THE STUDY OF DEBRIS FORMATION IN FRETTING WEAR OF A HIGH STRENGTH STEEL USING CROSSED-CYLINDER EXPERIMENTS

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KEYWORDS

Fretting; Wear; Experiments in tribology; High-strength steel.

1. INTRODUCTION

Fretting can be defined as the oscillatory motion of bodies in contact where the displacement amplitudes are small. Fretting wear is consistent with the gross-slip regime. Severity of fretting wear is dependent on the rate at which wear debris is formed, which has been shown vary with contact size and geometry [1, 2]; fretting wear is driven by the rates at which oxygen enters the contact, debris (oxide) is formed, and debris exits the contact. It is hypothesised that the observed rate of wear is driven by the smallest of these three rates.

2. EXPERIMENTAL STUDY

2.1. Specimens, Procedures and Conditions

A crossed-cylinder configuration as shown in Figure 1 is used to study fretting wear rates for a high-strength steel. A schematic of the fretting test rig is shown in Figure 2. Specimens of radius R, 6 mm and 160 mm, are used to have configurations *R6-on-R6* and *R160-on-R160* under the loading conditions in Table 1. One specimen is mounted on the lower specimen mounting block (LSMB), and the other specimen on the upper specimen mounting block (USMB). A constant normal load P of 450 N is applied on top of the USMB. The LSMB is held stationary whilst oscillating motion with an applied displacement Δ^* of 100 µm is applied to the USMB using an electromagnetic vibrator at a frequency f of 80 Hz. Each test duration is 1 million cycles.

2.2. Wear Characterisation

Optical profilometry is used to map the surface topology of worn surfaces, allowing for the estimation of worn volumes and wear depths. The morphology of worn surfaces is characterised using scanning electron microscopy in SE and BSE modes.

3. CONCLUSIONS

An understanding of oxygen- and debris-dynamics in a fretting contact of crossed cylinders can provide a starting point to comprehending these dynamics in the fretting wear of more complicated geometries like articulating spline couplings.

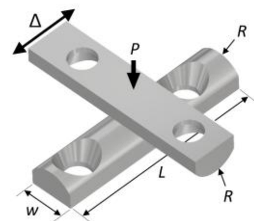

Figure 1: A CAD model of the specimen pair in the crossed-cylinder test configuration, where w = 10 mm, L = 44 mm, R = cylinder radius, P = normal load, and Δ = displacement.

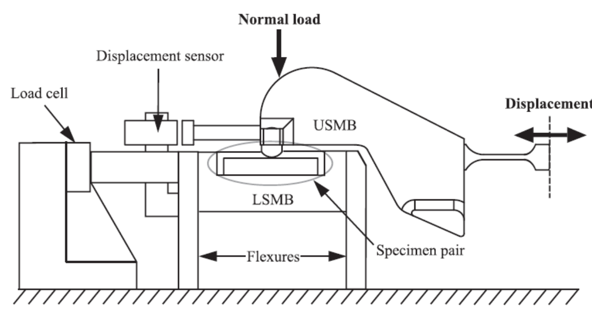

Figure 2: A schematic of the fretting rig.

Table 1: Test conditions.

Cylinder radius, *R* (mm)	**Normal load, *P* (N)**	**Applied displacement, Δ* (µm)**	**Frequency, *f* (Hz)**	**Test Duration, *N* (cycles)**
6, 160	450	100	80	1M

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