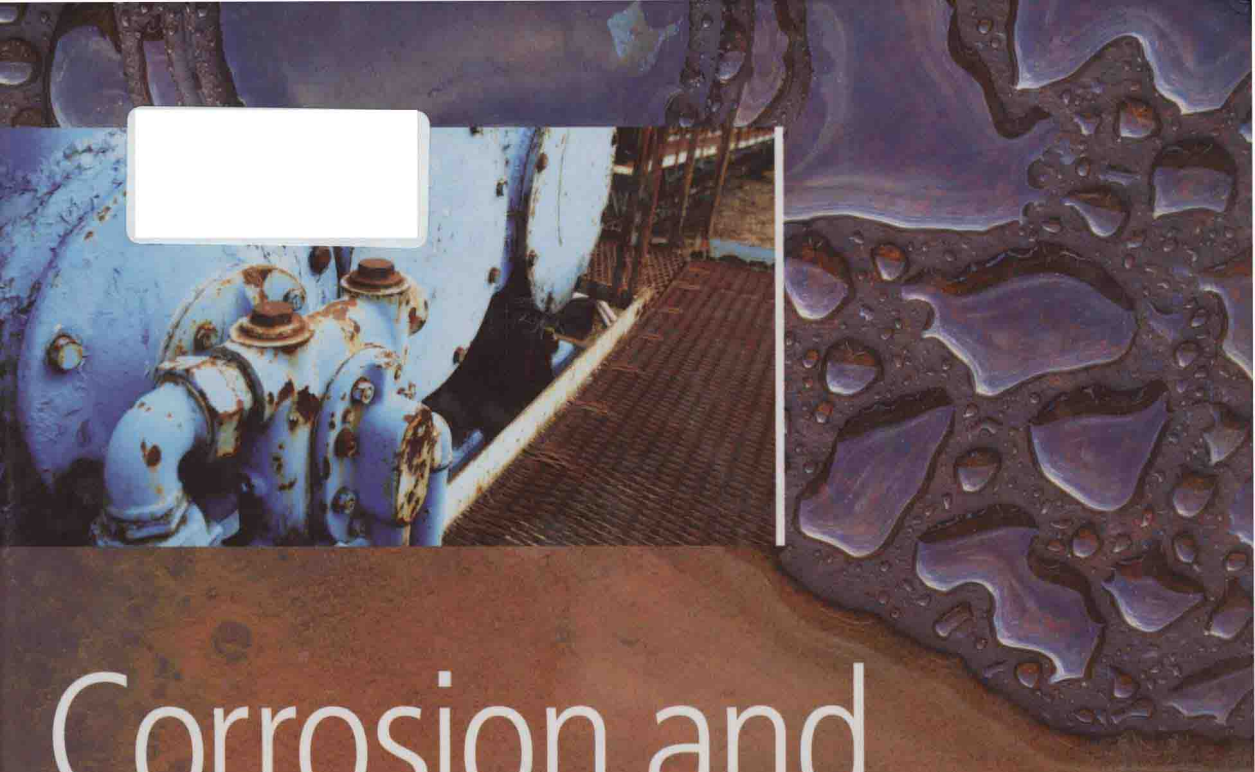

Corrosion and Materials Selection

A Guide for the Chemical and Petroleum Industries

Alireza Bahadori

WILEY

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Corrosion and Materials Selection

Dedicated to the loving memory
of my parents, grandparents,
and to all who contributed
so much to my work
over the years

About the Author

ALIREZA BAHADORI, PhD, is a research staff member in the School of Environment, Science and Engineering at Southern Cross University, Lismore, NSW, Australia. He received his PhD from Curtin University, Perth, Western Australia.

During the past 20 years, Dr Bahadori has held various process and petroleum engineering positions and has been involved in many large-scale projects at the National Iranian Oil Co. (NIOC), Petroleum Development Oman (PDO), and Clough AMEC PTY LTD. He is the author of around 250 articles and 12 books, published by prestigious publishers such as John Wiley & Sons, Elsevier, Springer, and Taylor & Francis.

Dr Bahadori is the recipient of the highly competitive and prestigious Australian Government's Endeavour International Postgraduate Research Award as part of his research in the oil and gas area. He also received a top-up award from the State Government of Western Australia through Western Australia Energy Research Alliance (WA:ERA) in 2009. Dr Bahadori serves as a member of the editorial board and a reviewer for a large number of journals. He was honoured by Elsevier as the outstanding author of Journal of Natural Gas Science and Engineering in 2009.

Preface

Metallic corrosion is costly. Several billion dollars annually in the USA, and about one-third of that is noted as *avoidable corrosion*, a cost that could be eliminated if proper corrosion protection methods were in place.

Today, there are a great deal of construction materials available, varying from metallic to non-metallic. There are also a large number of factors to be taken into consideration when selecting a material for a given application.

Factors that influence corrosion consideration in material selection are distinct from those that interact in a more complex fashion. For example, "application" influences selection because the type of process, and the variables during operation etc., will define whether a material can be used for the intended purpose or not. On the other hand mechanical and metallurgical properties are not uniquely defined for all environments. For example, if the material is to be used at low temperature then embrittlement can be a serious problem.

These considerations have a direct influence on corrosion consideration in material selection. However, when there is discrepancy amongst sections of this book, or between this and other disciplines regarding selection of materials, other priorities, such as client preference, in-house experience, and specific industry standards, should also be observed.

This book covers corrosion considerations in the selection of materials specifically used in the oil, gas, chemical and petrochemical industries. It provides the necessary tools for the design stage of a system, in order to avoid or minimize corrosion hazards technically, economically and safely during the designed life of such a system. Proper corrosion control of structures and units is most effectively and economically begun during the design stage.

Various forms of corrosion and prevention methods are discussed in this book.

It also deals with the control of corrosive environments by inhibitors, general requirements for the petroleum and chemical industries, and utility systems such as cooling water, boiler water systems etc.

Finally it deals with monitoring internal corrosion. It provides guidance for on-line monitoring of internal corrosion in plants associated with the oil, gas and chemical industries, and guidance on laboratory monitoring and evaluation of corrosion inhibitors. The book also covers experiments on the corrosion behaviour of high-alloy tubular materials in inhibited acidizing conditions.

Metallic corrosion is costly. However, the cost of corrosion is not just financial. Beyond the huge direct outlay of funds to repair and/or replace corroded and/or decaying structures are the indirect costs (natural resources, potential hazards, and lost opportunities). When a project is constructed with a material not able to survive its environment for the length of the designed life, natural resources are needlessly consumed to continually repair and maintain the structure. Wasting natural resources is a direct contradiction of the growing need for sustainable development to benefit future generations.

In addition to the waste of natural resources, facilities that cannot sustain their environment can lead to hazardous situations. Accidents caused by corroded structures can lead to huge safety concerns, loss of life and resources, and more. One failed pipeline, bridge collapse, or other catastrophe is one too many, and leads to huge indirect costs (more traffic delays, loss of business, etc.) and public outcry. Depending on which market sector (industrial, infrastructure, commercial, etc.) is being considered, these indirect costs may be as high as five to ten times the direct cost.

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