

Ferrographic Oil Analysis Technique for Lubricant Monitoring and Analysis in Internal Combustion Engines.

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ABSTRACT

Lubrication monitoring is the application of scientific principles to reduce the friction between two surfaces in relative motion. Lubricant monitoring is potentially a versatile method of conditioning monitoring for most internal combustion engines, particularly automobile engines, with dynamic parts, especially in a developing countries like Nigeria.

The paper discusses the current, widely utilized measurements and analysis techniques for lubricant monitoring. The Ferrographic Oil Analysis method is discussed. This technique, if properly applied, will not only prolong the life span of internal combustion engines but will also increase their efficiencies, thereby reducing their cost of maintenance.

(Keywords: measurement, analysis technique, lubrication, ferrographic method, oil analysis, wear rate, internal combustion engine)

INTRODUCTION

Without a doubt, lubricants reduce friction, thereby reducing the rate of wear on the two surfaces that are moving relative to each other (Roger, 1980). Liquid lubricants effect cooling of the heat generated between two moving parts as well as carry away dirt, moisture, and foreign materials between the sliding surfaces. Hence, in automobile engines, lubricants reduce wear and carry away any wear particles when such occur (Kelly and Harris, 1978).

Odi-Owei (1987) viewed component part wear as the major cause of machinery failure, most especial in automobile engines and other machineries, due to the contamination of the lubricant by the wear particles and debris. Also,

the deterioration of lubricant quality that results from additive depletion has significant effect on the life and performance of automotive engine parts. Therefore, there is need for a proper monitoring technique.

Barwell (1978), Okah-Avae (1982), and Waggoner (1971) observed that lubricant monitoring addressed to contaminant level assessment should be in place to monitoring the level and type of such contaminant wear elements - copper, boron, chromium, aluminum, lead, tin, molybdenum, silicon, nickel, magnesium and tungsten; air-borne dirt and sooth; un-combusted fuel; water; inorganic acids; oxidation; and salts. According to Henry (1979) lubricant monitoring and analysis can be carried out in either on load or off load condition.

The present situation of in automobile engine manufacturing industries in African countries, specifically Nigeria, represents some challenges. Most of them have folded, not because they don't have the necessary equipment and machines, but because the ones they have were not properly maintained and monitored due to lack of proper techniques. The case can be therefore made for the necessity of effective lubricant measurement and monitoring techniques.

THEORETICAL CONSIDERATIONS

In certain cases, the rate at which the metal elements in machines wear can provide useful information and tools for decision making. Wear rate is calculated using the results of two consecutive wear element consideration values, taking into consideration oil losses and oil top-up over a period of measurement.

$$\text{Total wear rate} = \frac{\text{Total amount of metal in lubricant}}{\text{Hours of loss}}$$

$$\text{Specific wear} = \frac{\text{volume of wear product (m}^3\text{)} \times 10^{12}}{\text{Density (g/m}^3\text{)} \times \text{no of revolution}}$$

In the case of the high temperature journal sleeve bearing tests, the specific wear is given as:

$$\text{Specific wear} = \frac{\text{Weight loss} \times 1,231,000}{\text{Density (g/m}^3\text{)} \times \text{no of revolution}}$$

METHODOLOGY

In this study, the Ferrographic Oil Analysis System method of measurement is used. It focuses on ferrous metallic wear debris and it consists of a special magnet situated in a housing below a clean inclined slide (as shown in Figure 1) on which debris adhere as the oil is pumped and directed by a pump along the slope of the slide. The magnet is then removed and the metallic debris is measured and recorded.

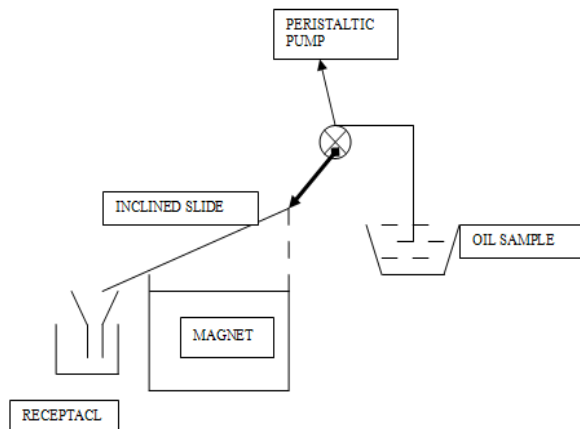


Figure 1: Schematic Diagram of the Ferrographic Oil Analysis System.

The Gallant Model of a Lancer motor car engine with Super Oleum SAE 40 oil was used. The vehicle tolled from Osogbo to Esa- Oke, Osun State, Nigeria. The oil was drained and passed through the ferrographic method as shown above. The process was performed five times and the quantity of metallic debris was measured each time. The mass of metallic debris was determined and used to calculate rate of wear in the vehicle engine.

RESULTS AND DISCUSSION

The use of ferrographic method for measuring the rate of wear in automotive engines is imperative. The lubricant sampled has shown changes in color and thickness as the hours of operation increased, indicating that some machine parts have undergone wear. This shows that the operator needs to change the oil frequently so that it will not hindered the operation of the engine.

Table 1: Wear Rate of Lubricant Samples of a Gallant Lancer Automotive Engine used between Osogbo and Esa- Oke Osun State Nigeria.

Sample	Amount of metal in the sample (g)	Operating hours of the Gallant engine	Wear Rate g/hour
1	0.3	1	0.36
2	3.5	6	0.58
3	8.5	11	0.77
4	13.0	16	0.81
5	17.3	21	0.82

Considering the table above, it can be deduced that as the hours of operation of the engine increased, the mass of metal particles in the lubricant samples increased, thereby indicating the rate at which wear is occurring.

Therefore, the owner of the vehicle can be given the insight as to when to expect the engine to break down as allows the owner to create alternatives before such a situation arises.

CONCLUSION

Measurement and analysis techniques for lubrication monitoring in metal-metal contact resulting in gradual wear and consequently leading to material failure, have been appraised for most automotive engines with dynamic parts. The ferrographic method is one of the techniques for monitoring lubricants in the automotive industry. It helps in showing the rate at which engine components are wearing away. It also indicates the level at which the lubricant contamination occurs or has been reached, thereby enabling the automotive engine or mechanic to know when to change the lubricant

as well as changing engine parts to avert break down of the vehicle or obstruction of work.

The ferrographic method, therefore, if properly employed, will give adequate monitoring of automotive engine lubrication.

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