EFFECT OF LUBRICATION ON THE FRICTION AND WEAR CHARACTERISTICS OF STEEL

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ABSTRACT

In engineering applications, surface wear remains a leading cause of mechanical inefficiency and premature failure of components under sliding contact. This study presents an experimental analysis of the wear behaviour of mild steel using a pin-on-disk tribometer, emphasizing the influence of key operating parameters like load, sliding radius and rotational speed. Tests were conducted under both dry and lubricated conditions, varying normal loads (20 N, 30 N, 40 N), sliding radius (50 mm, 60 mm, 80 mm), and rotational speeds (50 rpm, 75 rpm, 90 rpm). Results demonstrate a direct correlation between increased load and speed with elevated wear rates, particularly under dry sliding conditions, where the absence of lubrication intensifies frictional interactions and material removal. In contrast, the application of lubricant significantly reduced wear, highlighting its efficacy in minimizing surface contact, heat generation, and friction-induced damage. The findings provide valuable insights into the mechanistic behaviour of mild steel under sliding contact and offer practical guidance for optimizing material performance in tribological applications. This work contributes to the broader understanding of wear mitigation strategies and the selection of operating conditions to enhance durability in engineering systems.

Keywords: *Wear behaviour; Mild steel; Pin-on-disk tribometer; Lubrication; Sliding contact; Tribological performance*

1. INTRODUCTION

Progressive material loss during sliding contact between surfaces continues to be a significant degradation mechanism in mechanical systems. Detrimental effects observed on component longevity, functional dependability, and maintenance expenses. Applications like shafts, gears, bearings and bushings that involve frequent surface interactions are particularly vulnerable to this phenomenon. Mild steel is frequently chosen among the materials utilized in these situations because of its favorable mechanical qualities, affordability. However, when subjected to extended sliding or varying loading conditions, its comparatively low hardness and susceptibility to plastic deformation under stress render excessive adhesive and abrasive wear. In recent years, a growing body of tribological research has explored the wear behaviour of mild steel under various conditions. For instance, Verma et al. [1] conducted a detailed investigation on the tribological behaviour of mild steel under dry sliding, where variations in load, speed, and temperature led to a marked increase in wear rate. A complementary work by Hernández-Ramírez et al. [2] and Sánchez-Islas et al. [3] focused on surface modification via boriding, which was found to significantly improve the wear resistance of AISI 1018 steel in dry sliding conditions. Karthikeyan et al. [4] expanded on these results by contrasting other mild steel grades under the same test conditions, showing that alloy composition has a significant impact on wear performance. In order to make parameter-driven testing easier, Kuszewski et al. [5] developed a modular tribometer capable of controlling variables such as normal load, speed,