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To analyse the behaviour of AISI 4340 steel under lubricated condition using Pin On Disc apparatus

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Abstract
In the sliding pairs, friction and wear are the core reasons for energy losses that reduce the efficiency of the mechanical systems. This paper presents an experimental study to predictthe frictional and wear behaviour of AISI 4340 steel under lubricated conditions.
The experiment was conducted on a pin on disc machine in which EN-31 steel disc was used as a counter surface. The tribological characteristics of AISI 4340 material were observed under different loads varied as 30N and 90N at a fixed sliding distance of 1500m at a continuing speed of 1.0, 1.5, 2.0, 2.5 m/s. It was found that variation of load and sliding distance plays a crucial role in frictional force and wear behaviour of the gear material. The wear and tear of AISI 4340 steel was found to be increased with sliding distance. Load is the significant factor which liable for wear loss. The result showed that all loads the COF was minimum at the sliding speed of 2.0 m/s and COF increases with the rise in sliding speed.
Keywords: Sliding Speed , Sliding Distance, Pin on Disk, Coefficient of Friction , Normal Load

Introduction

When the surfaces of two or more components of a machine interact, various types of wear occur [1]. Under severe pressures, abrasion, sliding, and contact fatigue can cause more frequent and complex surface and subsurface damage to wear behaviour [2–4]. Scuffing occurs when the load and sliding speed cause an impulsive impact on the material's surface during operation. Better gear life is obtained by surface modification methods for several years [5–7]. Friction is the resistance to motion that occurs when a solid slides across another body. Wear, on the other hand, is a difficult concept to define clearly and completely [8]. There's also no way to totally eliminate friction from sliding pairs. Oiling is the most effective way to reduce friction between moving parts. An oil film is placed between the contact surfaces of moving parts to reduce wear [9]. Wear and friction can be easily decreased by using lubricants. It's a really effective way to lessen the effects of wear and tear. When executing an operation, friction occurs. We must use extreme caution while selecting the kind of lubricant to be utilised in the operation [10]. Wearing behaviour using tribometers required to minimize friction and wear of materials. The wear rate of the material can be assisted by using digital balances to calculate weight loss.
A tribometer is a device that allows pin-on-disk or ball-on-disk tests to be performed with precision. The best application of the tribometer device was used to conduct dry or lubrication type wear tests. The tribometer allows researchers to investigate tribological behaviour while altering pressure of contact, rubbing speed, time, and lubricants [11,12].

Materials and methods

AISI 4340 alloy steel was utilised as specimens for the experimental study. The major components of this alloy steel are Mn and Cr, which provide it with excellent strength and toughness. Specimen with a dia(d) of 10 mm and a length of 40 mm was used. Such pins were used because round heads of pins have proper contact with revolving disc. To achieve a hardness of 46 HRC, heat treatment was conducted. The Rockwell hardness machine was used to where the hardness of pins was tested using a diamond ball intender with a load of 150 kg. Chemical composition of work piece AISI 4340 is displayed in the following Table 1.

The hardness of the disc utilized in this wear test was 62 HRC . The disc was made of EN 31 material and the lubricant used for this wear test was SAE 80W-90 gear oil. The process parameters used in this investigation were sliding distance, sliding speed and varied loads. The setup of pin on disc is depicted in Figure 1.
Eightsample of pieces are used in order to determine the weight loss and COF values. For experimental work, sliding speeds of 1, 1.5, 2.0 and 2.5 m/s were employed with two different normal loads of 30 N and 90 N and sliding distances was fixed to 1500 m. Denver electronic machine was used to weigh the specimen. The specimens are washed in acetone before being cleaned. The difference between the original and final

weight loss values, as well as friction, was calculated to determine wear weight loss.

Fig.1. Pin on Disc Apparatus

TABLE 1. Chemical composition of the pin and the disc.

Material	C	Mn	P	S	Cr	Mo	Si	Al	Cu
AISI-4340	0.420	0.750	0.006	0.03	0.79	0.25	0.270	0.030	0.210
EN-31	1.03	0.4562	0.007	0.04	1.50	0.02	0.328	0.03	

Experimental design

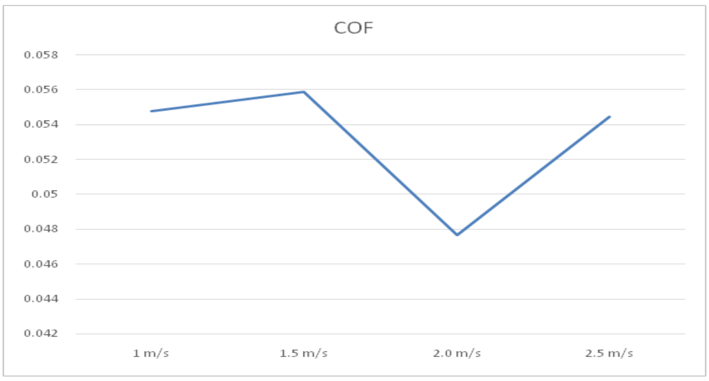
Under lubricated conditions, research was conducted as per ASTM G-99-17 standard. The results that was seen are shown in Table 2.

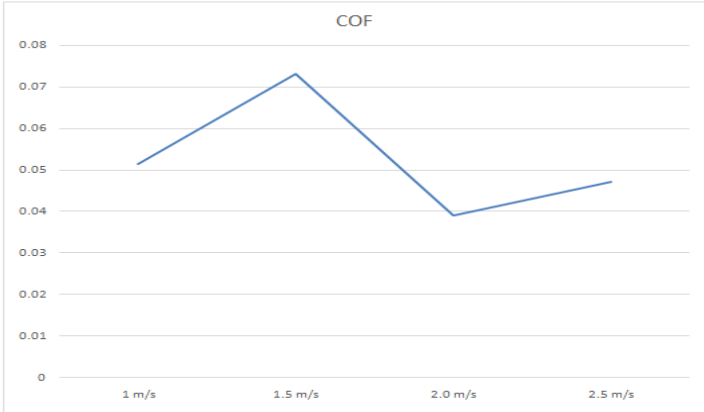
2-COMBINITION OF PARAMETER AND LEVELS

LOAD(N)	SPEED (m/s)	SLIDING DISTANCE (m)	C.O.F (μ).
90	0.5	1500	0.05476
90	1.0	1500	0.055876
90	1.5	1500	0.047651
90	2.0	1500	0.054423

Results

1-Graph between COF and sliding speed when applied load is 30N and sliding distance fixed 1500m





LOAD(N)	SPEED (m/s)	SLIDING DISTANCE (m)	C.O.F (μ).
30	1.5	1500	0.073214
30	2.0	1500	0.039138
30	2.5	1500	0.047303
30	2.5	1500	0.047303

1. COMBINITION OF PARAMETER AND LEVELS

Conclusions

1. At lower loads such as 30N the value of COF increases with the increase in the sliding speed from 1.0m/s to 1.5m/s and COF is minimum at the 2.0 m/s and then COF gradually rises with increase in the sliding speed.
2. At the higher load such as 90 N the value of the COF firstly slightly rises from when speed changes from 1m/s to 1.5 m/s and then COF value fall down at 2.0 m/s but after that COF abruptly increases. The result show that irrespective of the loads the COF is minimum at the 2.0 m/s sliding speed and then COF increases at the 30 N and 90 N loads
3. The weight loss rised with the increase in normal load as well as sliding distance. The amount of wear loss is high when load increases gradually as compared to sliding distance. Thus the load is the most significant parameter in this study

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