Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXXIII, págs. 129-145 (artículo completo)
Graciela Bertolino, Mariano Cantero, Mario Storti y Federico Teruel (Eds.)
San Carlos de Bariloche, 23-26 Setiembre 2014

TRIBOLOGICAL PERFORMANCE OF TEXTURED SURFACES IN THE PISTON RING/LINER CONTACT USING THE ELROD-ADAMS MODEL

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Keywords: Friction reduction, textured surfaces, piston ring, Elrod-Adams model.

Abstract. The possibility of improving the performance of lubricated surfaces through surface texturing has been a topic of intense research in the latest years. Considerable efforts in both experimental and numerical works have been made to study the effects of micro-textures in load capacity, friction and wear. In the industry it has been known for a long time that some texturing is required in the liners of combustion engines to avoid stiction with the piston rings. The numerical simulation of that problem poses a challenge in modeling the intervening phenomena (cavitation, starvation, ring dynamics) and solving it efficiently.

In this work we present numerical simulations of the piston ring/liner problem in the hydrodynamic lubrication regime using the Elrod-Adams model and a mass-conserving algorithm. Realistic values are assumed for the parameters defining the problem. The formation of cavitation bubbles and its relation with the load-carrying capacity, friction and clearance is analyzed by considering different texture configurations and shapes in one-dimensional tests. Afterwards, two-dimensional dimpled surfaces are simulated for more than a hundred different texture configurations in the hydrodynamic lubrication regime for several Stribeck numbers. A robust code accelerated by means of a multigrid implementation allowed the realization of this extensive study. Results show that friction and wear reduction are attainable by virtue of dimples of the size of the contact, although the gain decreases or disappears as the mixed lubrication regime is approached.