operating companies, engineering constructing companies and in research and development who need to prevent, understand or test for CO_2 corrosion. In most cases emphasis has been placed on electrochemical aspects with one paper on metallurgical effects. From the information presented, a greater appreciation can be gained of the strength and limitations of various

predictive models and how they can be used with the appropriate confidence and caution.

The practical problems with CO_2 corrosion and particularly its prediction are far from being solved, particularly in the case of main oil lines, subsea infield flowlines and topside facilities. The papers in this volume define the problem and offer some solutions. They will pave the way towards more work aimed at increasing our understanding of the mechanisms of attack, the development of relevant test methods and, ultimately, reliable engineering design criteria. Meanwhile they contain much useful information which will enable us to rationalise this insidious form of corrosion.

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