ROLLING CONTACT FATIGUE BEHAVIOUR OF NITROALLOY STEEL (CRONIDUR 30) UNDER VARIED SLIP CONDITIONS

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ABSTRACT
The high nitrogen steel, commonly referred to as Cronidur-30 (CR-30), has emerged as a promising material for future aerospace system bearings, prioritizing enhanced reliability [1]. Despite being commercially available for over two decades, comprehensive studies on its rolling contact fatigue (RCF) and wear behaviour under various slip conditions remain limited. This research addresses this gap by experimentally evaluating the performance of CR-30 material under zero slip, partial slip, and full slip conditions. AISI 440C steel, a widely used aerospace bearing steel, was chosen as a reference material and against which the RCF and the wear performance CR-30 were compared. All experiments are conducted utilizing a twin-disc-on-cylinder test rig [see Fig. 1(f)].

Load and speed parameters are selected to fall within the mixed lubrication regime. A detailed calculation of the minimum film thickness and specific lubricant film thickness is elaborated upon in our previously published article [2]. The experimental findings reveal notable insights into the behaviour across different slip conditions. Under pure rolling conditions, CR-30 exhibits significant improvements compared to AISI 440C, highlighting its potential for enhanced reliability in aerospace applications. However, contrasting outcomes emerge under partial and full slip conditions, where CR-30's performance notably deteriorates. The scanning electron micrographs of cronidur-30 and AISI 440C wear track under 0% and 0.5% slip conditions are depicted in Fig.1(a-d) and the corresponding wear volume removal is compared in Fig.1e. This observed variation in performance under slip conditions primarily stems from the carbide size effect inherent in the material.

In conclusion, this study contributes to a deeper understanding of CR-30 behaviour under varied slip conditions, offering valuable insight for material selection and design optimisation in aerospace applications. Strategies aimed at mitigating the adverse effects of carbide size on material performance could reveal CR-30's full potential as a reliable bearing material across a range of operational conditions.

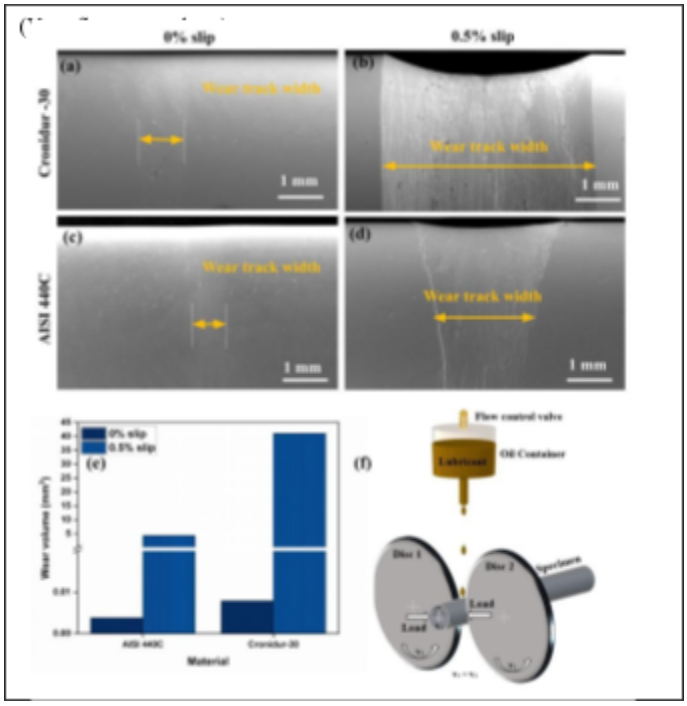

Fig.1 (a-d) SEM of Cronidur-30 and AISI 440C wear track under 0% and 0.5% slip conditions, (e) Wear volume results from RCF tests (f) RCF twin discs-on-cylinder setup

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