THE EFFECT OF ELECTRICAL CURRENT ON TRIBOLOGICAL CONTACT

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ABSTRACT
The presence of stray currents in wind turbine gearbox bearings is an undesirable and inevitable phenomenon, which leads to early failure through various mechanisms of wear such as frosting, fluting, pitting, WECs etc. Another important consequence of electrical current flow across the tribological contact is the change from being electrically neutral to polarized (electrochemical cell), the contact bodies being positively (anode) and negatively (cathode) charged.

The present study shows that the dissociated organic anions from lubricant additives, directly involved in the generation of wear track tribofilms (carboxylates, phosphates, sulphites, sulfonates etc.) are attracted and react/adsorb on the positively charged contact body (anode) forming a tribofilm while the negatively charged body (cathode) repels them and therefore does not generate a tribofilm and remains unprotected. Thus, the specimen polarity has a direct effect on the wear mechanism and fatigue life. The RCF results show that when the specimen is cathodic, the mechanism of wear is defined by micro-pitting and protrusions (a wear mechanism reported for the first time in this study), while the anodic specimen shows micro-pitting and uniformly distributed, severe spalling. As expected, the fatigue life was shorter for cathodic specimens. In addition, the present investigation showed that while lubricant formulation plays a major role in WECs generation, lubricants that do not form WECs in the absence of electrical current, will not generate WECs under the electrical conditions tested.

The RCF, friction, wear, wear track tribofilm, and subsurface characterisation results were provided by MTM and MPR electrical setup testing (designed and developed by the authors), profilometry, optical microscopy, SEM/EDX, and metallography.

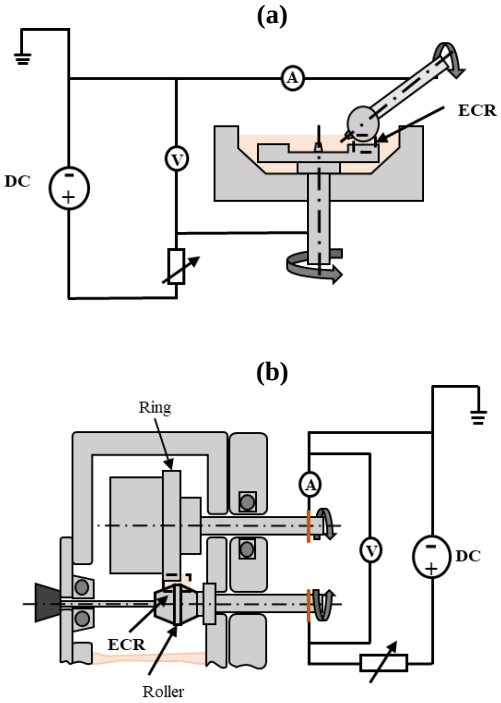

Fig. 1 Schematic representation of the (a) MTM and (b) MPR electrical circuit setups.