

Analysis and evaluation of corrosion in naval steels

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Abstract – The corrosion of steel due to seawater is a problem faced by all ships. In this work it has been analyzed two of the variables that most influence the degradation process of carbon steels in marine environments (pH and chloride concentration), as well as the galvanic couple, which arises when two metals of different potential make contact. The study was carried out with two types of steel (S275JR and S235JR) and 15 different environments were analyzed (Fig. 1).

The progression of corrosion was evaluated in two ways: i) by measuring the mass variation due to the corrosion phenomenon, which was subsequently used to determine the kinetics of the reaction, and ii) visually, by using free software ImageJ. The combined effect of the three variables was analyzed using the Statistics software, performing a factorial analysis in order to obtain response surfaces and their corresponding predictive equations, which allow predicting the effect of corrosion. Finally, in order to observe the differences between the model obtained and the degree of actual corrosion, both steel types were subjected to the effect of seawater from the dock of the Naval Academy.



Figure 1. Experimental setup in laboratory.

Results of the study showed a loss of 0,1 g a week, influenced by the chloride concentration and the acid environment (Fig. 2). From the data obtained, predictive equations were formulated and compared with experiments in laboratory. After 3 weeks of corrosion induced in laboratory, a deviation of 6,74% between the real and predicted mass of probes was observed for steel S275JR and 1,35% for steel S235JR, which evidence the accuracy of the experiments carried out and gives a valuable tool in order to predict effects of corrosion. Corrosion kinetics showed a degradation of 0,3 mm/year and predictive equations showed a deviation lower than 7% in both steels when compared with experiments in laboratory.

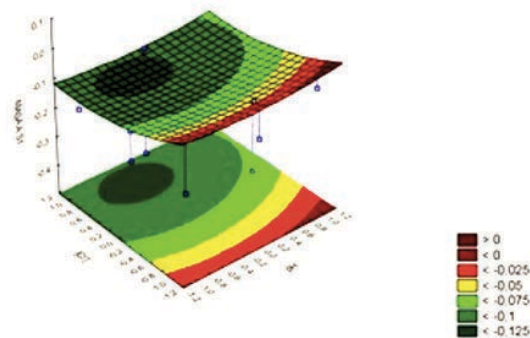


Figure 1. Surface response shows mass loss in steel probes after 1 week of exposure to acid and chloride environment.

Keywords – Corrosion, steel, seawater, vessel, factorial design.