ASIATRIB2002 International Conference
JEJU ISLAND, KOREA

A study on wear parameter of journal bearing

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Abstract:
In this paper the result of investigation of wear of journal bearing is presented. Different parameters as sliding speed, load, materials capacity etc, have influence on the Tribological behavior of journal bearing.
The wear of journal bearings of various issues is determined and analyzed.

Keyword: Wear, Journal bearing, Linear wear rate…

1. Introduction

The Journal bearing is important element for enhancing the quality of the diesel motor. The wear rate of Journal bearing will determine his wear life T .

The wear relationships are essentially functions of random argument because the external factors load, sliding speeds, materials properties (hardness, ultimate strength.) and others operating conditions are random variables.

Therefor the calculation of service life with respect to wear is a prediction determining the wear life and respective probability of journal bearing's failure-free operation.

The calculation requires knowledge of the development of wear in time. For most cases, relationship between the t taken by the wearing process and amount of wear U can be assumed to be linear, then time rate of wear:

$$w = U/t = const$$

In the present study: Average value of wear is sufficient to find from the test machine. On basic of average value of wear, the wear life and probability of Failure-free operation can be calculated.

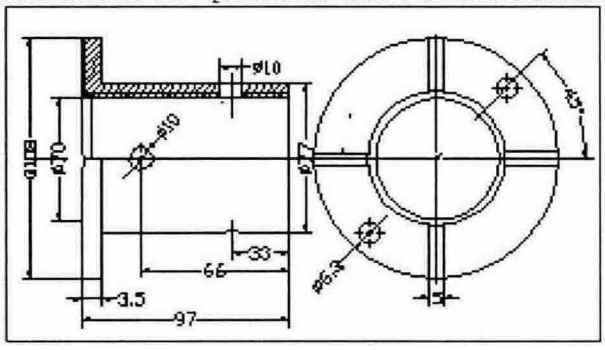


Fig 1 The Journal bearing of diesel Motor

2. The long-life of journal bearing on the wear basic

The wear life T of journal bearing can be determined by formula:

$$T=[U]/w,$$

Where:

[U]: the limiting values for wear

The time wear rate w is random variable.

Therefor it typically obeys the normal distribution law that is:

$$f_0(w) = 1/(\sigma_k\sqrt{2\pi}) . \exp[- (w-w_m)^2 / 2\sigma_w],$$

Where:

$f_0(w)$: probability density

w_m : mean value (mathematical expectation) of the rate of process

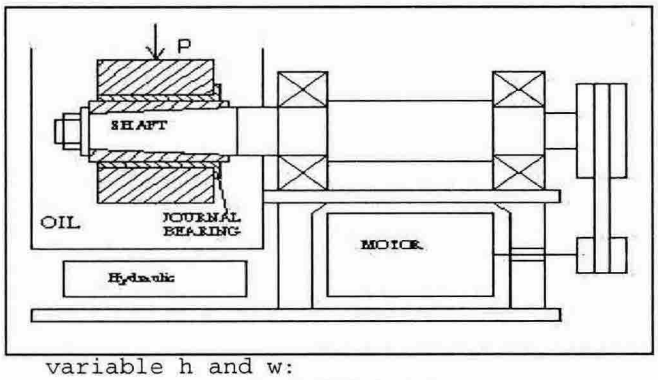
σ_w standard deviation (rootmean-square)

The manufacturing accuracy of rubbing-surface equation should be expressed in form:

$$U=h + wt,$$

Where: h is the initial parameter of product

The general, wear life is a function of two independent random variable h and w:



$$T= ([U]-h)/w$$

If each of the variables h and w obeys a normal distribution law, the wear U for h give value of t=T will also

conform to normal distribution with mathematical expectation $U_m=h_o+w.t$, and a standard deviation $\sigma_u=\sqrt{(\sigma_h^2 + T^2.\sigma_w^2)}$,

Fig 2 Schema of test machine

Where h_o is the mathematical expectation and σ_h is the standard deviation of random variable h.

The probability:

$P(t)= 0.5 + \Phi(([U]-h_o- w_m.T) / (\sqrt{(\sigma_h^2 + \sigma_w^2)})$

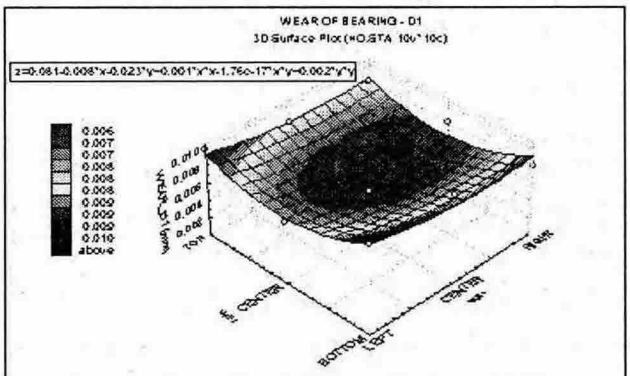


Fig 3: The Wear of Journal bearing D when v= 2.6 m/s

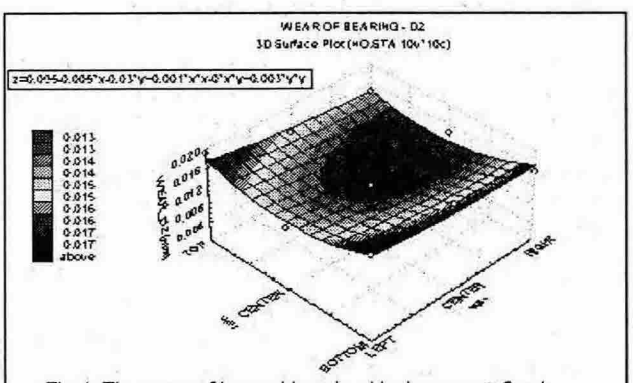


Fig 4: The wear of journal bearing H when v = 5.3 m/s

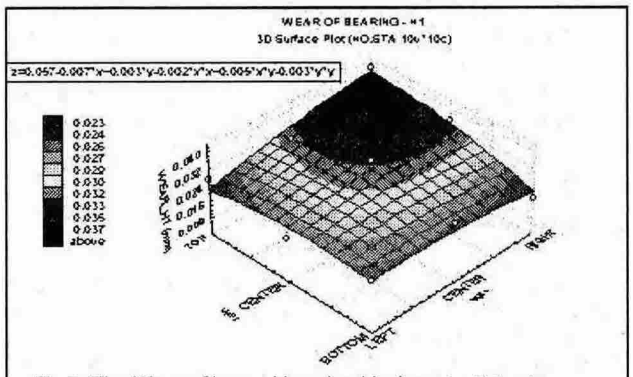


Fig 5: The Wear of journal bearing H when v = 2.6 m/s

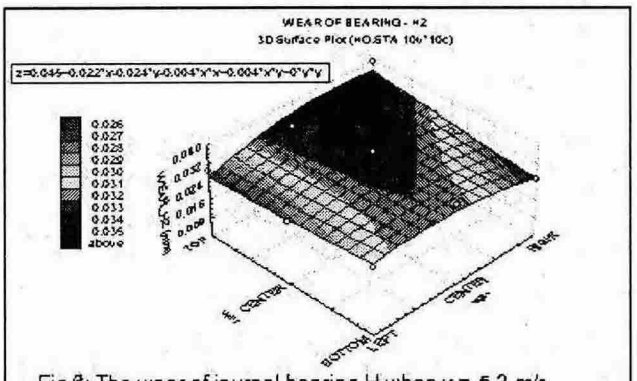


Fig 6: The wear of journal bearing H when v = 5.3 m/s

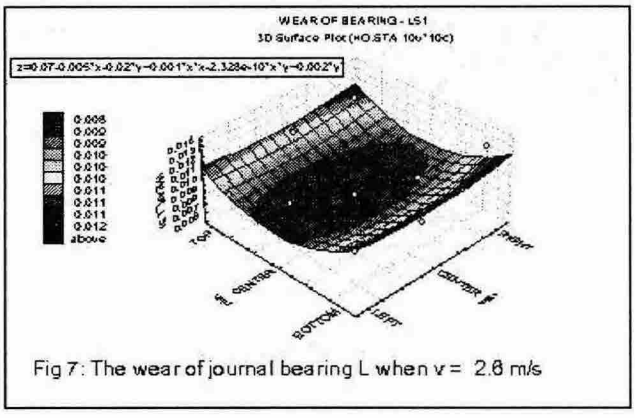


Fig 7: The wear of journal bearing L when v = 2.6 m/s

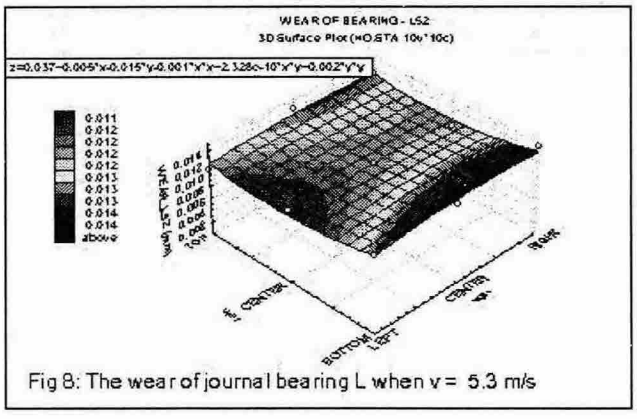


Fig 8: The wear of journal bearing L when v = 5.3 m/s

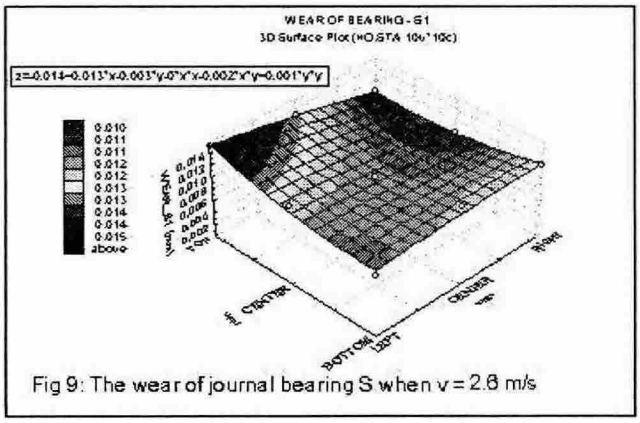


Fig 9: The wear of journal bearing S when v = 2.6 m/s

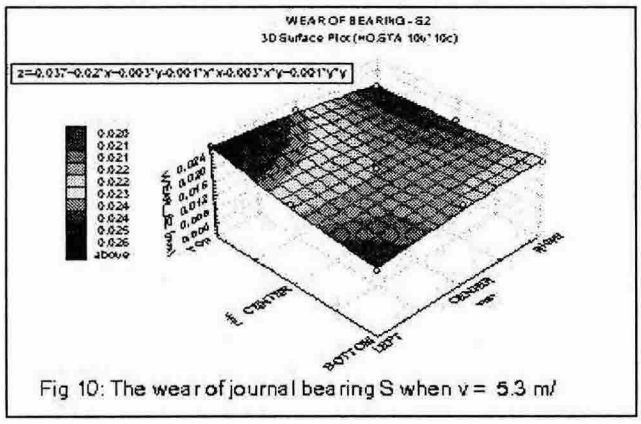


Fig 10: The wear of journal bearing S when v = 5.3 m/

3. Wear testing of journal bearing

The materials journal bearing is babbitt metals. It contained 83% Sn, 6% Cu, 10% Sb, 1% Pb. HB=30 with alloy layer thickness 1,2mm.

There are four series materials from differently issues: D, H, L, S.

The Load is 1.5 MPa.

The rotational speeds are: 5.3m/s and 2.6 m/s

The SAE 40W oil temperature Is about 60° C -70° C, The initial gap of shaft and journal bearing is $0.09^{\pm 0.01}$

The time of wear test is 72 hours

The results of wear test are presented on the figures.

The time wear rate when speed v= 2.6m/s and v=5.3 m/s are presented on table1 and table2.

Table 1: The wear rate with v = 2.6 m/s

Journal bearing	H	L	D	S
Time wear rate w (mm/h) $x10^{-4}$	4	1.3	1	1.6
Standard deviation σ_w $x10^{-5}$	6	1.7	2.8	2

Table 2: The wear rate with v = 5.3 m/s

Journal bearing	H	L	D	S
Time wear rate w (mm/h) $x10^{-4}$	4.5	2	2	3
Standard deviation σ_w $x10^{-5}$	4.5	1.1	3.4	2.3

Wear is usually characterized by the linear wear rate:

$$I = U/L$$

Where L: sliding distance.

Table 3: The linear wear rate (non-dimensional) x 10^{-11}

Journal bearing	H	L	D	S
Linear Wear rate I v=2.6m/s	4.4	1.4	1.1	1.8
Linear Wear rate I v=5.3m/s	2.4	0.9	1.1	1.6

3. Conclusions

- The calculation of service life with respect to Wear is presented by corresponding formula.
- The results of wear analysis and Wear testing in various operating conditions (p =1.5 MPa, v = 5.3 m/s and v= 2.6 m/s) are presented.

4. REFERENCES

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