

# CHAPTER 1

## INTRODUCTION

In many engineering applications, metallic materials are used in structures, components, and machinery that are subjected to cyclic loadings and exposed to marine environments. The combined action of cyclic loading and aggressive environment often results in a significant reduction in fatigue performance compared with that obtained under cyclic loading in inert environments. Fatigue damage occurring under the conjoint action of cyclic loading and aggressive environment is generically referred to as corrosion fatigue. This damage may be a simple superposition of fatigue cracking and corrosive attack or it may be a more complex synergistic interaction of these two modes.

Examples of equipment and structures where corrosion fatigue is an important consideration are ships, offshore platforms, mining and oil drilling rigs, aircraft, navigation and communication towers, bridges, and underwater pipelines. The marine environment may be (1) full immersion in natural seawater, brackish water, or polluted seawater; (2) alternate wet/dry areas in splash, spray, or tidal zones; or (3) atmospheric exposure near saline bodies of water. In all of these cases, designers, engineers, and operators must be aware of the possible deleterious effects of corrosion fatigue on material performance and must assess the potential impact of these effects on design, safety, and reliability of engineering systems. Moreover, in military uses—for example, in aircraft, amphibious vehicles, and communication equipment—operation without failure due to corrosion fatigue is vital to defense and security operations.

This book was prepared to document and review the major factors involved in corrosion fatigue of metals in marine environments. This includes both crack initiation and crack growth. Background information was obtained by searching technical literature through eight different sources—(1) Chemical Abstracts, (2) Metals Abstracts, (3) Metals and Ceramics Information Center (MCIC), (4) Engineering Index, (5) Copper Data Center, (6) National Technical Information Service, (7) Defense Technical Information Service, and (8) Proceedings of Offshore Technology Conferences. Unpublished and proprietary papers and reports were excluded unless permission was obtained to release the results contained therein. Thus, most of the information was from documents published in the open literature.

For convenient use and reference, discussions on corrosion-fatigue behavior are divided into separate chapters dealing with (1) carbon and alloy steels, (2) stainless steels, (3) nickel-base alloys, (4) copper-base alloys, (5) aluminum alloys, and (6) titanium alloys. Representative plots and tabulations of important data and factors influencing them are presented, but exhaustive plots and tabulations of all available data, such as might be found in handbooks, are not included because these are beyond the scope of this review. A general background for corrosion fatigue is presented in Chapter 2, which briefly discusses experimental procedures, general phenomena and mechanisms, variables affecting corrosion of metals in marine environments, and use of fatigue data in design.