FAILURE DETECTION IN BALL BEARING USING ACOUSTIC PARAMETERS IN CONTAMINATION

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Abstract-Bearings are very common components in rotating machinery. Hence, condition monitoring and the failure detection are very important for the normal and safe running of these machines. In this investigation the paper centered on the online condition monitoring with the help of Acoustic emission (AE) method on the ball bearing. In this method bearing is contaminated with the solid contamination(Greensand). The contamination was mixed at the various percentage with the grease and applied on the outer and inner race of the bearing. Then the experiment was conducted and the acoustic parameters (RMS, kurtosis, standard deviation, crest factor) were noted. Based on the result the bearing failure may be determined.

Key words: Bearing, Solid contamination, Acoustic emission(AE).

I. Introduction:

The contamination of lubricant oil by solid particles is one of the main reasons for early bearing failure. To investigates the effect of lubricant contamination by solid particles on the dynamical behaviour of rolling bearings, to determine the trends in the amounts of vibration affected by contamination in the oil and by the bearing wear itself. From the results changes in the R.M.S values of vibration in the high-frequency band, changes in oil lubrication in the bearing contacts caused by oil contamination and wear damage on the bearing damage. Vibration increases with concentration [1]. Vibration increases first and decrease with particle size increases, Size of contaminant particle.

The contaminant is added in the lubricant even in a small amount, there is a somewhat increase in the vibration signals of ball bearing. The parameters like speed and load are varied; the acceleration values also go on varying. As the particle size is increased, the corresponding acceleration values also go on increasing up to certain limit, and then it starts getting decreased [2].

Comparison between AE and vibration analysis over a range of speed and load conditions are presented. The defects of different sizes could be seeded onto the outer race of a test bearing. Both the raw signals (i.e., bearing without defect and with defect on outer race) were analysed by acoustic emission and vibration analysis [3]. There is a difference in Vibration and Acoustic emission spectrums. The Vibration spectrums don't have clarity in its peak rising at defect frequency whereas AE spectrums provide a clear peak at defect frequency.

Ball bearings rating life is reduced when they are installed operated and maintained under harsh environmental conditions as they suffer from excessive wear due to debris contaminants in the lubricant [4]. This life reduction is considered when calculating the modified rating life but the impact of contaminant's variables such as size, hardness and concentration level are not determined in detail. The greases contaminated with particles of different sizes and hardness (steel and corundum) are tested [8]. It can be concluded that wear is more severe when harder particles are used, but regarding their size, it seems that wear progresses in a different manner depending on particle's hardness and brittleness as soft ductile particles are rolled over and hard brittle particles are crushed down.

Fault analysis with the ball bearing made of defects by spalls using the wavelet-based feature on the bearing components. They use the artificial intelligence technique by minimum Shannon entropy criterion. To extract the coefficient of raw vibration signals they had selected the complex morlet wavelet. In this the raw signals shows the details about the fault from the

Extraction of wavelet theory methodology and then the artificial intelligence technique is used to find the type of defect on the bearings [6]. They use two supervised machine learning techniques are support vector machine and self-organizing maps [5.7].

II.Experimental setup:

The setup consists of the two bearings, shafts and the motor. The bearings are fixed to the shaft and the shaft is connected to the motor by belt and pully. The pully consists three adjustments of the speeds. The shaft length is about 1000mm and the distance between the two bearings is 450mm. The motor was connected to the ac supply and its capacity is 1hp and the shaft diameter was about 25mm.

Fig 3.1

The green sand was collected from the industry and is separated by sieve analysis. The various sizes of the green sand were taken at 70µ,105 µ,150 µ. Different sizes of the green sand are mixed with the amount of grease we are going to apply on the race of the bearing. Then the mixture is applied to one bearing and the test were conducted.

III.Results:

The comparison of good and contaminated bearings at the different particle size at the same concentration level of 5% is performed.

The signal is taken for 75µm,106µm and 150µm at the various speed of 900rpm, 1500rpm and 2100rpm at various loads (0kg,1kg,3kg,5kg).

3.1.RMS Reading:

Fig :3.1 shows the RMS value based on the three different speeds (900rpm,1500rpm,2100rpm) and at various loads of 0,1,3amd 5kg.

The result compared with the Good Bearing and 5% contaminated bearing at different particle size. Graph shows that the rmsvalue increases with the loading and at certain point it denotes the failure of the bearing.

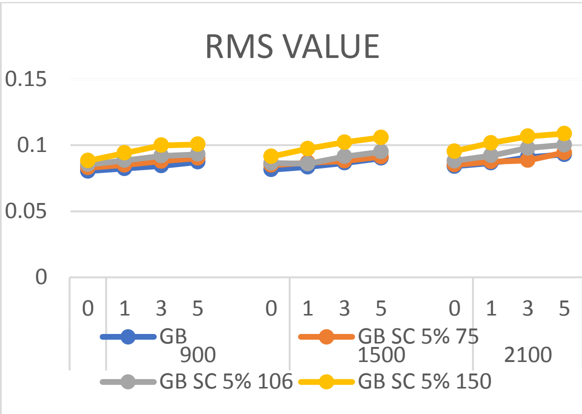

Fig 3.1

3.2. STANDARD DEVIATION:

The standard deviation is like the average deviation, expect the average is done with power instead of amplitude. By squaring each deviation before taking average and then square root is taken.

Fig:3.2 shows the standard deviation based on the different particle size, different speeds, and different loads. The standard deviation is compared with the good bearing with the different levels of particle size.

The results show the if the particle gets increased the life of the bearings simultaneously decreased. The bearing failure can be determined by this way.

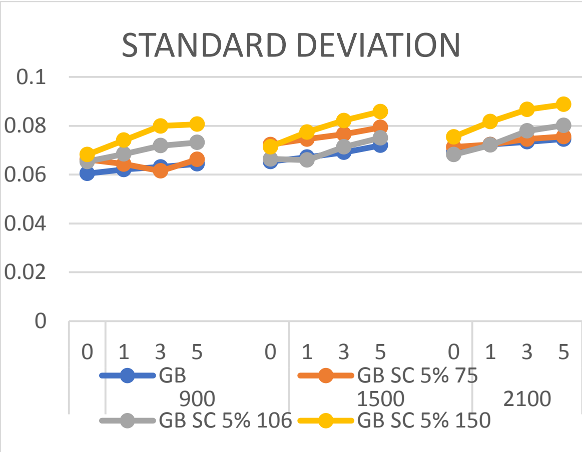

Fig:3.2

3.3. PEAK:

Fig:4.3 shows the Peak based on the different particle size, different speeds, and different loads. This also another parameters of the detection of sound in this the value 0.4 to 0.8. in this the lower particle size does not affect the much

But larger particle size will cause more changes in the value of the graph.

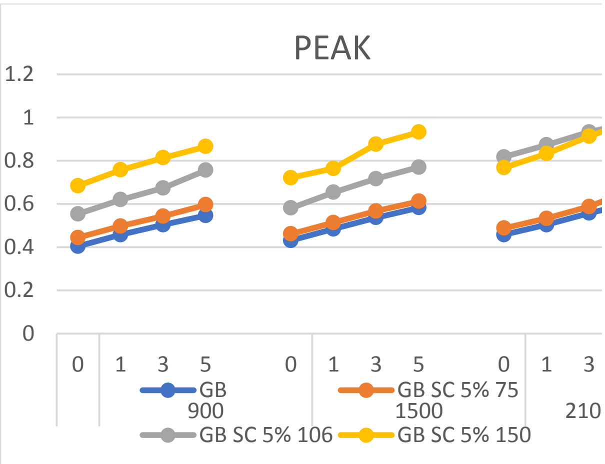

Fig:3.3

3.4. CREST FACTOR:

Fig:3.4 shows the Crest factor based on the different particle size, different speeds, and different loads.

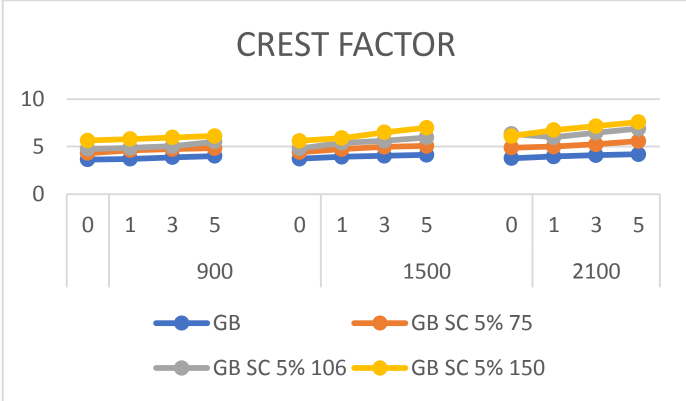

Fig 3.4

3.5. KURTOSIS:

Fig:3.5 shows the Kurtosis based on the different particle size, different speeds, and different loads. This value is also the major part that plays in life time of the bearing.

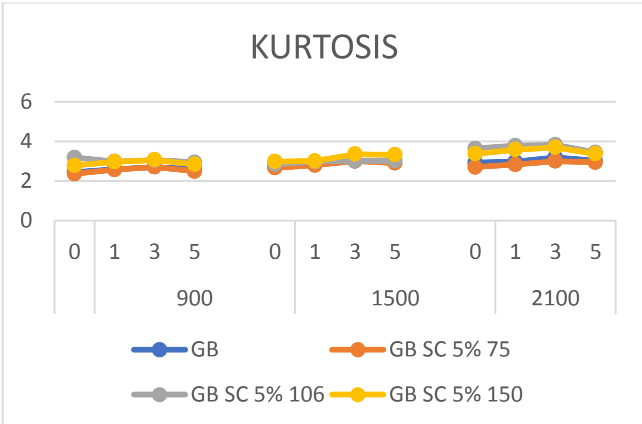

Fig 3.5

IV.CONCLUSION:

From the above analysis the energy level is more, since wear defects occurred on the surface of bearing parts by contaminants. The higher particle size of contaminant affects the bearing performance more than the other two particle sizes. By this the majorly noted parameters are kurtosis, RMS and standard deviation. These results show if the particle size increases the defect on the bearing also increase simultaneously. Thus, with this any one of the parameters we can determine the level of solid contamination that affected the balls and inner race of the bearing. By this we con0clude increase in the acoustic emission on the bearing denotes the increase in contamination level, increase in defects.

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