Out-of- Roundness: A Reliable Tool for Measuring Wear in Journal Bearings

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1. Abstract
Wear in hydrodynamic journal bearing was measured using 13 parameters using different techniques. It is found that out-of-roundness was the most reliable method for measuring small wear quantities. The out-of-roundness method was further developed to derive reliable results and a wear characteristic equation.

2. Introduction
The aim of this experimental study was to examine the effect of antiwear additives on journal bearing lubricated with oil containing solid contaminants. Thus the amount of wear was very low due to hydrodynamic regime as well as due to the effect of additives. Various sophisticated wear measurement techniques are available; however, these are expensive and time consuming (Sanawu et.al, 2000, Scherge, 2003). The aim of this research study was to use short duration tests and still measure wear reliably. The long duration tests are expensive and hence a quick but reliable methodology was required (Spero et.al, 1991).

3. Experimental Setup and Methodology
In this experimental study (Sharma et.al,, 2008), wear measurements included weight loss, geometry change: Out-of-Roundness (OR), and change in particle quantity. Amongst these parameters OR method was found to be most reliable as small changes in OR can be measure reliably.

The OR results were further improved by using a magnification 1000 on the traces, and then photocopying these on overhead transparencies, as per the following steps: Step1: Trace of the worn bearing was placed on top on the original unworn bearing trace, and the wear area was marked as shown in Figure 1. Step2: Out-of-roundness was measured with the help of concentric circles. Step3: Ratio of one division on the enlarged trace to that of the original trace = Scale Factor (SF). Step4: In Figure 1 lines drawn from the best located centre of the enlarged trace give the maximum wear depth.

Thus departure of the surface after the wear can be measured in mm and can be converted in to microns from SF relationship. Wear depth can be computed by this method all along the curve in the worn area. Using this data an equation can be derived for the wear characteristics of the antiwear additives using Microsoft Excel Equation function, as shown in Figure2.

4. Discussions:
With this method a small change in Out-of-Roundness can be magnified as much as 10,000 times without using optics or any other sophisticated method. Other methods such as measurement of changes in roughness are not as reliable. The particle count method results were also not reliable because the Al_2O_3 concentration was too high.

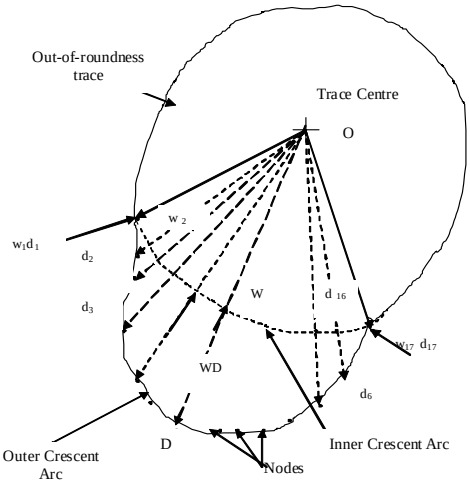

Figure 1: Wear characteristic equation development

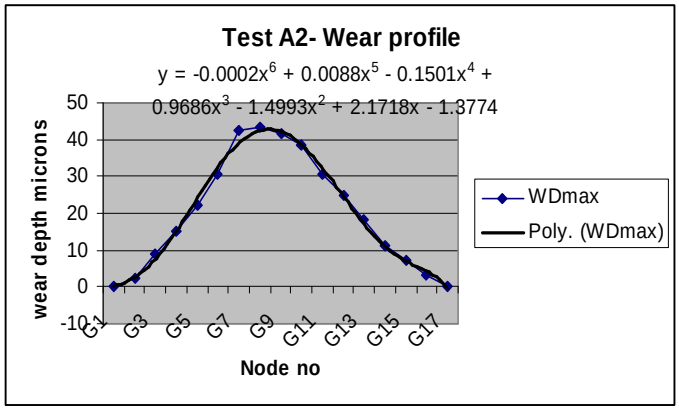

Figure 2: Equation developed from the data

Conclusions
Weight loss measurement is a traditional method for measuring wear, but measurement of small quantities in a lubricated bearing is not practical. Particle count method is not repeatable if concentration of dust particles is high. Out-of-roundness method proved to be an inexpensive, reliable and easy to use technique for detecting low wear in journal bearings.

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