A different approach towards two-body abrasion-corrosion of steels

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1. Introduction

Tribocorrosion of steels is often encountered in various engineering sectors especially in offshore applications such as dredgers, pipelines, drilling etc. Although these tribological environments with sand would, in general, be considered as three-body yet, in certain cases, e.g., sand being transported through suction pipes in dredgers and chains being moored on sand beds, the tribological system is two-body in nature, with metal sliding against abrasives. Several studies combine two-body systems, for example, jet erosion systems [1] and pin-on-disk testers (ASTM G99) [2], with three-cell electrodes. But in the former configuration the synergy in an erosion-corrosion system is obtained and in the latter case the synergy between a metal to metal contact is obtained. Offshore applications particularly, the examples suggested previously, are not only subjected to erosion-corrosion but also experience abrasion – corrosion and more importantly with a different contact configuration. Therefore, in the current set up, two-body abrasion – corrosion with metal on abrasive sliding contact has been attempted to be simulated.

2. Experimental work

2.1. Test rig

Tribocorrosion test rigs usually work on the basic principle of combining the simultaneous action of wear and corrosion [3-5]. The current test set up combines the principles of pin abrasion testing (ASTM G132) and three-electrode corrosion testing to simulate two-body abrasion-corrosion. The test rig is shown in *Figure 1*.

Figure 1: Two-body abrasion-corrosion tester coupling

2.2. Methodology

The main purpose of the current study was to develop a test protocol to obtain the synergy of the system according to the guidelines of ASTM standard G119. Test material used was an abrasion resistant martensitic steel. Abrasive paper grade of P180 (SiC) was selected. Artificial sea water (3.5 wt% NaCl) was used as the corrosive medium. 3M KCl saturated Ag/AgCl and Pt-10% Rh wire was used as the reference and counter electrode respectively. The abrasive wear tests were carried out for a sliding length of 9 m at a sliding speed of 10 mm/s and a normal load of 1 N. Tests were repeated three times to check for reproducibility of the results.

3. Results

A detailed test protocol was effectively designed to obtain the synergy of the system. For example, *Figure 2* shows the Tafel plots obtained in the presence and absence of two-body abrasion. The influence of wear on the electrochemical corrosion rates can be quantified from these measurements. Here, it can be clearly observed that the electrochemical corrosion rate (i_{corr}) is higher in the presence of abrasion.

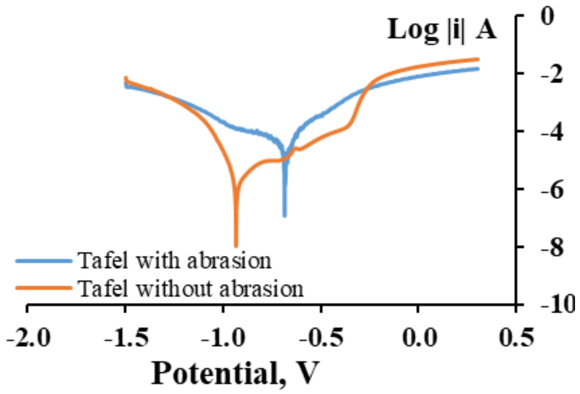

Figure 2: Tafel curves with and without abrasion

4. Conclusion

A different test approach towards abrasion-corrosion was successfully executed. The synergy of the system was also assessed quantitatively. The performance of abrasion resistant martensitic steel in corrosive environment was evaluated.

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6. References

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