Study and Detection of Faults in Gears

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Abstract— In recent days many works and research had been done to analyze the fault detection of gears. Many researchers conducted various methods to detect whether the gear are weared out or not or to check its conformity. In this paper very easy methods are used to detect the faults and conditions of gears. In this paper two methods are used;
1) Wear and Debris analysis of lubricating oil.
2) Voltage-Current analysis of working gears.
The properties of lube oil gets affected by continuous working of gears are studied in details. Further the current and potential analysis of gears drives is also studied. The objective of this paper is to review and encapsulate this literature, to provide a wide and good reference for researchers to be utilized.

Key words: Fault Detection, Gears

I. INTRODUCTION

Over more than two decades to monitor and analyze the gear defect vibration and wear debris analysis many research [1]-[5] are conducted. Yet these methods are suitably performed and very efficient methods. Wear and debris analysis are now-a-days working on molecular levels to refine the debris particles and detect the composition of debris particles. Debris are the particles which get weared out during the working of gears and bearings. Vibration techniques are getting an edge over the debris analysis as it is faster than former on vibration technique uses much more sophisticated devices and software's to detect the level of vibration in weared and good gears.

There is a need to develop much easier and simple method than these methods as the major shortcomings of vibration method is it is complicated and it is hard to detect whether the signal generated by the method is due to gear itself or others are also intervening in between as we know that a gear geometry comprises of gear drive connected with shafts and gears are supported over bearings thus while going vibration analysis we may get vibration due to combination of all these and it would different to segregate the signals.

Also for drives working on low speed the sensor would not measure the acoustic effects of drive thus hard to generate signals, since vibration analysis also uses acoustic sensors to generate the sensor.

Many other sophisticated devices are introduced which directly measure the contamination particles in lube oil (gear transmission oil) such as ferrous particles, total dissolved solids, acidity, viscosity etc. but the major problem is these devices are not available in most of the parts and the equipment costing is quite high. In this paper a quit simple method is used to detect the faulty gears these are
1) Wear and Debris analysis of gear lubricating oil.
2) Voltage-Current analysis of working gears.

II. BRIEF OVERVIEW OF METHODOLOGY

A. Wear & Debris analysis

In this article various physicals characteristic of lube oil are analyzed to detect the wear and tear of lube oil (gear transmission oil). The properties like acidity, density, relative density, kinematic-viscosity, flour point of oil, pour point of oil etc. are correlated with the gears to check its wearing. During working, two gears meshes with one another and a sliding as well as rolling occurs in between the gears during continuous sliding action gear started losing its physical properties. The surface of gear losses its upper layer continuously and further running of gear leads to the breakage of gear tooth. All these leads to vibrations in the system which is harmful for the system. In helicopters and aero-planes which are running at very high speed their gears losses its properties much faster and leads to some catastrophic accidents.

In fact nearly 40% of the accidents are associated with improper working and failure of gears. In slow running machines like in bikes this defect is not severe.

The surface of gears get weared out and tiny particles of gear gets mixed up with the lube oil used for lubrication .The analysis of gear lube oil to predict the gear failure is known as wear and debris analysis. The lube oil gets contaminated with the particles break from gear surface causing its (lube oil) density to increase as oil gets heavier. Also the rise in density is will also affects the relative density of the lube oil thus relative density may also be governing factor to judge the deformation of gears. Also continuous working leads to increase in temperature also which degrades the physical properties of lube oil since temperature rise is due to rubbing action of gears this may also be an indication to judge the wearing.

Various researches shows that contamination in lube oil and change in lube oil properties also affects the acidity of oil, thus acidity checking may also be a governing factor to check the gears failure.

Increase in density and temperature also affects the viscosity of lube oil. Viscosity is the property of lube oil which resists the fluid layer motion the greater the viscosity the more is the resistance in fluid flow. Also up to a certain viscous fluid is only used as an lubricating oil very viscous fluids are not used as if viscosity is more its transport properties are less thus it decreases the extent of heat transfer.

Thus change in viscosity and density also affects the kinematic viscosity of fluid such that;

$$\text{Kinematic viscosity} = \frac{\text{dynamic viscosity of fluid}}{\text{Density of fluid}}$$

Thus kinematic viscosity is also the governing factor for the analysis.

These are very simple and basic techniques to analyze the lube oil. In practice lube oil is analyzed by

various devices like oil analyzer, colorimeter, atomic emission spectroscopy AES etc [5]. But these devices are very expensive and not available in major pats of India. Thus there is a need to develop simple techniques to govern.

The flash point means that how effortlessly a concoction may consume. Materials with higher blaze point are less combustible or unsafe than synthetic substances with bring down flash point.

Flash point may differ with the idea of the first raw petroleum, the thickness and strategy for refinement.

Pour point is the temperature of oil at which it started freezing or it is the temperature at which the oil stops flowing under the effect of gravity.

B. *Voltage-Current Analysis of Working Gears*

Voltage-current analysis concept [6] measure the deflection in current and voltage by the use of good gear and faulty gears. A faulty gear need more torque than a standard gear, the gear is supplied power with a motor (synchronous motor) which is further connected with a multimeter with detect the load required to run the gears the required load for healthy and weared gears are different.

III. CONCLUSION

Summing up the review of above based methods the different conditions of healthy and faulty gears may be analyzed. Finally, some issues in this area of research are outlined and provision for improvement and thus research into new damage detection techniques is continuing.

REFERENCES

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