Experimental study on vibration characteristics of roller bearing Using Mixed Nanofluids: A Review

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ABSTRACT:

This paper presents a review of experimental investigation for vibration behavior of roller bearing. The purpose of this review paper is to summarize the important published paper on vibration behavior of roller bearings by using lubricants with and without additives. The most common viscosity grades, namely ISO (10, 22, 32, 64and 68) and additives (CuO , Al, Cu, Fe, Ni, TiO2, Al203 and Fe3O4) are considered as working lubricant and additives, by many authors. The nano particles within the liquid decreases the rms vibration of roller by increasing the lubricant viscosity while enhancing the maximum load it can carry. The rms vibration reduction of roller bearing is investigated at different load input by varying Nanofluids concentration as well as frequency.

KEYWORDS: Vibration, Lubricant, Nanoparticle, Roller bearing, Viscosity]

INTRODUTION:

Nanotechnology is regarded as the most revolutionary technology of the 21st century. It can be used in many fields and ushers material science into a new era. Nanoparticles can be considered as modern lubricant additives. In recent years, many studies have been carried out on Applications of nanoparticles in the field of lubrication. The reduction of friction and wear are dependent on the characteristics of nanoparticles such as size, shape and concentration their nanometer size allows them to enter into the contact area like molecules. They are immediately efficient; even at ambient temperatures. Various types of nanoparticles were used to prepare nano lubricants, including Cu, CuO, Fe, Ni, TiO2, and Al203 etc. [10-

14].These Nanofluids used in rolling bearings are manufactured using high precision machine tools and pass through the strict quality checks. In spite of these, rolling element bearings may develop early defects on their mating components during their usage depending upon the operating parameters and environments of operation [15].

Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts, which are shown in the following flow diagram as below:

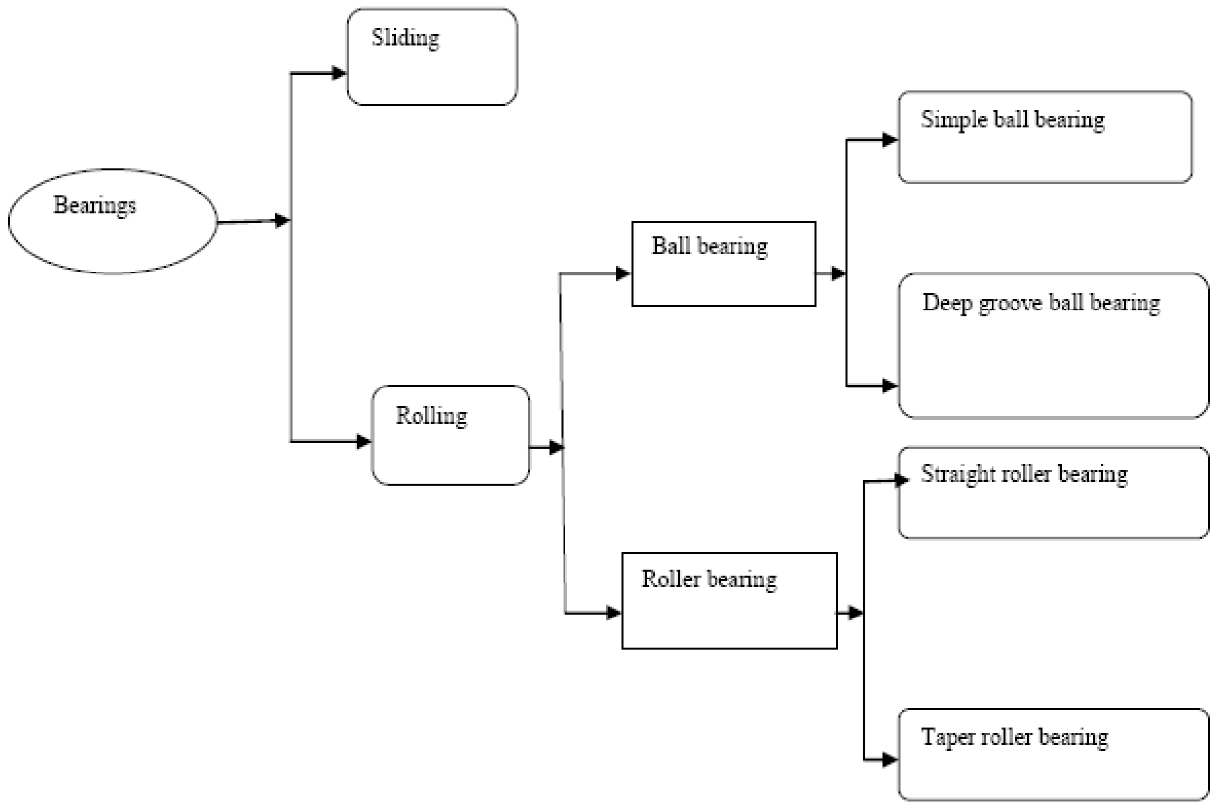

Figure -1 Classification of bearing

Among the group of mechanical components operating under EHL condition, there are the rolling bearings. This machine element type is one of those more sensitive for development of faults related to lubrication deficiency. From the total of faults found in this type of component, 50–80% is related to deficient lubrication, resulting from inadequate lubricant use, lack or excess of lubricant a, nanofluids, and presence of solid or liquid contaminant. In the face of high percentage of rolling bearing failures, the development of techniques for detection and diagnosis of faults in rolling bearings, due to lubrication deficiency, is a fundamental contribution to the preservation of machine precision. In terms of monitoring of rolling bearing performance, vibration measurements are among the most used techniques.

Nowadays, a lot of works on detection of localized defects in rolling bearing elements through vibration analysis can be found in the literature [15].

LITERATURE REVIEW:

The following literature review describes important research results regarding the Vibration Behavior of Roller Bearing for using lubricant with Nano particle:

Juha Miettinen et al. (2000) investigated was to clarify how the contaminants in the grease influence the acoustic emission of the rolling bearing. The results showed that the AE measurement indicated very clearly the smallest contaminant concentration included in the study that was as low as 0.02 weight-percent. Small size contaminant particles generated a higher AE pulse count level than large size particles [1].

M. M. Maru et al. (2006) investigated the effect of lubricant contamination by solid particles on the dynamical behavior of rolling bearings, in order to determine the trends in the amounts of vibration affected by contamination in the oil and by the bearing wear itself. Experimental tests were performed with radial ball bearings lubricated by oil bath. Quartz powder in three concentration levels and different particle sizes was used to contaminate the oil. Vibration signals were analyzed in terms of the root mean square (rms) value [2].

R. Serrato et al. (2007) characterize vibration behavior of roller bearings as a function of lubricant viscosity. Experimental tests were performed in NU205 roller bearings, lubricated with mineral oil of three different viscosity grades (ISO 10, 32 and 68). The mechanical vibration was determined through the processing and analysis of bearing radial vibration data, obtained from each of the lubrication conditions, during 2 h of test run for temperature stabilization and under several bearing shaft speeds. The applied radial load was 10% of the bearing nominal load. Through root mean square (RMS) analysis of the vibration signals [3].

Pavle Boskoski et al. (2010) the detection of improperly lubricated bearings from vibration patterns is a difficult task especially when records from short operating periods are available. This problem has been addressed by applying both cyclostationary analysis and spectral kurtosis for the selection of a frequency band in which variations in vibration patterns are most expressed. The approach was evaluated on a test-set comprising 63 electrical motors with fault-free and 21with improperly lubricated bearing. The results reveal that improper lubrication is expressed as increase in the spectral components at bearing cage and ball spin frequency [4].

Da Jiao et al. (2011) The tribological properties of the modified Al2O3/SiO2 composite nanoparticles as lubricating oil additives were investigated by four-ball and thrust-ring tests in terms of vibration, coefficient of friction . It is found that their anti-wear and anti-friction performances are better than those of pure Al2O3 or SiO2 nanoparticles. When the optimized concentration of nanoparticle additive is 0.5 wt. %, friction coefficients and vibration are smallest [5].

Nicoleta M. et al. (2012) The attenuation of the gear mesh noise /vibration by fluid film wave bearings relative to rolling element Bearings was experimentally investigated. Tests were performed on a gear box that can accommodate both rolling element bearings and wave bearings. It was found that at specific speeds and torques, the wave bearings could significantly reduce the noise/vibration compared to rolling element bearings [6].

Muthu Kumar et al. (2013) investigated the vibration characteristics of ball bearing supplied with nano-copper oxide (CuO) mixed lubricant. CuO nanoparticles were synthesized by chemical method and characterized using XRD and TEM to study the crystallanity and ultra structure. The synthesized CuO nanoparticles were of the size range 5-8 nm. 0.2%, 0.5%, and 1% (W/V) of CuO nanoparticles was added to the lubricant (ISO VG 68) and was used for further analysis. The bearing vibrations were measured using base lubricant and CuO lubricant mixture. Our results show a reduction of 41% vibration amplitude while using 0.2% (W/V) CuO nanoparticles in outer case defected compared to base lubricant [7].

William Jacobs et al. (2013) experimentally investigated the formation of a lubricant film in a deep groove ball bearing and its effect on the bearing dynamics. The behavior of the lubricant film between the rolling elements. The influence of the bearing Temperature is analyzed as well. During a run-up at constant bearing temperature describes the formation of the lubricant film. Due to The formation of the lubricant film, the bearing stiffness increases by3.2%while the damping increasesby24%.During a warm-up of the bearing, the viscosity of the lubricant film decreases strongly [8].

Stephan Schnabel et al. (2013) this work rolling bearings were tested with a degree of raceways and vibration signals were studied and the influence of the lubricant was investigated nano particle close to the ones in mining industry. The short term effect of this contamination on [9].

CONCLUSIONS:

1. The cleaning and re-greasing of a roller bearing that had been running with contaminated grease gave a reduction in the AE level of the bearing, to a level which was about one-half of the AE level with the contaminated grease, but after the cleaning and re-greasing the AE level was still much higher than it had been when the bearing was new and lubricated with the clean grease [1].
2. The presence of contaminant, in different concentration levels and particle sizes, only affects the large frequency bands of the vibration signal. Therefore, the signal RMS values for large frequency bands are good vibration parameters for detection of problems of contamination [2].
3. Variations in oil viscosity in roller bearings, caused by either the use of different oils or temperature variation, only affect the bearing vibration in HF band (600–10 000 Hz) [3].
4. The influence of the improper lubrication was detected as an increase in the spectral components of FTF and BSF obtained from Envelope spectra of the vibration signals [4].
5. The oil lubricating performance using such nanoparticles as additives was improved in comparison with pure Al2O3 or SiO2 particles. There was an optimal concentration of additive, which was 0.5 wt.% for the tested Al2O3/SiO2 composite nanoparticlesThe absorbed nanoparticles may result in rolling effect between rubbing surfaces, and the situation of friction is changed from sliding to rolling. Therefore, the vibration was reduced [5] .
6. The experiments showed that under certain operating conditions, the fluid film wave bearings can reduce the gear mesh vibration and noise, compared to rolling clement bearings [6].
7. The 0.2 %wt. CuO nano particle mixed lubricant functioning effectively in reducing vibrations of defected bearing compared to new bearing over the other concentrations [7].
8. The bearing damping is roughly unaffected by the speed. Whether the bearing stiffness and damping increase or decrease due to the formation of a lubricant film is highly dependent on the temperature conditions [8].

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