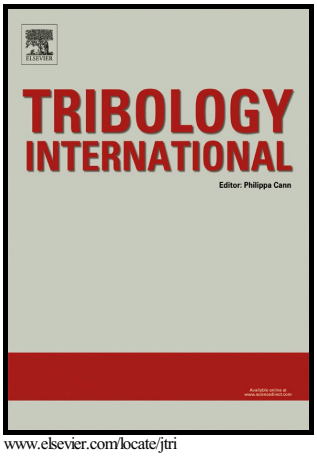

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The use of anisotropic texturing for control of directional friction

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Abstract

This paper presents a study on the influence of anisotropically shaped texture arrays on friction behaviour of an oil lubricated sliding contact, especially on directional friction control based on the diverging and converging characteristics of the textures. Experiments have been conducted on a TE77 reciprocating cylinder-on-plate test rig, where steel rollers were used to slide against steel plate samples with or without textures. A mineral base oil was used to lubricate the contacts. Three geometries of dimples were designed and laser textured on the steel plate samples with varied 3-dimensional features, including Square Flat (SF), Square slope (SS) and Triangular Flat (TF) shapes representing the shape in x-y (top view) and x-z (side view) planes respectively. These shapes were chosen to vary the converging and diverging properties of the lubricated contacts depending on the sliding direction. Relatively large dimple sizes (side length ~$500\mu m$ and depth ~$10\mu m$) have been used in this study to enable observation of the effect and easy control of the texturing process. The texture density has been kept at 10% as most literature suggested. The large dimple sizes resulted that the dimples were not be fully covered by the contact area, i.e. the dimple sides were bigger than the Hertzian contact width of the roller-flat contacts. This has eliminated the 'lift' or 'load bearing' effect discussed in most papers thus focuses on other effects investigated in this study. The results show that beneficial effects of the anisotropic textures present in all lubrication regimes including the boundary, mixed and hydrodynamic lubrications, especially under prevailing boundary lubrication conditions. Using high sampling rate for the friction data during the tests, it was able to study local friction effect due to individual dimple array especially at their leading and trailing edges. The results show that a local friction reduction is observed at the leading while an increase at the trailing edge. Overall directional friction effect of the anisotropic textures has been observed that the converging shape in both y-z plane and the x-y plane reduces friction. Furthermore, it was found that the triangular shape dimples have a greater local frictional response at each dimple array, while the sloped bottom square dimples have a more significant overall directional fricition effect.

Keywords: dimple shape; directional effect; friction reduction; laser surface texturing; reciprocating sliding