ME PhD Thesis Colloquium

Influence of surface topography and roughness on lubrication, friction and scuffing in high hardness steels

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Meeting link: Click here to join meeting **(Microsoft Teams)**

ABSTRACT

In engineering tribology, controlling friction and wear is a significant challenge. The Frictional variations and scuffing-wear can be highly influenced by surface topography and lubrication. In the present work, experimental studies were carried out to explore, understand and predict the influence of surface topography and roughness of hardened steels on lubrication, frictional variations, and scuffing in lubricated conditions. For this, EN31 60HRC hardened tool steel flats with Unidirectional Perpendicular (UPD), Unidirectional parallel (UPL), and 8G topographies with roughness ranging from ~Ra 886 nm to ~ 79 nm were used. The lubrication behavior studies using an industrial-grade lubricant revealed that the wettability increases with an increase in roughness in the higher range of ~Ra 886 to 236 nm and with a decrease in roughness in the lower range of ~Ra 151 to 79 nm. In terms of topographies, UPL exhibited the least lubricant retention capability. It was also observed that all roughness frequencies in a hierarchical rough surface contribute to the net Ra or RMS roughness; however, a critical range of roughness frequencies dictate wettability transitions. The friction and scuffing wear studies using SAE52100 steel countersurface revealed that, in some cases, the sliding interactions in the initial cycles lead to a 'peak friction,' and this was accompanied by scuffing. The existence of peak friction was found to be dependent on surface topography directionality. The influence was predominant in the higher roughness range of ~Ra 880 nm to ~ 600 nm. Reduction in surface roughness lowered the influence from topography directionality and resisted scuffing. Surfaces with UPL topographies, higher correlation lengths, negative skewness, higher surface energies, and higher roughness were found to be more prone to scuffing. The entire experimental study gives insights into the selective determination of surface topography and roughness combinations to prevent scuffing and improve the efficiency of interacting tribo-components in practical engineering applications.

ABOUT THE SPEAKER

Vimal Edachery is a Ph.D. student in the Dept. of Mechanical Engineering, IISc. His research interests includes Tribology, Surface Engineering, Composites, Manufacturing, Materials characterization, and Mechanical behaviour of Materials. He works with Prof. Satish V. Kailas in the Surface Interaction and Manufacturing Lab, IISc.