World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:19, No:01, 2025

Investigations Of The Service Life Of Different Material Configurations At Solid-lubricated Rolling Bearings

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Abstract : Friction reduction is an important aspect in the context of sustainability and energy transition. Rolling bearings are therefore used in many applications in which components move relative to each other. Conventionally lubricated rolling bearings are used in a wide range of applications, but are not suitable under certain conditions. Conventional lubricants such as grease or oil cannot be used at very high or very low temperatures. In addition, these lubricants evaporate at very low ambient pressure, e.g. in a high vacuum environment, making the use of solid lubricated bearings unavoidable. With the use of solid-lubricated bearings, predicting the service life becomes more complex. While the end of the service life of bearings with conventional lubrication is mainly caused by the failure of the bearing components due to material fatigue, solid-lubricated bearings fail at the moment when the lubrication layer is worn and the rolling elements come into direct contact with the raceway during operation. In order to extend the service life of these bearings beyond the service life of the initial coating, the use of transfer lubrication is recommended, in which pockets or sacrificial cages are used in which the balls run and can thus absorb the lubricant, which is then available for lubrication in tribological contact. This contribution presents the results of wear and service life tests on solid-lubricated rolling bearings with sacrificial cage pockets. The cage of the bearing consists of a polyimide (PI) matrix with 15% molybdenum disulfide (MoS2) and serves as a lubrication depot alongside the silver-coated balls. The bearings are tested under high vacuum (pE < 10-2 Pa) at a temperature of 300 °C on a four-bearing test rig. First, investigations of the bearing system within the bearing service life are presented and the torque curve, the wear mass and surface analyses are discussed. With regard to wear, it can be seen that the bearing rings tend to increase in mass over the service life of the bearing, while the balls and the cage tend to lose mass. With regard to the elementary surface properties, the surfaces of the bearing rings and balls are examined in terms of the mass of the elements on them. Furthermore, service life investigations with different material pairings are presented, whereby the focus here is on the service life achieved in addition to the torque curve, wear development and surface analysis. It was shown that MoS2 in the cage leads to a longer service life, while a silver (Ag) coating on the balls has no positive influence on the service life and even appears to reduce it in combination with MoS2.

Keywords : ball bearings, molybdenum disulfide, solid lubricated bearings, solid lubrication mechanisms
Conference Title : ICTIE 2025 : International Conference on Tribology and Interface Engineering
Conference Location : Sydney, Australia
Conference Dates : January 28-29, 2025