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The Behavior of Treated Metal Curvature Cup: Improving Friction in Hard on Hard Sliding Contact

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Abstract

This research investigated the tribology on the metal curvature surface in lubricated of palm olein to determine pits capability friction in hard on hard sliding contact. The study was performed using a four-ball tribotester with holder cup modified and digital microscope. The sliding friction between untreated and treated curve cup were evaluated. The experiment was conducted of constant parameters as speed; load and time under the American Society for Testing and Materials (ASTM), number D 4172. To evaluate lubricant ability all results of this research were compared to findings regarding mineral oil. For qualitative analysis worn wear on the curvature cup without applying lubricant to the sample. The results showed that, the measured friction was low significantly influenced by the treated curvature surface embedded with pits and palm olein as potential anti-friction bio-lubricant.

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Keywords: Metal, Pit, bio-Lubricant, Friction

1. Introduction

In biomedical engineering, the curvature cup surface was investigated as ball and socket in tribology of hip, shoulder, knee and joint prosthesis in medical implant technologies [1-4]. In other application, curvature surface that frequently used on the engine block . Studied on tribological hard hemi-curve surface have been applied in ball bearing , gear tooth in power mechanism system [5,6].

Nowadays, surface modification technology is important on hard curvature cup to reduce friction and wear which may reduce life span of metal based equipment or metal prosthesis. Surface modification on the hard metal with holes, dimples, grit is one of the approaches or machinates for avoiding direct metal – on-metal contact from

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rubbing surfaces [7,8]. Friction and wear mechanism not only destroys the sliding surfaces, but the generation of wear particles which cause cavitation and can lead to the failure of the component function.

Friction between hard on hard (HoH) sliding contact can cause a great deal of wears and tears. The in vivo test approach is one of the experimental techniques which has been proven to identify wear and friction . In this study, authors will be determined the behavior of treated hard curvature cup for improving the friction value and wear figure sliding motion. Sliding motion generates wear determined leading loosening and friction induced from the motion sliding in metal on metal [9].

Friction coefficient decreased depending on the surface pattern, and the dimple such as groove [10]. Thus, the focus of this study is to identified the behavior of pits on hard on hard (ball and curvature surface), that the treated curvature cup with pit in lubricated of palm olein optimize the rate of frictional and allow for a stable of hard on hard sliding contact. Authors also discussed the effect of palm olein and commercial mineral oil for improving the lubrication between hard on hard curvature cup contact sliding.

2. Test specimens, apparatus and procedures

2.1Electrical discharge machine die sinker (EDM DS)

In this study for a successful machining pits on the hard metal of curvature cup using CNC EDM Die sinker machine (EDM DS).

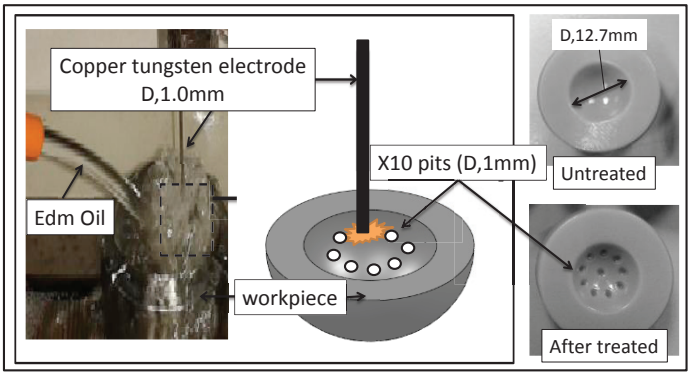

Fig 1. Experiment set up for machining micro pits of hard curvature surface.

The parameters in EDM DS are considered such as current, diameter of electrode Ø, QD_{up} (length of retraction gap distance of electrode),QD_{on}(duration of machine head pulse discharge),T_{on} (discharge on time adjustment),T_{off} (Off discharge time adjustment),V_{gap} (*voltage* during the *EDM* process). Detail of the parameter setting on this experiment is shown in Table I. An electrode radius of 0.5mm was selected for machining pits or holes of 0.5mm for radius and depth on curvature cup workpieces. Fig 1 shows the experiment set up for machining micro pits of curvature cup. The curvature cup is round in shape and curve in the center (flatten). Electrode copper tungsten rod with composition (copper25%, tungsten 75%) is used to machine ten pits on the workpiece.

Table 1- Setting condition for EDM DS neuar A50

Parameters used	***Value set***
Current	0.5 A
Diameter electrode ,Ø	0.5mm
QDup	1mm
QDon	30µs
Ton	0.50µs
Toff	4 stages=10µs
Vgap	60V