SOME INVESTIGATION ON WEAR MEASUREMENTS

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Abstract: Wear means a damage of material or removal of material when they come in facial contact with each other, many publishers have conducted an experiment on wear test, and results produced in their own way like volume loss, weight loss, and weight loss per unit time so on. To understand a wear behavior, one wear investigations carried out on a two different specimens under the influence of Pin-on-Disc test machine. The results of above testing investigations states volume loss per unit sliding distance gives a better understand of wear behavior, however normal load is not to consider for the further wear calculations, one must be consider to get a appropriate wear results normal pressure.

Keywords: Wear measurement, volumetric wear rate, specific, normalized.

I. INTRODUCTION

Wear means a loss or removal of material due to the relative motion between the surface and the contacting substance or substance. And Wear is defined by American society for testing and materials (ASTM) as a “damage” to a solid surface [1]. This may influence a component lead to failure gently, in order to design a cost-effective and cost-efficient and a reliable product , the tribological operating limits of applied materials need to be exploited. One approach to examine the wear behavior of contacts is to perform test on model system such as Pin-on-Disc or ball-on-disc test conducted [1]

Archard’s Equation:

$$Q = \frac{k*W*L}{H} \text{ --(1.1)}$$

Where,
k: dimensionless constant.
Q: is the total volume of wear debris (mm3).
W: normal load (gm).
L: sliding distance (mm).
H: hardness (gm/mm2).

Wear test is carried out to determine the amount of materials removed after a wear test. The loss of material can be expressed as in weight loss, volume loss or height loss.

So many authors have studied in their own way, some of them are impractical to change over into volume loss per unit sliding separation, Some of them are impractical in light of the fact that not accessibility of point by point parameter of operation conditions[2].

II. EXPERIMENTAL PROCEDURE

The test bench was used to conduct the wear experiments is (DUCOM TR-20LE,) to achieve this, the 2 samples were considered of same length of different diameter of Diameter 6mm and Diameter 10mm represents a ASTM G99 standard. The initial and final weight of the both the specimens graduated individually back and forth of the test and noted. Select the new track diameter so that to get an appropriate results and the disc on which specimen mounted cleaned with an emery paper and each specimen was attached to the holder which was a block of a carbon steel. Wear debris found by each test, these debris have to be removed and then weight test is graduated. The wear rates wear determined by weight loss, volume loss and height loss above experiments were repeated till the accurate wear rate is found [2].

2.1 Fixed Variable and moving variable [2]

Fixed variable	Variables
Al-6063 grade	Specimen size 6mm Dia and 10mm Dia.
Track distance 130mm	Load 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0. kg
Sliding distance 2500m	Speed 0.5, 1.0, 2.0, 3.0, 4.0. m/s.

2.2 Estimation of time for 0.5m/s speed.

$$\text{Velocity}=\frac{\pi*D*N}{60*1000} \text{ --------------------------------------(2.1)}$$

Where 1000 is conversion factor

$$0.5=\frac{\pi*130*N}{60*1000} \text{ ---(2.2)}$$

N=73.456 rpm
w.k.t 1rev=π*D
1rev= π*130=408.40rev ----------------------------(2.3)
Time for above rotation

$$\text{Time}=\frac{2500*1000}{408.40*73.456} \text{ -----------------------------------(2.4)}$$

Time=82.60 ≅ 83min.
Wear rate formulae:

1. Linear wear rate (μm/m).
   K1= [thickness of layer removed] / [sliding distance].
2. Volumetric wear rate (mm^3/m).
   Kv= [height loss * cross section area of the pin] / [sliding distance].
   Kv= [weight loss / density] / [sliding distance]
3. Wear coefficient (dimensional less).
   V=kWL / H
   k=[volume of the material removed* hardness] / [load applied*sliding distance].
4. Specific wear rate (mm^3/N-m).
   Ws= [volume of material removed] / [normal load * sliding distance]
5. Energy wear rate (mm^3/N-m).
   Ke= [volume of layer removed] / [work of friction].
6. Volume loss (mm^3).
   V= [weight loss] / [density of the material].
7. Normalized wear rate (dimensional less).
8. Wn= [volume loss] / [sliding distance * cross section area].

III. RESULTS AND DISCUSSION

Numerous specialists have measured the wear in various ways like weight reduction per unit time, weight reduction per unit separation, volume loss per unit time, volume loss per unit sliding separation, height loss per unit sliding separation, weight reduction per unit rpm, volume loss per unit rpm, height loss per unit rpm like this. So it is exceptionally hard to comprehend their outcomes furthermore it is verging on difficult to contrast their outcomes and alternate looks into. So it is exceptionally key to make a one standard estimation, so it ought to be straightforward and conceivable practically identical with alternate analyst's results [3].

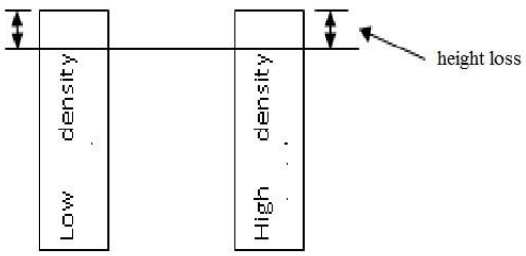

Fig. 3.1, Height loss

Fig 3.1 shows it can be said as, if the height loss of the material under same operation conditions for various thickness materials is same then if weight is considered, weight reduction is more for higher thickness material and weight reduction is less for low thickness material. Despite the fact that, the volume loss is same for two materials. Since the cross sectional and height loss is same for two materials. Consequently, it is ideal to consider the volume loss strategy for exploration work. Typically wear test will be directed on Pin-on-Disk wear testing machine. While leading the wear test, track width on the circle, rpm of the plate and typical burden will be chosen to direct the wear test. Numerous analysts have considered the rpm as a particular sliding rate for their examination work and talked about upon the rpm itself. Rpm is the insurgency every moment. In the event that the track width is little then sliding distance per unit time is low though if the track measurement is all the more then sliding separation is more for a specific settled rpm.

$$v = \frac{\pi * D * N}{1000} \quad \text{---------------------------(3.1)}$$

v – Speed (m/minute).
D – Track diameter (mm).
N – Rpm (Revolution per time).
1000 – Conversion factor to convert mm into meter

Speed is a component of rpm and track width. On the off chance that the track breadth is less then more rpm is required for the same velocity. While if the track measurement is all the more, then low rpm is required of the same speed. Henceforth, rpm (N) ought not be considered but rather speed (v) ought to be considered for the exploration work. Amid wearing, at first a little partition of the example will come in contact with the sliding plate. Later gradually the range of contact will increment with the sliding separation. Thus at first because of low contact zone for a settled ordinary load the anxiety is high. Henceforth the wear loss in height is more. With expansion in contact territory the wear loss in height is diminished. Once the just about 100% evident contact as shown in fig 3.2 & 3.3

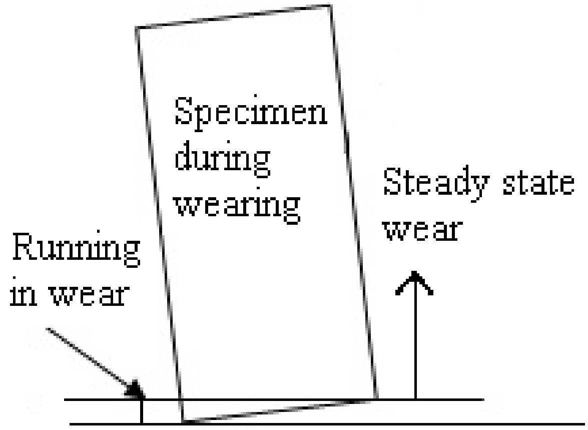

Fig. 3.2 Position of the pin during wearing

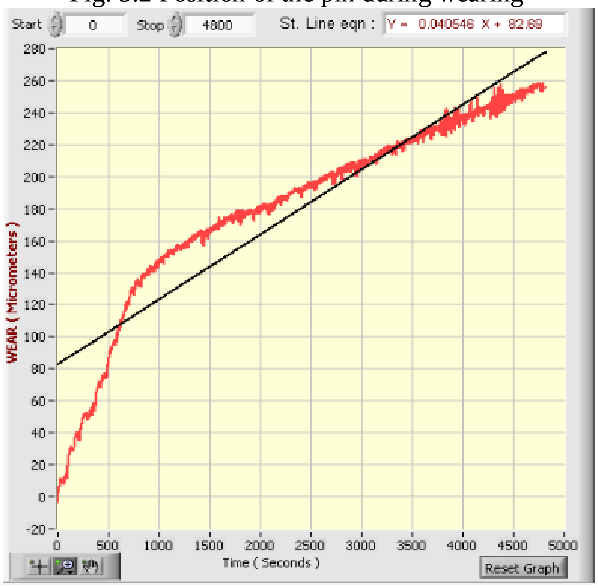

Fig. 3.3 Effect of time on height loss of the wearing pin

Subsequently wear rate is to be evaluated amid this period. The wear rate is height loss per unit time. At that point the time ought to be changed over as far as separation. At that point this height loss will be changed over into volume loss by duplicating with the cross sectional zone of the sample. Henceforth, wear rate can be evaluated as far as volume loss per unit sliding separation.

Height loss estimation: Usually all scientists have considered the height loss strategy for their examination work. Amid pin on circle wear testing, at first the pin is in not verging on obvious contact with the sliding plate. This is called running in wear. Amid running in wear the wearing surface of the pin goes on expansions till it comes to very nearly 100% obvious contact zone of the pin. Once the right around 100% obvious contact range happens, then the height loss will practically in the same incline and this is known as the enduring state wear. Along these lines, the height loss ought to be considered amid the relentless state as it were [4].

3.1 Specific wear rate

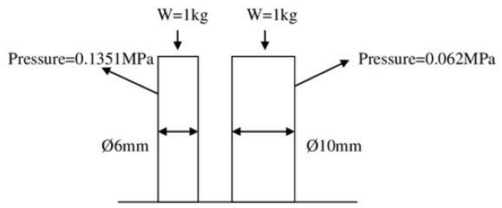

Fig. 3.4, Different wearing size pins.

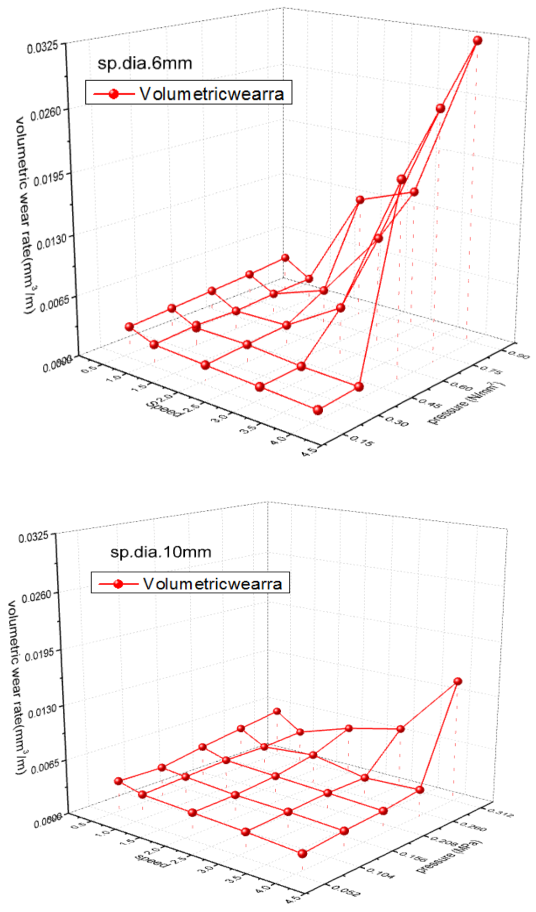

Fig. 3.5, Effect of Pressure and Speed on Volumetric wear rate for 6 & 10 mm diameter specimens.

Volumetric wear rate is volume loss per unit sliding separation; volume loss is the more proper one than weight reduction. Sliding separation is more fitting one than time and rpm. Thus volumetric wear rate is superior to anything all wear estimations [5]. The typical burden will be connected on example amid the wear. Despite the fact that the heap is same on the distinctive cross sectional zone of the example, then the comparing weight on every example differs. As the distance across of the pin diminishes the typical weight on the wearing surface increments. Consequently, it is ideal to consider the ordinary weight than the typical weight as shown in above figures.

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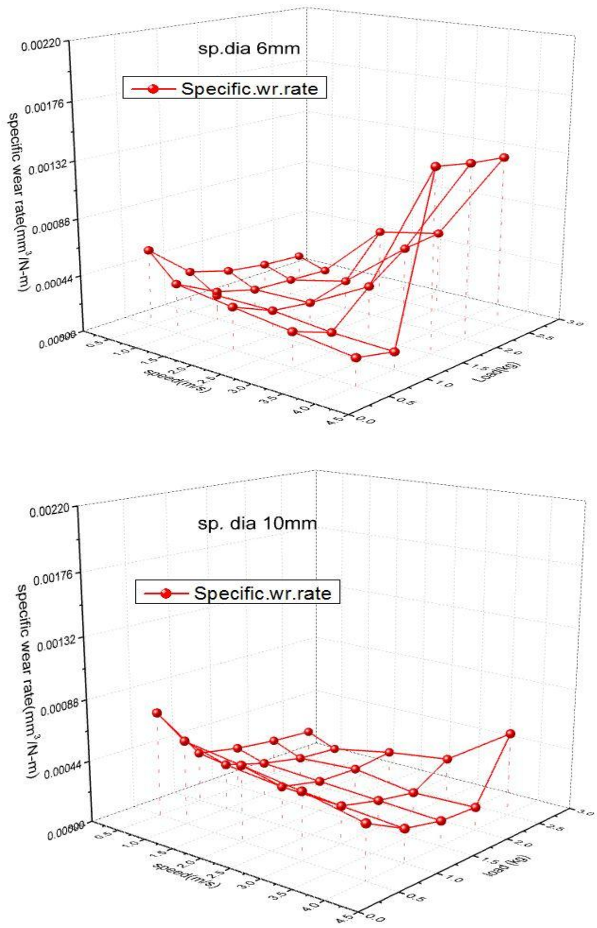
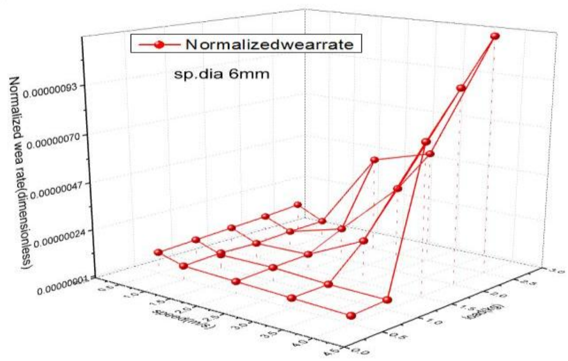


Fig.3.6 Effect of Load and speed on Specific wear rate for 6 & 10 mm diameter specimens

Figure 3.6 represents a Particular wear rate is the proportion of volumetric wear rate to the ordinary burden. When this is the proportion, then the Specific wear rate continues as before when volumetric wear rate increments in numerous of ordinary burden. At that point the Specific wear rate continues as before with expansion in the typical burden, despite the fact that the genuine volumetric wear rate is expansion with the ordinary burden. The particular wear rate increments with the ordinary burden, if the particular wear rate is more than the various of typical burden and the same is abatements with ordinary burden if the particular wear rate is numerous of not exactly the ordinary burden [7]. So despite the fact that volumetric wear rate goes high, a portion of the scientists have inferred that particular product rate is tumbling off with expanding in the ordinary burden which may gives not right data to the readers [8-9].

3.3 Normalised wear rate:



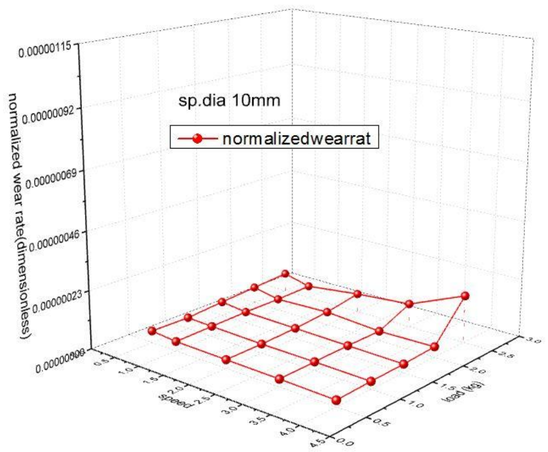


Fig.3.7 Effect of Load and speed on normalised wear rate for 6 & 10 mm diameter specimens

Figure 3.7 represents Normalized wear rate is the proportion of volume loss unit sliding separation to the cross sectional zone of the example. Standardized wear rate can be considered on the grounds that it will consider the relating cross sectional region of the pin [10].

IV. CONCLUSIONS

- Over all height loss not to be considered for the estimation of wear
- Height loss ought to be viewed as just amid in the enduring state.
- Volume loss for every unit time should not to be considered.
- Volume loss for every unit sliding separation ought to be considered.
- Specific wear rate should not be considered for the wear estimation, since particular wear rate is the proportion of volumetric wear rate.
- Weight loss should not be considered, on the grounds that for same volume loss, low thickness material shows low wear, though high thickness material shows high wear.

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