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A Review on Bearings of Casting Shakeout

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Abstract

The present review provides the brief information about the casting shakeout machine used in the foundry industry and the actual shakeout process. The bearing used in the casting shakeout machine plays a vital role in complete shakeout process. Roller element bearings are used in the casting shakeout machine. Here, the failure of roller element bearing is also discussed in detail. In particular, the fault detection in the rolling element bearing of casting shakeout, diagnosis of the fault and also the prognosis, which is in combine called as condition based maintenance (CBM) is discussed in this paper. The emphasis has been put on various prognosis methods used for bearings. Although lot of work has been carried out in the area of bearing fault diagnosis but area of bearing prognostics need to be explored to estimate correctly remaining useful life (RUL) of bearing. Further development is required particularly for difficult cases of rotating machinery in practical applications, where number of failure modes could be expected due to different loading and operating conditions. Accurate bearing prognosis requires signals from several sensors which are costly and difficult to install in already mounted industrial machines. All these methodologies related to the bearings of casting shakeout machine is discussed in this paper.
Keywords: Bearing, Casting, Diagnosis, Prognosis, Shakeout

I. INTRODUCTION

In foundry industry once the molten metal has been poured in cavity of mould box to produce a casting, the solidification starts within 3 minutes. The whole assembly containing mould and casting is processed to shake out after the span of 1-2 minutes. In shakeout process, the casting and mould are kept on vibrating deck with jerk. Due to vibrations of deck, sand is separated from casting. After the separation, sand is processed to sand plant through hopper which is fixed below the casting mould vibrating screen to the conveyor. The various parts of casting shakeout machine are shown in figure 1.

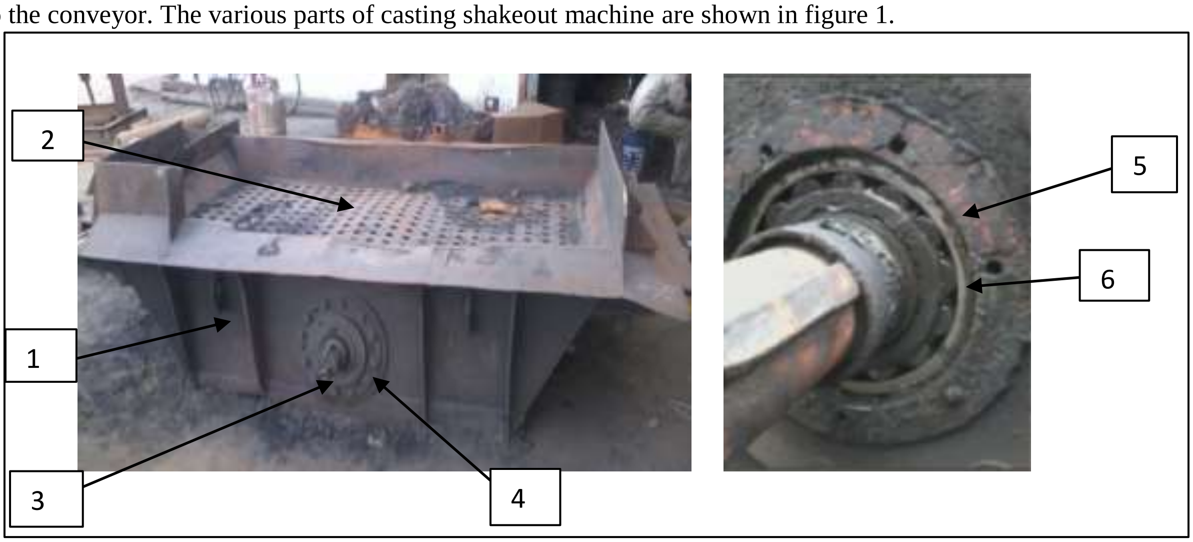

Fig. 1: Parts of casting shakeout machine

Where, 1-Body, 2-Deck, 3-Center shaft, 4-Bearing housing, 5-Outer races, 6- Roller

The bearings used in casting shakeout machine in the foundry industries are rolling element bearings.

II. ROLLING ELEMENT BEARINGS

The rolling element bearings are widely used in industrial machinery to allow relative motion and support shaft load. In these bearings, a Rolling Contact Fatigue (RCF) occurs due to the result of cyclic stresses developed during operation and mechanism that involve in fretting failure of rolling element bearing. Rolling contact fatigue includes tri-axial stress state, high hydrostatic stress component, non-proportional loading, and during loading cycles changing planes of maximum shear stress, that leads to sub-surface cracks. Sliding forces can cause failure to originate at the subsurface that propagate parallel to the surface and it may significantly reduce bearing life. Rolling contact fatigue may divide into two categories i.e. surface and sub-surface initiated. Further classification of RCF can be done by location and appearance of the fatigue, and factor that leads to crack initiation which causes bearing failure. These factors may relate to lubrication, materials, operation and mountings. The details of rolling element bearing are shown in fig.2. [1]

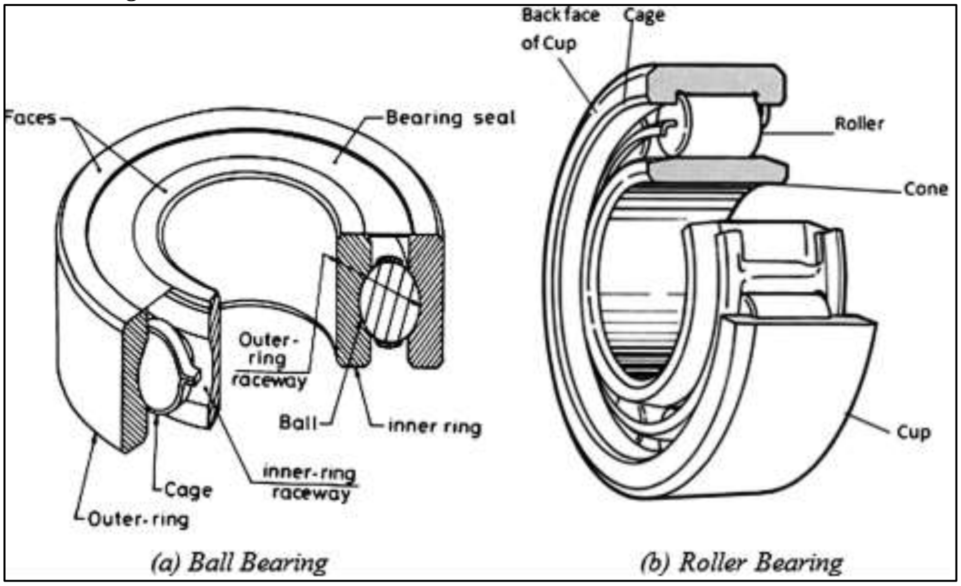

Fig. 2: Rolling element Bearings

III. Fault Diagnosis of Rolling Element Bearings

The fault diagnosis of rolling element bearings is based on discrete wavelet transform (DWT) and wavelet packet transform (WPT). In order to obtain the useful information from raw data, db02 and db08 wavelets were adopted to decompose the vibration signal acquired from the bearing. Further De-noising technique based on wavelet analysis was applied. This de-noised signal was decomposed up to 7th level by wavelet packet transform (WPT) and 128 wavelet packet node energy coefficients were obtained and analyzed using db04 wavelet. The results show that wavelet packet node energy coefficients are sensitive to the faults in the bearing. [2]

Prompt diagnostics of rolling element bearings fault is critical not only for the safe operation of machines, but also for the reduction of maintenance cost. The vibration based signal analysis is one of the most important methods used for condition monitoring and fault diagnostics of rolling element bearings because the vibration signal always carry the dynamic information of the system. The selection of proper signal processing technique is important for extracting the fault related information. Over the years with the rapid development in the signal processing techniques, for analyzing the (FFT) and Short Time Fourier Transform (STFT) are well established. Fourier analysis is one of the classical tools to convert data into a form that is useful for analyzing frequencies. The Fourier coefficients of the transformed function represent the contribution of each sine and cosine function at each frequency. The defects in rolling element bearings are categorized as localized and distributed defects. Pitting, spalling etc. are the examples of localized defects while waviness, surface roughness, misaligned races are the examples of distributed defects. [3]

IV. Prognosis of Rolling Element Bearings

The presence of faults in bearings results in severe vibrations of rotating machinery. Timely detection of these faults and estimation of the time required due to failure are the areas of concern for researchers because abrupt failure of bearings may cause malfunctioning of the entire system and this result in downtime for the system and economic loss to the customer. A bearing failure also has the potential to damage machinery causing soaring machinery repair and/or replacement costs. Thus for the last decades, condition based maintenance (CBM) has been the subject of extensive research. Fault detection, diagnosis and prognosis are the three main stages of CBM. Detection comprises of determining that the damage has occurred to the bearing, while diagnosis is a determination of the location and type of fault, whereas prognosis involves estimation of the remaining life of the damaged bearing and investigation of failure modes. A significant objective of CBM is to predict the machine health or the remaining useful life (RUL) instead of its service time, which leads to anticipated usage of the machine, reduction in downtime and enhanced operational safety. Assessment of bearing performance degradation is more effective than fault diagnosis to realize CBM. An effective prognostics program provides sufficient time to schedule a repair and to acquire ancillary components before catastrophic failures occur. [4]

In prognostics, failure progression should be modeled and forecasted in addition to the diagnostics. The prognostics methods can be broadly grouped into two categories: physics-based and empirical-based. Physics based methods analyze the physical nature of the system and have potential to lead to precise estimations if it can be modeled properly. However, reaching to perfect physical modeling is very difficult, if not impossible, especially for complex systems. Even though physics based prognostics models have been attempted for a variety of mechanical components with some success and might give better results than empirical-based models, they are much more expensive to implement. In addition, the replication of a physics-based method to slightly different equipment is prohibitive and intractable. Any small modification in the material or sub-component of the system will lead to need of remodeling. Physics based methods also have scalability problems. Bearings are unique in failure progression since spall formation occurs as a result of thousands of small cracks rather than the propagation of a single dominant crack. Thus, traditional fatigue modeling cannot represent the failure progression perfectly. Empirical prognostic methods can be grouped into three categories: First approach, evolutionary prognostic, involves trending of features combined with simplistic thresholds set from past experience and analysis of change rate from current condition to the known failure in feature space. FFT, Wigner-Ville distribution, wavelet, Hilbert-Huang transform, blind source separation, statistical signal analysis are examples of the first group. Second approach in empirical prognostic methods is to utilize statistical regression models and/or computational intelligence methods such as Artificial Neural Network (ANN)-based, Genetic Algorithm (GA)-based, Fuzzy Logic (FL) based methods to model known failure degradation paths in feature space. Thus, some valuable properties (features) of signals are extracted and used in intelligent systems for processing. Third approach, future state estimation, estimates a state vector that represents the equipment health condition from brand new to failure by employing subspace and non-linear dynamic methods. These methods forecast the progression of health states of the machine from current state estimated by diagnostician to the failure state by employing transition probabilities between states and time spent in each state. [5]

V. Conclusion

Thus, from the above literature we can conclude that, the role of rolling element bearings is important in the casting shakeout machine. Failure of the bearing results in the stoppage of the machine for maintenance which increases the idle time and also the production loss. So, the faults in the bearing must be detected properly and immediately after the detection of faults, the diagnosis must be done in order to find out the exact location of the fault in the bearings of casting shakeout machine. As soon as diagnosis is over, the prognosis should be done before directly doing the maintenance of the machine. From the prognosis, we can predict the remaining useful life (RUL) instead of its service time, which leads to anticipated usage of the machine, reduction in downtime and enhanced operational safety.

References

[1] R. K. Upadhyay, L .A. Kumaraswamidhas and Md.Sikandar Azam, “Rolling element bearing failure analysis: A case study,” in elsevier, (2013), pp. 15–17.
[2] P. G. Kulkarni and A. D. Sahasrabudhe, “Application Of Wavelet Transform For Fault Diagnosisof Rolling Element Bearings,” in IJSTR, vol. 2, issue 4, April 2013, pp. 138-148.
[3] D. Azad and K. Ramji, “Identification of bearing assembly defects using Finite Element Analysis and Condition Monitoring Techniques,” in IJERT, Vol. 1 Issue 6, August – 2012, pp. 1-13.
[4] N.S. Jammu and P.K. Kankar, “A Review on Prognosis of Rolling Element Bearings” in IJEST, Vol. 3 No.10 October 2011, pp. 7503-7497.
[5] F. Camcia, K. Medjaherb, N. Zerhounib and P. Nectouxb, “Feature Evaluation for Effective Bearing Prognostics,” published in "Quality and Reliability Engineering International”, 2012, pp. 1-15