Chapter 13
Integrating Industry Research in Pedagogical Practice: A Case of Teaching Microbial Corrosion in Wet Tropics

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ABSTRACT

This chapter discusses how the issue of microbial corrosion can be incorporated in the Materials Engineering curriculum. Research in this field contributes to knowledge building in microstructural effect of corrosion, and development of advanced corrosion protection techniques, which aligns with the essence of Materials Science and Engineering. This chapter suggests an instructional approach where students undertake a project in which they produce a database summarizing the relationship between corrosion rate and factors as types of bacteria, functional genes, types of alloys, and welding procedures. The benefit of such approach is two-fold. First, discussion of this topic in the curriculum provides an opportunity to introduce approaches for efficient management of the current issues encountered in industry. Second, there is currently no comprehensive database on the microbial corrosion conditions. Additionally, this chapter provides some insights into the best instructional strategies for the efficient management of an online engineering course in higher education.

INTRODUCTION

Microbiologically influenced corrosion (MIC) has been a major problem for industries operating in tropical environments as it results in two to three fold corrosion rate. Nevertheless, very little work has been done to date to understand how the microstructure of materials can be modified to control MIC and when done, the data is not consistent and is not readily available for the industry use. The industry is looking for a fresh approach to the control of MIC. The research work

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discussed in this chapter provides a means for setting up a comprehensive database containing detailed information on MIC conditions, while at the same time strengthening the Materials Engineering curriculum.

In any corrosion phenomenon, the system needs a material and an environment. Nearly all of the methods used for controlling MIC are aimed at controlling the environment through the use of biocides or isolating the metals surfaces from bacteria. Due to the fact that most biocides are harmful not only to the bacteria causing MIC but also to the humans that share the same eco-system, coatings containing Cr^{+6} and copper in biocides are increasingly being banned. Currently the research group at Charles Darwin University (CDU) located in the Northern Territory, Australia, is looking at new ways of controlling microbiologically influenced corrosion (MIC) through an understanding of the microstructural effects. Since welding is the main, and sometimes the only, fabrication method used to produce various structures, particular attention is paid to the study of weldments and other heat affected zones (HAZ) of the materials. There is a need for control of microstructures and welding procedures that are relevant to the Australian industry given that there is a boom in oil and gas industry in Northern Australia.

On the other hand, industries, particularly those operating in difficult climatic conditions and remote areas, have been looking to universities to help improve the retention of employees in the areas of engineering and trades. At the university level this can be achieved through two initiatives. First, in order to prepare the graduates to enter the workforce and ensure higher retention, the courses can be tailored to fit with the current local industry issues. This has been increasingly achieved through project based learning environment (PBL). Second, a learning environment suitable for people in the workforce seeking to upskill can be developed. At CDU, all courses including Materials Engineering are available online, providing flexible access to learning materials and assessment items.

From the educational perspective, one of the most important concepts taught in a Materials Engineering course is the possibility to manipulate properties of the materials by altering their micro and macro structure. Therefore, current research in MIC provides solid grounds for a case study in the Materials Engineering course delivered in problem or project based mode. Not only can this approach allow the students to have an insight into the modern research, but it also presents a complex authentic problem which requires a systematic solution.

In summary, this chapter focuses on the major problem of integration of industry needs within the engineering course based on a case of teaching MIC. The benefits of such approach are two–fold. On one hand, it provides an insight into the relationship between the corrosion rates and such factors as bacteria type, functional genes, type of alloy, and welding procedures. This is particularly important since currently there is no database on MIC conditions available in Australia. On the other hand, the chapter discusses the strategy by which this important issue can be incorporated in the engineering curriculum, and the learning outcomes that can be achieved. Also, advice is given for the presentation of the course through online environment. Significant advantage of this strategy lies within the possibility to create an authentic learning environment as well as to cater for the up-skilling needs of industry.

BACKGROUND

Darwin is a small city situated in the Northern Territory of Australia which is about 3,500 km from any major cities of Australia. Nevertheless, the massive oil, gas and mining industry devel-