Corrosion of Steel Piles in Seawater

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Abstract In this study, the latest available data on steel pile corrosion in sea water was reviewed and analyzed. Steel corrodes, particularly in a marine environment, through a number of mechanisms that depend on the location of the steel in structure and several other factors. Microbial activity is known to contribute to accelerated corrosion in a number of environments. Based on preliminary laboratory investigation, the rate of initial corrosion of steel is 2.45 % salt water has been quantified.

1. Introduction

Accelerated Low Water Corrosion (ALWC) is defined as the localized and aggressive corrosion phenomenon that typically occurs at or below low-water level and is associated with microbial induced corrosion. ALWC corrosion rates are typically 0.5 mm/side/year averaged over time to the point of complete perforation of steel plate (MNC, 2005). ALWC has been reported to cause severe corrosion of mainly steel piles in ports and jetty structures all around the world such as USA, Europe and Australia. In many cases of ALWC, corrosion occurs on unprotected steel structures in any location, and varies in intensity depending on local variables.

2. Objective

The objective was to investigate the corrosion modes of steel pile in offshore environment. Also initial corrosion rate of steel in a salt solution was experimentally investigated.

3. Analysis and Discussion

Maritime structural design has traditionally considered corrosion conditions in distinct vertical zones in relation to the sea. These zones and microbiological contribution to ALWC are summarized in Table 1 and Figure 1. The results from steel corrosion experiment in salt water are shown in Figure 2. Semi-immersed specimens showed great buildup of corrosion and after 28 days had over 9 μm corrosion thickness.

Table 1: Description of Steel Pile Corrosion (MNC, 2005).

Environment	Zone	Description of zone environment	Corrosion Rate	Affected factor
In water	Atmospheric zone	in the dry	severe	Salt-laden atmosphere
	Splash Zone	wetting is intermittent	the same to low water zone	Salt, carbon, pollutant
	Tidal zone	wet and dry	0.04-0.1mm/side/year	oil and similar pollutants
	Low water zone	rich in oxygen and energy	0.08-0.17mm/side/year	SRP and Metal-reducing bacteria
	Immersed Zone	in water	0.04 to 0.13mm/side/year	sufficient oxygen and conductivity
	Embedded zone	in coarse granular material	slow and uniform	corrosion can proceed in acidic or contain SRB soil

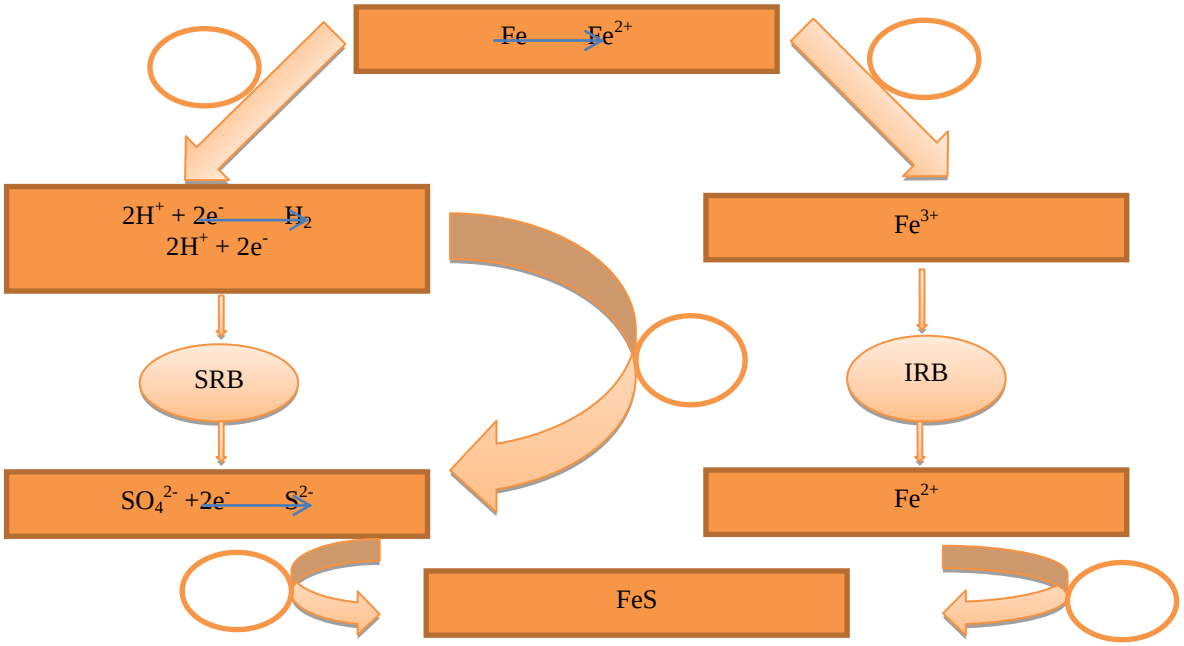

Figure 1 An example of possible microbial consortia (sulphate reducing bacteria and iron reducing bacteria) contributing to MIC-assisted ALWC (Reza.J., 2005)

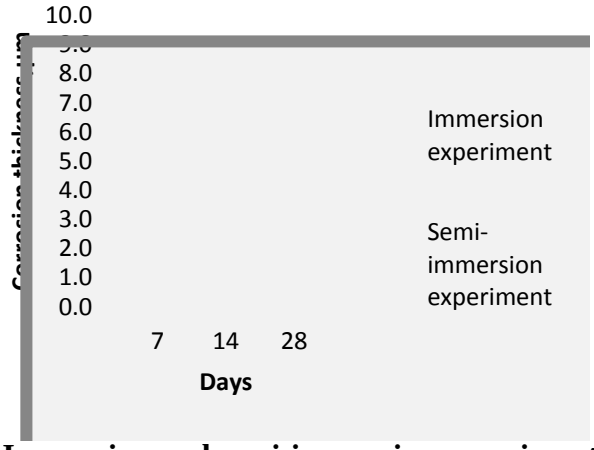

Figure 2: Immersion and semi-immersion experiment of steel corrosion

4. Conclusion

In sea water environment, the severe corrosion occurred in low water zone, corrosion rate of 0.08 to 0.17 mm/side/year are typical. Corrosion rates in the splash zone can be as rapid as those in the low-water zone, corrosion of tidal zone is usually relatively slow and uniform. Experimental result showed corrosion of 111.48 μm per year in salt water solution and the corrosion rate of steel in semi-immersion experiment was faster than specimens in immersion.

5. Acknowledgement

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6. Reference

Maritime Navigation Commission, (2005), "Accelerated Low Water Corrosion," report of working group 44, International Navigation Association. PP1-32

Reza Javaherdashti, (2005), Microbiological contribution to accelerated low water corrosion of support piles.