REVIEW & ANALYSIS OF BEARING FAILURE IN INDUSTRIAL BLOWERS MANUFACTURING INDUSTRIES: CASE STUDY

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***Abstract*- When moving an object, friction force often comes into play, and must be surpassed to move the object. Various types of bearings are used to lessen this friction force for moving mechanisms such as machines. The bearing gets its name from the fact that it bears a turning axle or shaft, but those parts used for sliding surfaces are also called bearings. Bearings include rolling bearings, which use balls, or rollers called "rolling elements. Bearing life expectancy based on material fatigue can be calculated if the operating loads and speeds are known. These calculations must assume that the bearing is correctly mounted, lubricated and otherwise properly handled. It cannot take into consideration the effect of adverse operating conditions.**

I. INTRODUCTION

Mechanical failure prevention and condition monitoring have been one of the mechanical engineers' concerns in recent years due to the personal safety, reliability, failure cost, and equipment downtime issues. Proper system failure prevention process helps to reduce the possibility of the system malfunction, identification of source causes, and troubleshooting. Generally, failure prevention can be identified as the process of fault detection, diagnosis, and prognosis:

i. Fault detection is the process of observing the measured system data and system status information and comparing them with a normal range of observed attributes to determine whether some measurements fall outside the range representing the healthy condition of the system.

ii. Diagnosis is the process of determining the state of failing components, and identifying the cause(s) of the failure.

iii. Prognosis is the process of predicting impending component failures or abnormal system states before they actually occur, and estimates their remaining useful life.

Bearings are among the most critical mechanical components that have wide applications in many industries and have proven to be reliable and long-lived when properly applied. As a result of improvements in bearing materials, design, lubrication technology and service life, they have been gradually employed under more severe application requirements such as higher load, higher speed, and restricted lubrication. These requirements have made condition monitoring and fault diagnosis of bearings very important to ensure safe operation of rotary machines.

II. LITERATURE REVIEW

Bearing failure can cause not only personal injury but also unscheduled replacement or repairs, which lead to high maintenance costs in rotating machinery. To list, all the known types and causes of bearing damage is beyond the scope of this thesis and for this reason only the most common bearing failure causes are mentioned.

As you know, every automotive engine part will eventually wear out. And if every part always performed for the full length of its expected life, your job would be fairly simple. . . to replace parts that have worn. Unfortunately, we cannot always count on an engine part failing only because its normal lifespan is exceeded. A mechanic must not only be a "replacer of parts" but, like a doctor, he must be capable of diagnosing his "patient" to determine why a part failed prematurely. The table below lists the eight major causes of premature engine bearing failure, along with percentage figures which indicate how often each has been found to be the prime contributor to a bearing's destruction. However, it is important to note that in many cases a premature bearing failure is due to a combination of several of these causes.

MAJOR CAUSES OF PREMATURE BEARING FAILURE:

Dirt 45.4%
Mis-assembly 12.8%
Misalignment 12.6%
Insufficient Lubrication.....11.4%
Overloading 8.1%
Corrosion 3.7%
Improper Journal Finish 3.2%
Other 2.8%

CONTAMINATION

Contamination symptoms are denting of the bearing raceways and balls resulting in high vibration and wear. Contaminants include airborne dust, dirt or any abrasive sub-stance that finds its way into the bearing. Principal sources are dirty tools, contaminated work areas, dirty hands and foreign matter in lubricants or cleaning solutions

BRINELLING

Brinelling occurs when loads exceed the elastic limit of the ring material. Brine marks show as indentations in the raceways which increase bearing vibration (noise]. Severe brinell marks can cause premature fatigue failure. Any static overload or severe impact can cause brinelling. Examples include: using hammers to remove or install bearings, dropping or striking assembled equipment, and pressing a bearing onto a shaft by applying force to the outer ring.

FATIGUE FAILURE

Fatigue failure-usually referred to as spalling is the fracture of the running surfaces and subsequent removal of small. discrete particles of material.

Spalling can occur on the inner ring, outer ring, or balls. This type of failure is progressive and once initiated will spread as a result of further operation. It will always be accompanied by a marked increase in vibration, indicating an abnormality. The remedy is to replace the bearing or consider redesigning to use a bearing having a greater calculated fatigue life.

LUBRICATION FAILURE

Discolored (blue/brown) ball tracks and balls are symptoms of lubricant failure. Excessive wear of balls, ring. and cages will follow, resulting in overheating and subsequent catastrophic failure. Ball bearings depend on the continuous presence-of a very thin-millionths of an inch-film of lubricant between balls and races, and between the cage, bearing rings, and balls. Failures are typically are caused by restricted lubricant flow or excessive temperatures that degrade the lubricant's properties.

CORROSION

Red/brown areas on balls, race- ways, cages, or bands of ball bearings are symptoms of corrosion. This condition results from exposing bearings to corrosive fluids or a corrosive atmosphere. The usual result is increased vibration followed by wear, with subsequent increase in radial clearance or loss of preload. In extreme cases. corrosion can initiate early fatigue failures.

MISALIGNMENT

In a bearing with one side misaligned in relation to the other, the ball or roller path will run from one side of the race to the other around one-half of the circumference on the non-rotating ring. The rotating ring will have a wide roller path. Because of the extra pressure imposed on the bearing due to misaligned conditions, an excessively high temperature may develop which will discolor the raceways and the rolling elements while destroying the lubricant.

III. METHODOLOGY USED

Torque Wrench Use

A torque wrench is a precision instrument designed to apply a specific amount of force to a fastener. Whether tightening head bolts on an Blower manufacturing industry automobile engine, lugs for tire and rim installation or inspecting fastener tolerances on high-performance equipment, it is extremely important that proper care is used.

Guidelines are typically provided noting acceptable torque ranges, the order in which specific fasteners are tightened and the number of times a fastener must be tightened and loosened to ensure uniform torque application. Failure to properly torque fasteners can lead to equipment damage, personal injury or worse.

Time-domain Analysis

Time-domain metrics play a critical role in analysis of simple machine components but are not viable for complex components. These time-domain analyses may detect the failure of these components allowing replacement prior to total failure.

Although the damaged component may be beyond repair by this time, the component replacement cost is generally insignificant compared to the potential cost of catastrophic failure of the machine.Because of the large number of records that took place during the tests

(stored at the regular interval of 5 minutes at the approximately 120 hours), the trend of the time is possible.

Frequency Analysis

Frequency analysis is a method used to extract the frequency content of the time domain signal. Spectrum analysis is the most common technique for health management in rolling elements, and it is an important tool for detection and fault diagnosis in simple rotating machinery. Frequency analysis is a measure of the vibrations over a large number o f discrete neighboring narrow frequency bands.

For bearings operating at an identified constant speed and geometry, the frequencies of the vibrations produced by the various bearing components

Time-Frequency Analysis

Signals with time-varying frequency content cannot be treated with the traditional Fourier Transform because this method averages the time varying signal and loses the non-stationary characteristics, which may be important. In order to treat such signals and to provide a time-frequency picture of a signal, the tendency is to use methods to show how the frequency content of the signal changes with time.

Time-frequency techniques map the one-dimensional signal to two-dimensional function of time and frequency.

IV. RESULT & DISCUSSIONS

The major objective of this study is to identify the factors that significantly affect the operation of Bearings in an industry so that preventive as well corrective actions should be taken for resolving & sorting out these type of factors.

In this study, an Torque wrench use has been developed to analyze the interactions among different operational risk factors. It identifies he hierarchy of actions to be taken for handling different factors which affect the operation of bearings.

This thesis is a report of a study of techniques for fault detection and diagnosis on rolling bearing elements based on vibration and acoustic analyses. The primary objective of this research thesis is to identify the capability of novel sensors through experimental evaluations and apply suitable techniques to diagnose defects on the bearings.

The secondary objective is to present a comparative study of four representative bearing vibration analysis techniques commonly employed for non-stationary signal processing.

The final objective is to evaluate a classification methodology to determine the bearing as healthy or defective and identify the type of defect(s) as well as the level of the defect severity.

V. CONCLUSION

In this paper, some important factors are discussed which affect the flexibility of a supply chain management. This chapter presents some important conclusions obtained from present work. In this work, The ability of vibration and acoustic sensors for detection and diagnosis of a defective bearing has been investigated using various processing techniques.During this research the following proceedings were performed:

i. A review of failure modes of rolling elements bearings, the consequences of failures, the procedures that could be used to detect these faults and the fault signatures was conducted. A general model of faulty bearing vibration was developed.

ii. The available signal analysis techniques for bearing defect detection were reviewed and analyzed. The review showed that techniques based on time - frequency (especially wavelet analysis) and frequency analysis are the most appropriate diagnosis techniques for faulty bearings, respectively.

iii. To provide healthy and faulty bearing under desired running conditions, a test rig was built and simulated faults on the bearing components were created.

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