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Impact of Ball Bearing Geometry and Operational Load on the Volume of the Lubricant in the Bearing's Loaded Zone

Ljubojević Pavle[a*], Ćoćić Aleksandar[b] and Lazović Tatjana[c]

University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia

[a*]pljubojevic@mas.bg.ac.rs, [b]acocic@mas.bg.ac.rs, [c]tlazovic@mas.bg.ac.rs

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Abstract. This paper presents the mathematical model for determining the quantity of lubricant in contact between balls and raceways of a deep groove ball bearing. In the deep groove ball bearing, balls participate in transferring the load from one ring to another, as they pass through the contact zone [1]. In doing so, the balls are in mutual elastohydrodynamic lubrication (EHL) contact with the raceways [2]. In the EHL contact between the balls and the raceway, there is a certain amount of lubricant between contacting surfaces. The volume of lubricant in contact can be determined as the product of the contact zone's area multiplied by the thickness of the lubricant film between them. The relationship between the lubricant volume V_{Lq} (q = 1 for ball-outer ring contact, q = 2 for ball-inner ring contact) within the contact zone and the relative radial clearance e/δ_0 (e – radial clearance; δ_0 – contact deformation between ball and raceway) as well as the relative operational load F_R/C (F_R – operational load; C – bearing dynamic load rating) of the deep groove ball bearing 6206 is shown in Figure below.

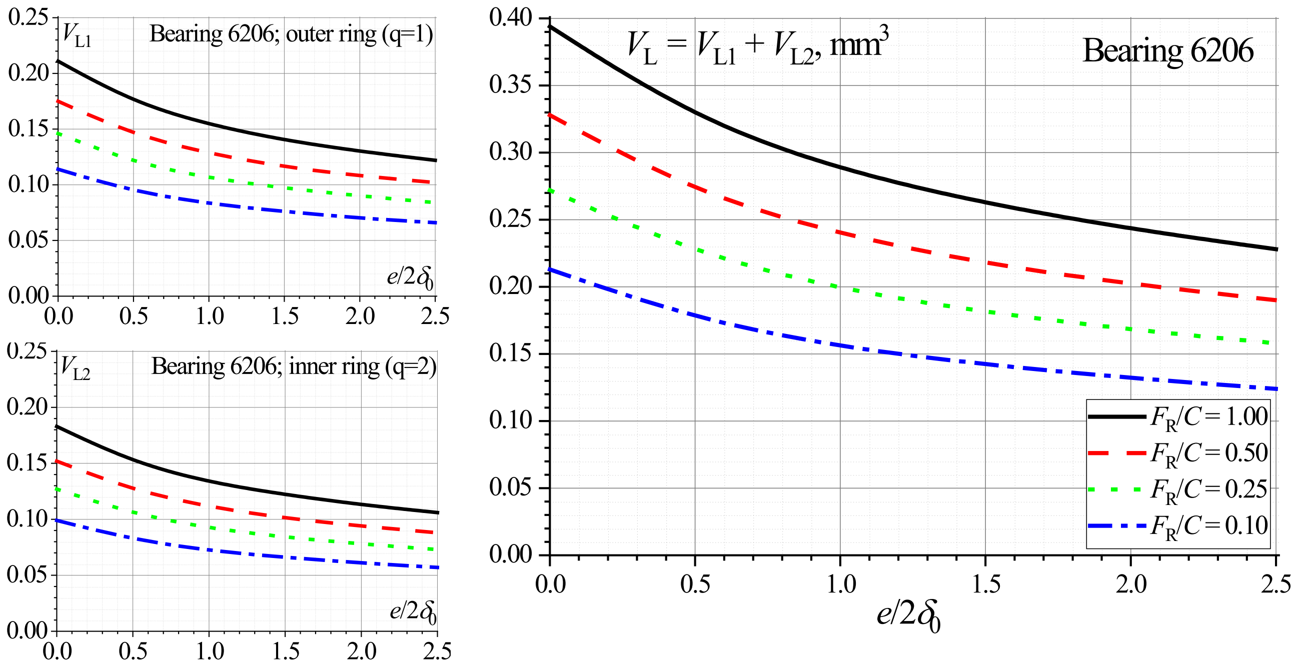

Figure 1. Amount of lubricant within the contact zone between balls and raceways.

Based on known quantity of lubricant volume V_L within the both contact zones, it becomes possible to estimate the concentration of contaminating particles that are entrapped in contact between balls raceways. This estimation can be related to the overall known concentration of abrasive particles within the bearing lubricant. Through this approach, it becomes feasible to assess and predict the level of abrasive wear occurring within bearing components during operation.

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