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Performance Analysis of Polytetrafluoroethylene as Journal Bearing Material

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Abstract

In this study, the friction and wear behaviour of solid lubricant polytetrafluoroethylene (PTFE) reinforced with carbon, MoS2, glass fiber, polyether ether ketone (PEEK) particles are tested as journal bearing material with respect to varying high loads, under dry and wet condition against AISI SS 304 stainless steel using a pin-on-disc arrangement. Compared with pure PTFE, introduction of the fillers made composites have longer wear life. Among the all PTFE composites under experimental investigation due to friction and wear mechanism the lowest wear loss is observed for the composite of PTFE composite reinforced with 15 % Glass fiber + 5% MoS2 particles by weight for the values of loads and sliding velocity.

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*Keywords:*polytetrafluoroethylene; wear; composites

1. Introduction

Solid lubrication is an attractive option for the design engineer for a variety of reasons, including, simplicity, cleanliness, low expense, quiet operation, low maintenance, and high temperature capability. Often, a design necessitates a low wear solid lubricant either for long life or to maintain proper kinematics. There are significant efforts dedicated to the research and development of such solid lubricants; polymers and polymer composites are commonly used as solid lubricants. In recent times, there has been a remarkable growth in the large-scale production of polymers and polymer matrix composites. Polymer composites are being more and more used as structural components that are very often subjected to friction and wear while loadings. In certain situations, the coefficient of friction is of the highest importance, but largely it is the mechanical load-carrying capacity and the wear life of components that determine their acceptability in industrial applications under different operating conditions [1].

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PTFE is a kind of self-lubricating material having super low coefficient of friction, outstanding corrosion resistance, chemical inertness and wide service temperature range. PTFE is a frequently used as a solid lubricant both as a filler and matrix [3]. PTFE is currently finding increasing utility in high performance mechanical seals due to its unique properties like high chemical resistivity, low coefficient of friction and high temperature stability. However, its application has been greatly limited due to its poor mechanical properties, high linear expansion coefficient, bad thermal conductivity and poor wear and abrasion resistance. The wear resistance of PTFE can be significantly improved by addition of suitable filler materials. Besides the type, the shape and size of the materials added also influence the tribological properties. In the past, research in this area has been confined to the PTFE filled with conventional filler materials like glass fibers, graphite, carbon fibers, etc. [2].
Therefore the concern work investigates the comparative analysis of PTFE composites that how tribological properties of solid lubricant PTFE can be improved as a journal bearing surface material for high load and low velocity applications like sugar cane mill bearing. The influence of normal load, sliding speed and percentage of composites are discussed in results and discussion.

2. Experimental work

2.1. Preparation of PTFE based composite

These fillers are chosen because of the following two considerations. Firstly, they have simple components and broad applications. Secondly, these fillers are so different in physical–chemical properties that we can get a comprehensive understanding of the effect of fillers on properties of composite, especially, the wear behaviour of the composite and corresponding transfer film and to developed upon the earlier study of PTFE based composites. According to the provider's communications, the PTFE samples come from a process of compression moulding of the PTFE and filler powder mixtures, and subsequently sinterization and cooling. The proportions of fillers in the composite are shown in Table 1.

Table 1.PTFE composites

Sr. No.	Sample
1	PTFE
2	PTFE+25% Carbon
3	PTFE+15% Graphite
4	PTFE+10% PEEK
5	PEEK+15% Glass Fibre+ 5% MoS_2

2.2. Friction and Wear Testing

The friction and wear behaviour of solid lubricant PTFE reinforced with carbon, MoS2, glass fiber, PEEK particles against AISI SS 304 stainless steel were carried out using a pin-on-disc arrangement for sliding velocity of 0.09, and 0.12 m/s and each normal load of 159.16 N and 184.02 N under dry and wet condition using a Pin-on-Disc Tribometer. As per ASME G99 code, testing was carried out for 60 minutes for each sample pin.

3. Results and Discussion

3.1. Friction and Wear Behaviour

- Discussion at Dry Condition

The variations in total wear loss of PTFE composite sample with normal load under dry condition are shown in fig.1 for the normal loads of 16.23 kg and 18.76 kg. It is seen from these figures that for the selected range of normal load, the total wear loss due to friction and wear increases with increase in load. This may be due to the faster peeling-off of transfer films with increasing load and velocity. The variations in coefficient of friction with normal load under dry condition are shown in fig.2 for the normal loads of 16.23 kg and, 18.76 kg. It is observed from the above figures that for the selected range of normal load and sliding velocity, the coefficient of friction decreases with the increase in load. This may be due to stability of the transfer film.