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## **Corrosion in Oil Refineries: Inspection, Monitoring and Control**

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### **Course Overview**

Statistics shows that the total cost of corrosion control in refineries in the US alone is estimated at \$3.692 billion. Of this total, maintenance-related expenses are estimated at \$1.767 billion annually, vessel turnaround expenses account for \$1.425 billion annually, and fouling costs are approximately \$0.500 billion annually. Significant cost reduction can be achieved with timely and appropriate corrosion inspection. Asset integrity can be enhanced with corrosion monitoring and corrosion mitigation methods such as materials selection and chemical treatment. This 5-day corrosion short course covers corrosion inspection, corrosion monitoring and corrosion control in oil refineries.

This corrosion short course is available for on-site training, online and distance learning worldwide. It can also be customized to meet the specific needs of your organization.

### **Who Should Attend**

Designers, Inspection Engineers, Maintenance Engineers, Plant Inspectors, Mechanical Engineers, and Process Engineers in the refining and petrochemical industries.

### **Course Outline**

1. Review of Corrosion Basics
  - 1.1 Why Do Metals Corrode? - The Driving Force for Corrosion
  - 1.2 How Do Metals Corrode? - Different Forms of Corrosion
  - 1.3 Practical Corrosion Cells Important to Corrosion Diagnosis
2. Overview of Refinery Operations
  - 2.1 Overview of the Refining Process
  - 2.2 Process Interactions with Corrosion
3. Refinery Corrosion and Inspection
  - 3.1 Low-Temperature Refinery Corrosion
  - 3.2 High-Temperature Refinery Corrosion
  - 3.3 Metal Loss—General and/or Localized Corrosion
    - 3.3.1 Galvanic Corrosion
    - 3.3.2 Pitting
    - 3.3.3 Crevice Corrosion
    - 3.3.4 Intergranular Attack
    - 3.3.5 Erosion-Corrosion



- 3.3.6 Hydrogen Chloride
- 3.3.7 Ammonium Bisulfide
- 3.3.8 Carbon Dioxide
- 3.3.9 Process Chemicals
- 3.3.10 Organic Chlorides
- 3.3.11 Aluminum Chloride
- 3.3.12 Sulfuric Acid
- 3.3.13 Hydrofluoric Acid
- 3.3.14 Phosphoric Acid
- 3.3.15 Phenol (Carbolic Acid)
- 3.3.16 Amines
- 3.3.17 Atmospheric Corrosion
- 3.3.18 Corrosion Under Insulation (CUI)
- 3.3.19 Soil Corrosion
- 3.3.20 High-Temperature Sulfide Corrosion
- 3.3.21 Naphthenic Acid Corrosion
- 3.3.22 High-Temperature Oxidation
- 3.4 Stress Corrosion Cracking (SCC)
  - 3.4.1 Chloride Stress Corrosion Cracking (ClSCC)
  - 3.4.2 Alkaline Stress Corrosion Cracking (ASCC)
  - 3.4.3 Carbonic Acid (Wet CO<sub>2</sub>)

# Corrosion In Oil Refineries Inspection Monitoring And Control

**Saman Zehra, Ruby Aslam, Mohammad  
Mobin, Chandrabhan Verma**



## **Corrosion In Oil Refineries Inspection Monitoring And Control:**

*Corrosion Problems and Solutions in Oil Refining and Petrochemical Industry* Alec Groysman, 2016-10-24 This book addresses corrosion problems and their solutions at facilities in the oil refining and petrochemical industry including cooling water and boiler feed water units Further it describes and analyzes corrosion control actions corrosion monitoring and corrosion management Corrosion problems are a perennial issue in the oil refining and petrochemical industry as they lead to a deterioration of the functional properties of metallic equipment and harm the environment both of which need to be protected for the sake of current and future generations Accordingly this book examines and analyzes typical and atypical corrosion failure cases and their prevention at refineries and petrochemical facilities including problems with pipelines tanks furnaces distillation columns absorbers heat exchangers and pumps In addition it describes naphthenic acid corrosion stress corrosion cracking hydrogen damages sulfidic corrosion microbiologically induced corrosion erosion corrosion and corrosion fatigue occurring at refinery units At last fouling corrosion and cleaning are discussed in this book

**Corrosion in the Petrochemical Industry, Second Edition** ,2015-12-01 Originally published in 1994 this second edition of Corrosion in the Petrochemical Industry collects peer reviewed articles written by experts in the field of corrosion that were specifically chosen for this book because of their relevance to the petrochemical industry This edition expands coverage of the different forms of corrosion including the effects of metallurgical variables on the corrosion of several alloys It discusses protection methods including discussion of corrosion inhibitors and corrosion resistance of aluminum magnesium stainless steels and nickels It also includes a section devoted specifically to petroleum and petrochemical industry related issues

**Shreir's Corrosion** ,2009-02-27 This four volume reference work builds upon the success of past editions of Elsevier s Corrosion title by Shreir Jarman and Burstein covering the range of innovations and applications that have emerged in the years since its publication Developed in partnership with experts from the Corrosion and Protection Centre at the University of Manchester Shreir s Corrosion meets the research and productivity needs of engineers consultants and researchers alike Incorporates coverage of all aspects of the corrosion phenomenon from the science behind corrosion of metallic and non metallic materials in liquids and gases to the management of corrosion in specific industries and applications Features cutting edge topics such as medical applications metal matrix composites and corrosion modeling Covers the benefits and limitations of techniques from scanning probes to electrochemical noise and impedance spectroscopy

**Oil and Gas Corrosion Prevention** James G. Speight, 2014-03-13 According to NACE National Association of Corrosion Engineers the total annual cost of corrosion in petroleum refining takes up 3 7 billion in the US alone Corrosion control is always a challenge for the downstream industry but as the quality of feedstock is declining due to refineries accepting more of the heavy and shale gas and oil resources that are more readily available today refinery managers petroleum and natural gas engineers are unprepared for the new set of corrosion problems that are showing up in their equipment and processing units Oil and Gas Corrosion Prevention From

Surface Facilities to Refineries quickly gets the engineer and manager up to speed on the latest types of corrosion common for these lower grade crude oils and gases as well as the best prevention methods for all of the major sections of the refinery especially desalting and sulfur recovery units which are the most common problem areas for unconventional feedstocks Also covering the unique midstream sections or point of entry to the refinery as well as the major critical refinery equipment Oil and Gas Corrosion Prevention From Surface Facilities to Refineries offers the perfect quick cross reference for the oil and gas community Gets engineers and managers up to speed on the latest types of corrosion common for lower grade crude oils and gases Provides the best prevention methods for all of the major sections of the refinery especially desalting and sulfur recovery units Covers additional topics such as unique midstream sections or point of entry to the refinery as well as major critical refinery equipment

**Corrosion Control Technologies for Aluminum Alloy Vessel** Zhigang Fang,Jingyi Cao,Yong Guan,2020-01-03 This book elaborates the corrosion testing and assessment methods for the aluminum alloy vessel in the service and internal environment The emphasis is placed on the research of general materials corrosion characteristics electrochemical protection design surface protection coating and painting etc This book helps readers to keep abreast of the whole technology system of the corrosion prevention and control of aluminum alloy vessel especially the systematic engineering view of life cycle corrosion control for the vessel is of particular interest to readers

**The Cost of Corrosion in China** Baorong Hou,2019-09-26 This book comprehensively covers corrosion and corrosion protection in China in the areas including infrastructure transportation energy water environment as well as manufacturing and public utilities Furthermore it presents a major consulting project of Chinese Academy of Engineering which was the largest corrosion investigation project in Chinese history including the corresponding methods processes and corrosion protection strategies and provides valuable information for numerous industries Sharing essential insights into corrosion prediction and decision making this book will help to decrease costs and extend the service life of equipment and facilities accordingly it will benefit scientists and engineers working on corrosion research and protection as well as economists and government employees

Crude Oil Refining Marcio Wagner da Silva,2022-10-04 This book provides an overview of crude oil refining processes and presents a deep analysis of the current context and challenges imposed on players in the downstream industry Crude Oil Refining A Simplified Approach covers traditional processes of the refining industry the impact of current trends and technological routes available to help these players survive in a highly competitive environment FEATURES Offers a simplified approach to crude oil refining processes Discusses economic information related to the downstream business including refining margins and profitability Introduces newer trends in the industry such as petrochemical integration crude to chemicals refineries and renewables coprocessing in crude oil refineries Presents the challenges related to these new trends and offers technological solutions to overcome them for profitable and sustainable operations Describes how the use of biofuels can minimize the environmental impact of transportation fuel in nations of high demand like Brazil Offering a

contemporary view of current challenges and opportunities in the downstream oil and gas business this practical book is aimed at readers working in the fields of petroleum and chemical engineering *Corrosion in Systems for Storage and Transportation of Petroleum Products and Biofuels* Alec Groysman, 2014-02-17 This book treats corrosion as it occurs and affects processes in real world situations and thus points the way to practical solutions Topics described include the conditions in which petroleum products are corrosive to metals corrosion mechanisms of petroleum products which parts of storage tanks containing crude oils and petroleum products undergo corrosion dependence of corrosion in tanks on type of petroleum products aggressiveness of petroleum products to polymeric material how microorganisms take part in corrosion of tanks and pipes containing petroleum products which corrosion monitoring methods are used in systems for storage and transportation of petroleum products what corrosion control measures should be chosen how to choose coatings for inner and outer surfaces of tanks containing petroleum products and how different additives oxygenates aromatic solvents to petroleum products and biofuels influence metallic and polymeric materials The book is of interest to corrosion engineers materials engineers oil and gas engineers petroleum engineers chemists chemical engineers mechanical engineers failure analysts scientists and students designers of tanks pipelines and other systems for storage and transportation fuels technicians The book is of interest to corrosion engineers materials engineers oil and gas engineers petroleum engineers chemists chemical engineers mechanical engineers failure analysts scientists and students designers of tanks pipelines and other systems for storage and transportation fuels technicians The book is of interest to corrosion engineers materials engineers oil and gas engineers petroleum engineers chemists chemical engineers mechanical engineers failure analysts scientists and students designers of tanks pipelines and other systems for storage and transportation fuels technicians

**Guidelines for Asset Integrity Management** CCPS (Center for Chemical Process Safety), 2017-01-06 This book is an update and expansion of topics covered in Guidelines for Mechanical Integrity Systems 2006 The new book is consistent with Risk Based Process Safety and Life Cycle approaches and includes details on failure modes and mechanisms Also example testing an inspection programs is included for various types of equipment and systems Guidance and examples are provided for selecting and maintaining critical safety systems Corrosion in the Petrochemical Industry Linda Garverick, 1994-01-01 A comprehensive collection of peer reviewed data and information on corrosion in the petroleum petrochemical and chemical processing industries from a number of ASM International publications The principal sources are Corrosion Volume 13 and Failure Analysis and Prevention Volume 11 of ASM H **Industrial Corrosion** Saman Zehra, Ruby Aslam, Mohammad Mobin, Chandrabhan Verma, 2025-06-02 The book equips professionals with essential insights into corrosion science practical techniques for diagnosis and prevention and access to the latest advancements in the field making it an invaluable resource for enhancing industry practices and safeguarding assets Industrial Corrosion Fundamentals Failure Analysis and Prevention offers an in depth look at the science behind corrosion and its impact on industries worldwide Covering both theoretical and

practical aspects this volume provides a clear understanding of corrosion mechanisms materials degradation and the reasons behind common industrial failures It explores advanced techniques for diagnosing corrosion issues and presents effective solutions to mitigate and prevent them The book not only delves into traditional corrosion control methods but also highlights the latest advancements in corrosion inhibitors and smart coatings showcasing cutting edge technologies that can revolutionize industry practices With practical case studies real world examples and expert insights this comprehensive guide serves as a crucial resource for engineers researchers and professionals seeking to enhance their knowledge and apply corrosion prevention techniques in their work Provides a detailed exploration of corrosion fundamentals failure mechanisms and prevention strategies perfect for professionals and students alike Includes practical case studies and examples to help readers apply corrosion prevention methods in various industries Highlights the latest innovations in corrosion inhibitors and smart coatings for enhanced industrial protection Audience Engineers materials scientists chemists academics researchers and professionals in corrosion prevention oil and gas manufacturing transportation and infrastructure where corrosion control is critical Fossil Energy Update ,1976 Advances in Structural Health Monitoring Maguid H.M.

Hassan,2019-11-20 The concepts presented in this book are some of the new advancements in the design of structural health monitoring systems It is envisaged that such advancements will lead to smart structural health monitoring that will result in sustainable engineering systems Sustainability is considered an important objective in today s engineering design due to the current state of climate change and global warming both of which are hugely aggravated by industrial and construction activities This book presents demonstrations of and applications for new advancements such as infrared thermography ultrasonic guided waves and strain sensors among others The information presented will encourage further research and implementation of these advanced techniques and technologies in structural health monitoring **Failure Modes, Effects and Causes of Microbiologically Influenced Corrosion** Reza Javaherdashti,Farzaneh Akvan,2019-10-22 Failure Modes Effects and Causes of Microbiologically Influenced Corrosion Advanced Perspectives and Analysis presents academic research about microbial corrosion MIC integrating it into engineering applications that result in a more thorough understanding of MIC and how it is recognized and treated In addition new concepts that will be useful in understanding integrity and corrosion management practices are explored This book will be useful for industry professionals particularly maintenance and operation engineers corrosion and material engineers and R D personnel working in the field of corrosion protection Focuses on the skills and knowledge necessary to understand how Failure modes and why Effects and Causes materials fail Explains why corrosion control measures such as the use of coatings cathodic protection and inhibitors are useful Discusses the practical side of MIC treatment in terms of fundamental concepts of time and cost of operation

*Corrosion and Materials Selection* Alireza Bahadori,2014-08-11 The petroleum and chemical industries contain a wide variety of corrosive environments many of which are unique to these industries Oil and gas production operations consume a

tremendous amount of iron and steel pipe tubing pumps valves and sucker rods Metallic corrosion is costly However the cost of corrosion is not just financial Beyond the huge direct outlay of funds to repair or replace corroded structures are the indirect costs natural resources potential hazards and lost opportunity Wasting natural resources is a direct contradiction to the growing need for sustainable development By selecting the correct material and applying proper corrosion protection methods these costs can be reduced or even eliminated This book provides a minimum design requirement for consideration when designing systems in order to prevent or control corrosion damage safely and economically and addresses Corrosion problems in petroleum and chemical industries Requirements for corrosion control Chemical control of corrosive environments Corrosion inhibitors in refineries and petrochemical plants Materials selection and service life of materials Surface preparation protection and maintainability Corrosion monitoring plant inspection techniques and laboratory corrosion testing techniques Intended for engineers and industry personnel working in the petroleum and chemical industries this book is also a valuable resource for research and development teams safety engineers corrosion specialists and researchers in chemical engineering engineering and materials science *SME Mining Engineering Handbook, Third Edition* Peter Darling, Society for Mining, Metallurgy, and Exploration (U.S.), 2011 This third edition of the SME Mining Engineering Handbook reaffirms its international reputation as the handbook of choice for today's practicing mining engineer It distills the body of knowledge that characterizes mining engineering as a disciplinary field and has subsequently helped to inspire and inform generations of mining professionals Virtually all of the information is original content representing the latest information from more than 250 internationally recognized mining industry experts Within the handbook's 115 thought provoking chapters are current topics relevant to today's mining professional Analyzing how the mining and minerals industry will develop over the medium and long term why such changes are inevitable what this will mean in terms of challenges and how they could be managed Explaining the mechanics associated with the multifaceted world of mine and mineral economics from the decisions associated with how best to finance a single piece of high value equipment to the long term cash flow issues associated with mine planning at a mature operation Describing the recent and ongoing technical initiatives and engineering developments in relation to robotics automation acid rock drainage block caving optimization or process dewatering methods Examining in detail the methods and equipment available to achieve efficient predictable and safe rock breaking whether employing a tunnel boring machine for development work mineral extraction using a mobile miner or cast blasting at a surface coal operation Identifying the salient points that dictate which is the safest most efficient and most versatile extraction method to employ as well as describing in detail how each alternative is engineered Discussing the impacts that social and environmental issues have on mining from the pre exploration phase to end of mine issues and beyond and how to manage these two increasingly important factors to the benefit of both the mining companies and other stakeholders **Quality Technology Handbook** R S Sharpe, J West, D S Dean, 2017-03-28 Quality

Technology Handbook Fourth Edition offers a wide discussion on technology and its related subtopics After giving some information on its background content and authors the book then informs the readers about the quality problem check list and enumerates the questions one has to ask to ensure that a problem will be solved This part is followed by a discussion on non destructive testing NDT and the several committees formed for it among which are the British National Committee and the Harwell NDT Center The book also includes information on two organizations that are closely related to the topic the Institute of Quality Assurance IQA and The Welding Institute TWI A directory of international organizations related to quality assurance and non destructive testing is provided in the latter part of the text The book serves as valuable reference to undergraduates or postgraduates of courses that are related to science and technology

Testing Tribocorrosion of Passivating Materials Supporting Research and Industrial Innovation Jean-Pierre Celis, 2017-07-05 This first edition of Testing Tribocorrosion of Passivating Materials Supporting Research and Industrial Innovation A Handbook treats in a clear concise and practical manner an important material degradation and protection matter It is designed as a handbook and provides a well structured approach of the basics needed to investigate the tribocorrosion behavior of passivating materials and to conduct in a correct way a laboratory investigation on it It provides answers on practical and theoretical approaches of tribocorrosion phenomena to engineers and medical persons involved with material assemblies subjected to aggressive environmental and mechanical conditions For academic researchers it is a pertinent tool assisting them in how they can perform a tribocorrosion investigation and obtain results that are correctly interpreted and can be exchanged Different parts of the book are illustrated with practical examples This handbook is truly an indispensable guide for every professional who comes into contact with the complex material degradation and protection processes that take place under combined corrosion and wear conditions Fields of interest include transportation aeronautics maritime rail automotive medical implants orthopaedics dentistry biochemistry food production energy production and machining The coordination of this handbook writing was done by Professor Jean Pierre Celis Katholieke Universiteit Leuven Belgium and Professor Pierre Ponthiaux Ecole Centrale Paris France assisted by twelve European experts who contributed jointly to the nine chapters of this handbook Main topics dealt with are tribocorrosion phenomena in medical and industrial sectors depassivation and repassivation phenomena impact on synergism in tribocorrosion specific testing techniques coupling tribology to corrosion design of a testing protocol and normalisation

Process Operations Safety Darryl M. Yoes, 2025-02-05 Provides crucial lessons in process safety operations drawing from 100 global case studies Written from an operator's perspective Process Operations Safety provides valuable information and education on the fundamentals of process operations safety by providing background on process safety and key leading operational management and equipment failures that have led to catastrophic process safety incidents including loss of life Written by an expert with more than five decades of industry experience this book enables readers to learn how simple jobs that they perform every day can lead to catastrophic safety incidents without



proper caution protocol and attention A self learning quiz is provided near each chapter s end with answers to all questions provided in the Appendix A listing of additional resources or reference material many with internet links is also included at the end of each chapter Readers will find Principles of process safety properties of hydrocarbons vapor cloud explosions VCE and boiling liquid expanding vapor explosions BLEVE Most frequent causes of significant process safety events in refining and petrochemical industries Causal factors in over 100 global case studies of operations and incidents divided into thirty five subchapters with several examples for each explaining what happened and what could have happened Key lessons learned written in simple terms using descriptions without jargon or complicated formulas Process Operations Safety is an essential learning resource for petroleum refining and petrochemical plant operators line supervisors and critical support staff with field responsibility such as process and mechanical engineers along with advanced students at community and four year colleges and technical trade schools taking a process operations course

*Standardisation of Thermal Cycling Exposure Testing* M Schütze, M Malessa, 2014-01-23 The thermal cyclic oxidation test has become one of the most widely accepted ways of measuring high temperature corrosion There has long been a need for an agreed code of practice with standardised methods and procedures to ensure both the comparability and reliability of the results obtained Based on an EU project Cyclic oxidation testing development of a code of practice for the characterisation of high temperature materials performance COTEST this volume provides the essential background to an appropriate code of practice The first part of the book reviews the range of existing test procedures Part two summarises research on the influence of various test parameters on thermal cycling oxidation behaviour including both long dwell and short dwell thermal cycling oxidation The third and final part of the book describes the resulting code of practice which is being considered by the ISO TC 156 Working Group 13 responsible for an appropriate international standard With its distinguished editor and team of contributors this important book is a standard reference for all those conducting thermal cycling oxidation testing or assessing its implications in such sectors as the power industry Provides the essential background for an appropriate code of practice Reviews the range of existing test procedures

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## Corrosion In Oil Refineries Inspection Monitoring And Control Introduction

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