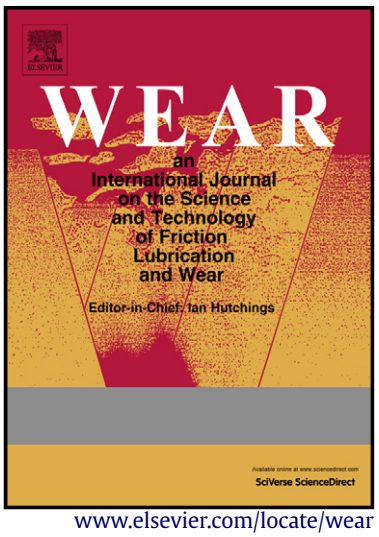

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Impact of corrosion on sliding wear properties of low-alloyed carbon steel

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Abstract

Corrosion phenomena play an important role in limiting the lifetime of tribological systems. It is well known out of different studies that synergistic effects between mechanical sliding and corrosion often lead to increased volume losses when compared to their individual contributions. The aim of this work is to describe the tribological performance of low-alloyed C-steel under sliding / corrosion conditions at specific oxygen-free environments using CO_2 atmosphere and brine. Low-alloyed C-steel was used as base material and was tribologically loaded in a novel close-to-reality test rig under reciprocating sliding contact against spray Ni-based coating counterpart. Additionally, pure sliding tests were carried out under N_2 atmosphere with distilled water for comparison. Different microscopic methods were applied (e.g., SEM-FIB) for understanding the sliding / corrosion phenomena in addition to quantitative wear measurements by mass loss. The results show a significant influence of the microstructure on the tribological performance under sliding / corrosion conditions, where the formation of corrosion siderite layers ($FeCO_3$) and their tribological properties plays a crucial role.

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Keywords: sliding / corrosion, CO_2 corrosion, C-steel, tribology, wear

1. Introduction

The relevance of the synergism between mechanical wear and corrosion, i.e. tribo-corrosion [1] has been highlighted in a vast number of relevant engineering systems, ranging from biotribology [2] to off-shore applications [3]. Under the presence of an electrolyte, passive metals undergo wear accelerated corrosion due to the continuous passivation, removal of the passive layer and repassivation processes at the contacting surface due to rubbing.

Steel components used in the oil production industry are often exposed to carbon dioxide (CO_2) corrosion. Under CO_2 environmental conditions and lack of oxygen, the prevailing corrosion mechanism is substantially different. For typically used plain carbon or low alloyed steels, the main corrosion product is siderite ($FeCO_3$). The siderite layer formed at the surface can provide a good protection against further corrosion. Dense and good adhered CO_2