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A REVIEW ON VIBRATION & TRIBOLOGICAL ANALYSIS OF BEARING UNDER DIFFERENT LOADING & SPEED CONDITIONS WITH FEA & EXPERIMENTAL METHOD

Mr.Godse A.B.
Mechanical Engineering
Tatyasaheb Kore Institute Of Engineering Technology,
Warnanagar, India.
akshaygodse12@gmail.com

Prof. Patil P.J.
Mechanical Engineering
Tatyasaheb Kore Institute Of Engineering Technology,
India.
pjpmech@tkietwarana.org

ABSTRACT

To meet today's requirements for higher performance of machines, bearing of various types used in those machines becomes more important to give high performance continuously. Bearing play vital role in rotating machinery members. The bearings operating under higher load & temperature conditions increase the vibration this increases the probability of fatigue failure. On the basis of way to provide the carrying capacity, we recognize radial hydrodynamic bearings and hydrostatic bearings. Hydrodynamic bearing are the elements of machines which works under elasto-hydrodynamic lubrication conditions. Due to radial clearance journal bearings have self induced vibrations. There is trend of monitoring different machine components with the help of data generated by vibration by these components for ensuring their reliable and effective working. Bearing vibration analysis is becoming popular for monitoring bearing performance. This study deals with vibration and tribological analysis for different bearings.

Keywords

Vibration Analysis, Tribological Analysis, FFT Analyzer, FEA

1. INTRODUCTION

Vibration is a phenomenon in which oscillation occurs about an equilibrium point. Vibration is undesirable, wasting energy and creating unwanted sound. A vibration signature measured on external surface of a machine contains a large amount of information, which, if properly interpreted can reveal the running condition of machine. A vibration signature taken from appropriate location in a machine can reveal presence of machine defects such as imbalance, misalignment, imperfect foundations, mechanical looseness, rubs, bearing defects, faults in transmission drives etc.

Bearings supports radial loads, axial loads, thrust loads etc. and provide frictionless running of rotors. These bearings allow for transmission of large loads at mean speed of rotation. On the basis of way to provide the carrying capacity, we recognize radial hydrodynamic bearings and hydrostatic bearings. In hydrodynamic bearings lubricant is fed through a throttling hole and carrying capacity is produced as a result of hydrodynamic pressure in the wedge shaped clearance between plain bearing and the shaft.

Hydrodynamic journal bearing plays important role in various machines like rotors, turbines, pumps, hard disk etc. It comes under the group of machine elements working under elasto-hydrodynamic

lubrication (EHL) conditions. Due to radial clearance journal bearings have self-induced vibrations. Lots of efforts are made by researchers to study such vibrations and effects of vibrations on bearing performance and methods to reduce these vibrations. The journal bearing surfaces encountered in many studies were assumed to be smooth. However, the possibility of improving bearing performance by modifying bearing surface geometry has attracted attention of many researchers and they have performed several theoretical studies on hydrodynamic lubrication field for rough journal bearing surfaces in recent years.

1.1 History

The mostly used hydrodynamic bearings possess cylindrical shape. It consists of two axial groves for lubrication purpose and cylindrical bore. They are smaller,lessexpensive and less maintenance is required. The bearing may be split or solid type for assembly aroud the shaft. For hydrodynamic bearing lubricant is an important element. The purpose of lubrication is to carry heat caused friction. A journal bearing obtains its capacity to support and apply load through the resulting eccentric position of the shaft when comes under action.

2. LITERATURE REVIEW

A considerable research work in the area of vibration analysis of journal bearing has been carried out. A brief review of some selected references on this topic is presented here.

HakanAdatape et al.[1] have investigated tribological behavior of plane journal bearing and grooved journal bearing. They developed experimental test rig for determining friction force, friction coefficient, and film thickness for comparing non grooved and grooved journal bearing. They found that, grooved journal bearing have better tribological characteristics than non-grooved journal bearing.

Tandon et al. [2] proposed a comprehensive bearing vibration model which relates specific components of vibration spectrum with fault origin. This model has become a starting point for majority of methods addressing bearing fault detection problems. He suggested various monitoring techniques for detection of defect in induction motor ball bearings. He investigated several vibration problems regarding bearing vibrations and lubrication of bearing and specified various vibration measurement and analysis methods. He reviewed vibration measurement in both time and frequency domain along with signal processing techniques such as high frequency resonance techniques.

Boskoski et al. [3] have discussed method to detect the lubrication starved bearings by means of vibrations of the bearings. Method for relating the vibration and lubrication of bearings of electrical motors is discussed. They found that improper lubrication is expressed as increase in spectral components at bearing cage and ball spin frequency. They showed that lubrication starved bearing exhibits vibrations with significantly higher energy within narrow frequency band.

Zengli Wang et al. [4] they have investigated dynamic analyses for the rotor-journal bearing system of a variable speed rotary compressor. Due to the inertia force, the contact force and the gas force loads change rapidly with speed variation of the compressor which lead to serious vibration of the system, and then result in abrasion and performance reduction. The dynamic behavior of the rotor-journal bearing system was calculated by solving three-dimensional numerical model using finite element method, and the vibration characteristics of the system were investigated.

J. Sep et al. [5] they have done experimental study of abrasive wear of slide bearings consisting of journal with the helical groove on its surface, operating in lubricant contaminated by Al2O3 abrasive particles. They have compared wear resistance of slide bearings with different surface geometry on the journal. They found that helical groove on the journal significantly reduced wear of sliding pairs. The helical groove application on the journal resulted in decrease in sleeve wear.

Thaker Salih Dawood et al [6] He studied that, The race ring in vehicle are subjected to sever load acting between the rolling elements and raceways in rolling bearings which develop only small area of contact between the mating members. Large level of stresses is developed on the surface of the rolling elements and raceways. Consequently, although the elemental loading may only be moderate, stresses induced on the surfaces of the rolling elements and raceways are usually large. The determination of deformation and stress distributions due to both static and dynamic loading is essential in the design stage of the raceways. Finite element model of a stress analysis of the ball bearing has been built considering the race ring as a plane stress problem and choosing the 8 node isentropic quadrilateral element. A computer package Ansys5.4 for both static and dynamic analysis. The more damping

ratio used, the more stabilizing of the stresses with respect to time. The model analysis of the ball bearing that was used in this paper considers elastic characteristics and the obtained results express the behavior of deformation, and stresses with different conditions for the deformation along x-axis, it can be concluded the same behavior can be obtained for the two conditions (longitudinal and lateral) due to the direction of the applied force acting between the outer race and the ball. Also for deformation along xz axis, the same behavior has been obtained with minus sign indicates the total direction of deformed race. The location of the maximum deformations for both Ux and Uz was congruency with the mathematical model calculations, with represent to the area of contact between the ball and outer race. Von misses' stresses behavior was similar to both cases (longitudinal and lateral). Also there was congruency between the numerical and mathematical work for the location of maximum von misses stresses.

3. Proposed System

It is proposed to investigate the effect of groove geometry on mechanicalvibrations of journal bearing. For this proposed work plain journal bearing, two and three groove journal bearings are to be used. To investigate behavior of these bearings different load and speed conditions are applied. This work involves the application of FFT analyzer for experimental analysis and CATIA & ANSYS for FEA analysis will be used. The results of experimental analysis are to be compared with FEA results and conclusion will be made.

4. SUMMARY

From study of literature available on vibration analysis, tribological analysis we come to know that vibrations in the non groove type journal bearing are higher than the vibrations in groove type journal bearings

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REFERENCES

[1] Hakan Adatepe, Aydin Biyiklioglu, Hasan Sofuoglu, "An investigation of tribilogical behaviours of dynamically loaded non-grooved journal bearing,"Tribology International, pp. 12-19,2000.

[2] Tandon N, Choudhay A.A.,"A review of vibration & acoustic measurement methods for the detection of defects in rolling element bearings," Tribology International, pp. 469-480, 1999.

[3] Pavle Boskoski, JankoPeetrovcic, BojanMusizza,DaniJuricic,"Detection of lubrication starved bearings in electrical motors by means of vibration analysis" .Tribology International, 43, pp. 1683-1692, 2010.

[4] Zangli Wang, Xiaoling Yu, Feilong Liu, Quankefeng, Qin Tan," Dynamic analysis for the rotor-journal bearing system of a variable speed rotary compressor",International Journal Of Rrfrigeration, pp 1938-1950, 2013.

[5] J. Sep, P. Pawlus, L.Galda, "The effect of helical groove geometry on journal abrasive wear,"Archives of Mechanical Engineering, pp. 150 -157, 2013

[6] Thaker Salih Dawood, " Investigtion The Dynamic tresses of vibration in outer race of low speed Ball Bearing",Journal of Engineering & Applied Science , vol 7 , No.8,August 2012 ISSN 1819-6608,1008-1016