Chapter 9
Successes in the Development of an Arabian Gulf Materials Program

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ABSTRACT

A materials research program was established to identify new corrosion resistant stainless steel alloys for the oil and gas industry. One important goal of this work was developing professionals to address the critical materials issues in the Arabian Gulf Region. This chapter reports the results of these efforts. Development of research professionals involved a multifaceted approach. One key element involved laboratory work to develop the critical research tools required in this area. The effort also included development of important course content for both undergraduate and graduate-level materials education. The research in this program stems from a collaboration between Texas A&M University at Qatar and the Colorado School of Mines. Collaboration provided many of the important tools required for this new Middle Eastern education initiative. The present chapter describes the challenges that were addressed in order to develop crucial new materials research and education capabilities in this major petroleum producing region.

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INTRODUCTION

The future of the world-class Middle Eastern oil and gas business is greatly dependent on the availability of highly trained materials engineering professionals. Universities in the Arabian Gulf Region are a vital source of materials professionals who solve corrosion problems in this important petroleum producing region. The current chapter describes the development of courses and research programs at Texas A&M University at Qatar to provide quality personnel who can address Middle Eastern corrosion and plant integrity issues.

Texas A&M University at Qatar (Texas A&M University at Qatar, 2014a) is an ABET accredited branch of Texas A&M University, College Station, Texas, USA (Texas A&M University, 2014). The Middle Eastern branch campus started operation in Doha, Qatar in 2003 under funding from Qatar Foundation (Qatar Foundation, 2014; Texas A&M University at Qatar, 2014b). Research started with Qatar Foundation support in 2007, and the first Graduate Studies Program in chemical engineering was initiated in 2010. The university is an important supplier of engineers in the Arabian Gulf Region and graduates technical personnel with strong materials engineering backgrounds. This chapter describes the development of a key research program, one goal of which is to provide skilled corrosion professionals for the Middle Eastern region.

BACKGROUND

Importance of the Arabian Gulf Energy Business

This chapter discusses the development of critical corrosion research infrastructure and educational programs to provide engineers that can address important Middle Eastern materials issues. These Middle Eastern issues are important because of the magnitude of petroleum resources in this region. Petroleum reserves in the Middle East dwarf those of most other regions in the world, both in terms of quality and quantity (OPEC, 2013).

The demand for Middle Eastern crude oil and gas has been high for decades because these feedstocks have relatively low sulfur contents. However, in recent years, Middle Eastern producers have been forced to tap reservoirs that have increasingly higher sulfur contents. The United Arab Emirates Shah Development is an example of a project to develop such reservoirs (Al Hosn Gas, 2014).

Petroleum producers face a number of new challenges in tapping high-sulfur (sour) reservoirs. The corrosive nature of sulfur-bearing compounds coupled with higher water cuts in such environments present a number of challenges. Hydrogen sulfide and carbon dioxide in these feedstocks are particularly problematic as these gases are highly corrosive. Also, corrosion can manifest itself in insidious forms that cause catastrophic failure of many materials. For example, hydrogen sulfide causes environmentally assisted cracking that leads to premature failure by an interconnected network of destructive cracks which rapidly spread through otherwise unaffected metal (Cheng, 2013). Metals that undergo attack can fail much more rapidly than metals that are subjected to more common uniform corrosion.

The components of the oil and gas production facilities must be designed to withstand the attack of corrosive petroleum fluids. For example, produced water saturated with carbon dioxide can be corrosive as the acidity of such water is quite high. Additionally, the chloride content seriously compromises the