Tribological Characterization of Iron Based Ceramic Reinforced Self- lubricating Material

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Abstract. In this paper, the effect of ZrO_2 reinforcement and MoS_2 as solid lubricant on tribological properties of iron-copper-tin composite for plain bearing application have been investigated . This paper includes two studies, one in which wt% of MoS_2 is varied keeping wt% of ZrO_2 constant and in another wt% of ZrO_2 is varied keeping wt% of MoS_2 constant to see the effect of ZrO_2 as reinforcement and MoS_2 as a solid lubricant for improving tribological properties of sintered Fe-Cu-Sn material. The material was prepared by sintering at temperature of 1150 °C. The tribological properties of developed materials were analysed by ball on disk test.Least value of COF 0.0421 is shown by sample with 2 wt.% of MoS_2 and 2 wt.% of ZrO_2. Least wear rate of 0.4581×10^{-4} mm\Nm for sample with 2 wt.% of MoS_2 and 2 wt.% ZrO_2.Characterization of worn surfaces revealed abrasive and adhesive wear including third body abrasive wear, delamination and micro-ploughing in reinforced composites. The addition of MoS_2 has improved tribological properties, whereas ZrO_2 addition not only improved tribological properties, but also improved strength and hardnessof the composite. Maximum hardness value 208HV (701.4MPa) is shown by the composite with 2 wt.% of MoS_2 and 2 wt. % of ZrO_2. The findings show that the developed material could be used for antifriction andantiwear plain bearing applications.

Keywords: Iron based composites, ceramic reinforcement, ZrO_2 , MoS_2 , self lubricating material, Friction, Wear, Plain bearing material.

1. Introduction

Plain bearings are mechanical elements used to reduce friction between rotating shaft and stationary support members.Plain bearings are used primarily in machinery that has a rotating or sliding shaft component.Plain bearings are used in very critical applications where failure of bearings might have severe consequence, example in turbomachines,such as power plant steam turbines,compressors operating in critical pipeline applications,etc. Plain bearings are subjected to extreme conditions of load, temperature and velocities at operational stage.Various materials have been developed to withstand these extreme conditions.Plain bearing materials are developed by various techniques, Powder metallurgy iron based materials, due to their low cost and excellent mechanical properties hold a significant place in industrial sector. Using powder metallurgy, iron (Fe) based composites are tailored to achieve desirable properties [1].The research and production of iron-based self-lubricating materials is considerably increasing, due to their higher strength, ease of availability and low cost iron powders in the last decades [2,3]. Adding copper and tin to Fe matrix, stabilizes its pearlite structure,that improves strength and corrosion resistance, and also has a rapid surface diffusion over solid iron[4]. Moreover, to reduce friction,solid lubricants are preferred for eg.,graphite, MoS_2 etc. Such