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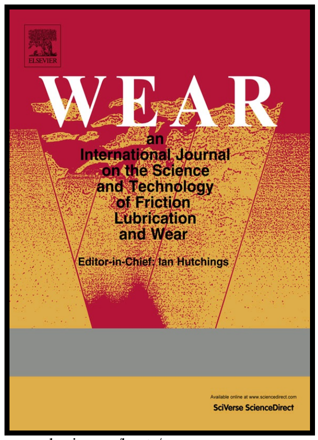

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Effect of surface roughness on friction-induced noise: Exploring the generation of squeal at sliding friction interface

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Abstract

An experimental study was conducted to investigate the influence of surface sandblasting on squeal generation. A reciprocating ball-on-flat sliding configuration was used with two different arrangements that varied in mechanical characteristics. The effects of using grit-blasted surfaces with different roughness on the generation and evolution of squeal were systematically investigated. The generation and intensity of squeal were suppressed and reduced with an increase in the prepared surface roughness. Both surface roughness and the wear of asperities played a key role in the triggering and evolution of squeal. Adhesion and tearing caused by the irregularities, such as the accumulation of wear debris, and particle detachment, were found likely to cause the high-frequency components of the friction force and consequently a higher squeal propensity. The real contact areas of the sandblasted surfaces, generated by the wear of asperities, comprised a discontinuously distributed "contact plateau" on which the surface features mainly indicate wear by ploughing. Therefore, the type of rough surface produced by sandblasting could significantly reduce the formation of the irregularities that in turn contribute to adhesion and tearing. Such factors indicate good potential for reducing and suppressing squeal.

Keywords: Surface roughness, Friction force, Self-excited vibration, Wear topography, Squeal

1. Introduction

Friction-induced noise can easily radiate out if the vibration generated by the friction interface occurs, because the vibration energy must be released to the surroundings. Noise of $f \leq 1$ kHz is usually called flutter, chatter, etc., while noise with f=1–20 kHz is called squeal [1]. The former generally has a low sound pressure level and is easy to control, while the latter, e.g., automobile brake, mechanical gear, wheel/rail of mass transit systems, gearboxes, sliding bearing, hinge joint and artificial joint, is a health hazard, and the road to eliminate it poses many challenges [2–7]. In the past few decades, most research has been concerned with friction-induced noise by virtue of experiments, theoretical analyses, finite element analyses and new ideas such as surface modifications and damping materials, and significant breakthroughs have been made [8–19].

During the interaction process among interfaces, the interface friction and wear put the time-varying char-

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