VIBRATION ANALYSIS OF THE RMHS (RAW MATERIAL HANDLING SYSTEM) BOOSTER FAN

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Abstract- Prevention is better than cure. Machine vibration is a useful indicator of machine condition. Vibration monitoring and analysis is a preventive tool that is applied to various bearings and gearboxes used in industries to understand the machine condition and take preventive action that helps avoid sudden breakdown, increase machine durability, and efficient machine performance. The objective of this study is to gather data using a specific tool and analyze the data. The analysis identifies the location of the defect and eliminates vibration sources which may cause detrimental effect to the machinery or the process.

Keywords- Vibration, demodulation, condition monitoring, vibration analysis, spectrum

I. INTRODUCTION

Condition monitoring techniques can be used easily to indentify bearing health and performance. The available condition monitoring techniques to monitor the health of a bearing are wear debris analysis, motor current analysis, noise monitoring, temperature monitoring, and vibration monitoring etc. Among these techniques, vibration monitoring is the most useful technique because of its reliability and sensitivity to fault severity. A bearing becomes a source of vibration and noise if defects are present in parts of bearing. These vibration signals give us overall information about the condition of bearing. Vibration monitoring is the most popular technique to diagnosis fault of rolling element like bearing. In this research, I used the FAG Detector III as a vibration measuring device and data collector. Together with the FIS Trendline 3 software, the device allows improved planning of maintenance and increased machine availability. By using the Detector III, I monitored machine vibrations according to ISO 10816 and roller bearing condition by means of the demodulation detection method. The base curve and demodulation signals stored in the system were used to analyze the signals in the time and frequency range.That allowed detection of alignment errors and imbalance as reliably as a roller bearing damage or gearing problems. Other process parameters that can be recorded are temperature and rotational speed.

II. ANALYZING VIBRATION

Sometimesa mere feeling, watching and listening can determinethe severity of some vibrations i.e., sometimes hot or noisy machines indicates that some things are wrong about it. It's better to express vibration numerically rather than verbally. The two major numerical descriptors are amplitude and frequency. Amplitude is related to the severity of the vibration; higher amplitudes are usually more prone to vibrations. The overall vibration measurements are normally expressed in terms of RMS [2]. Root mean square (RMS) amplitude indicates the energy of vibration. The RMSvalue should always be lower than peak amplitude. The above feature is useful to track the overall noise level but it does not track which component is failing. However, it gives a good idea about the imbalance of the rotating system [3].The rate at which the machine component oscillates is called the vibration frequency or the oscillation. Frequency shows the oscillation rate of vibration [1]. Higher vibration frequency indicates faster oscillations of a machine. Generally, the units used to express the frequency are cycles per second (cps), cycles per minute (cpm) and Hertz (Hz).

1 Hz = 1cps= 60 cpm.

How the vibration level changes with time is graphically represented by waveform[1]. Duration and resolution of a waveform contain the basic information. The total time period over which the information is obtained from the waveform is called the duration. The level of detail is defined as resolution or the number of samples present in the waveform.

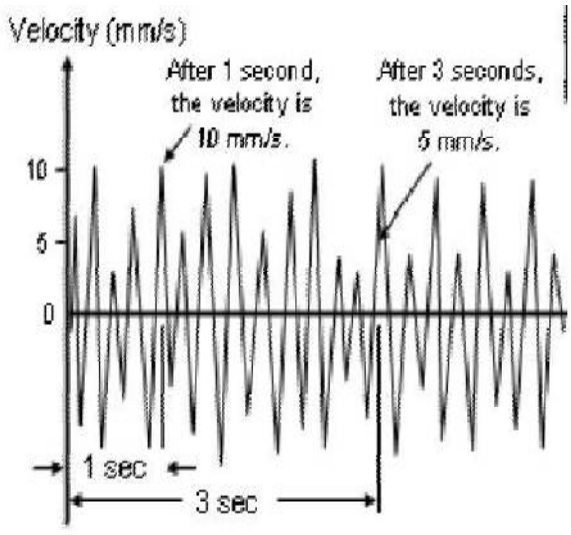


Fig. 1 waveform

A spectrum is also used in vibration analysis which is analogous to a waveform. Spectrum is a graphical display of the frequencies at which a machine component vibrating[1]. It is a very effective analytical tool for vibration analysis. F_{max} (maximum frequency) of a spectrum helps to analyze vibration. The F_{max} depends on the operating speed of the machine. Resolution depends on the spectral lines; more spectral lines give a more detailed spectrum.

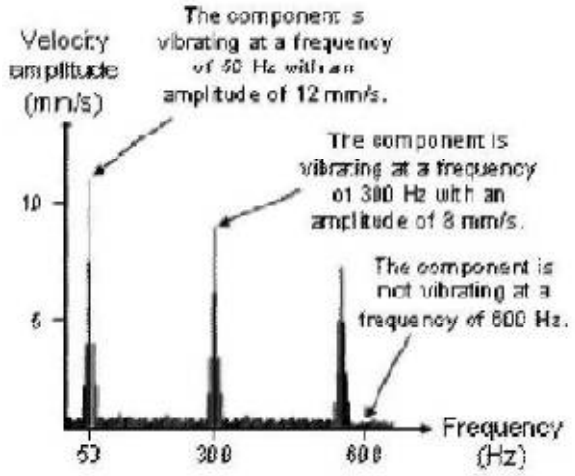


Fig.2 spectrum

III. FREQUENCY DOMAIN TECHNIQUES

The most popular approach for diagnosing bearing defects is frequency domain, also known as spectral analysis. Fast Fourier Transform (FFT) is a mathematical tool that converts time-domain vibration signals trace into a series of discrete frequency components. The Fast Fourier Transform (FFT) is an algorithm for calculation of the Desecrate Fourier Transform firstpublished in 1965 by J.W.Cooley and J.W.Tuckey [4]. In a frequency spectrum plot, frequency is shown in X-axis and the amplitude of displacement, velocity, or acceleration is shown in Y-axis. The frequency-domain analysis exceeds time-domain analysis bythe ability of detecting the certain frequency components of interest. James Taylor [5] well explained the sequence of appearing and disappearing of peaks in the spectrum.

Another popular technique, known as envelope analysis or amplitude demodulation is used to detectincipient failure of rolling element bearing. This method was addressed differently by different researchers, such as high-frequency resonance technique [6]-[9], amplitude demodulation [10], demodulation resonance analysis and narrow-band envelope analysis [11]-[12]. Envelope analysis or amplitude demodulation technique can extract the periodic impacts from the modulated random noise produced within a deteriorating rolling element bearing. This process is eligible if the signal from the rolling element bearing is relatively low in energy and buried within the other vibrations produced from the machine.

Suppose, there is a defect on any element in a rolling element, when the rolling element or another surface in the bearing passes over this defect produces impulse or impact of very short duration. The energy of this impact is distributed at low level over a wide range of frequencies. As identification of bearing defect is difficult for the presence of normal spectrum due to the vibration of other machine parts.This impact excites the natural frequency of the bearing element resulting in the increase in vibration energy at a much higher frequency than the vibration generated within other machine elements. In envelope spectrum, periodic impacts show up as a peak at the characteristics defect frequency corresponding to the faulty bearing element.Spyridon and Ioannis [13] studied vibration signals of the radial ball bearings which was loaded in a radial direction and compared the results taken from FFT and envelope analysis and conclude that bearing fault can be easily found by using FFT whereas envelope analysis is a tool for detection of the bearing failure.

IV. BEARING INFORMATION

The bearing specification is given in the table:

Table No: 01

Bearing No	Bearing Cover No
22219 EK C3	SNL 519-616

V. MEASURING PARAMETERS

1. The template is created using the Trendline software.
2. Motor rpm is given(For the RMHS Booster Fan rpm is 1490)
3. Tolerance is given
4. Type of the machine (machine class) according to its power is selected.
5. Alarm type is selected to always.

VI. MEASUREMENT PROCEDURE

By using Trendline software templates are created. Created template transferred from the computer to the detector (accelerometer). A sensor (magnetic foot) was attached to the detector. Thesensorwas attached to different position of RMHS (Raw Material Handling System) Booster Fan whose vibration was to be measured. The accelerometer is used as a sensory device which produces electrical signals based on the acceleration/vibration of the vibrating component[1],[6]. After taking the data the readings were transferred from the detector to the computer for vibration analysis. This captured signal is converted into velocity signal, can be viewed as the users choice i.e., waveform or spectrum.



VII. SPECTRUM ANALYSIS

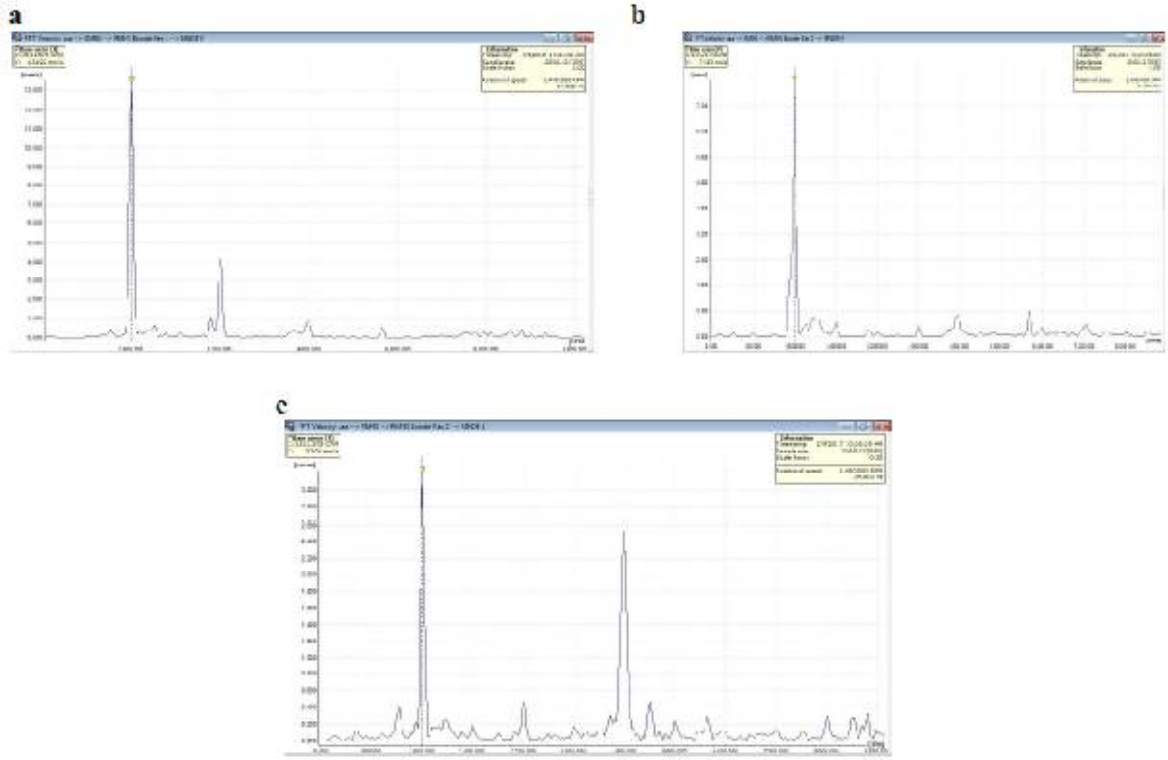


Fig3: Spectrum of Motor NonDriver End (a) vertical, (b) horizontal, (c) axial

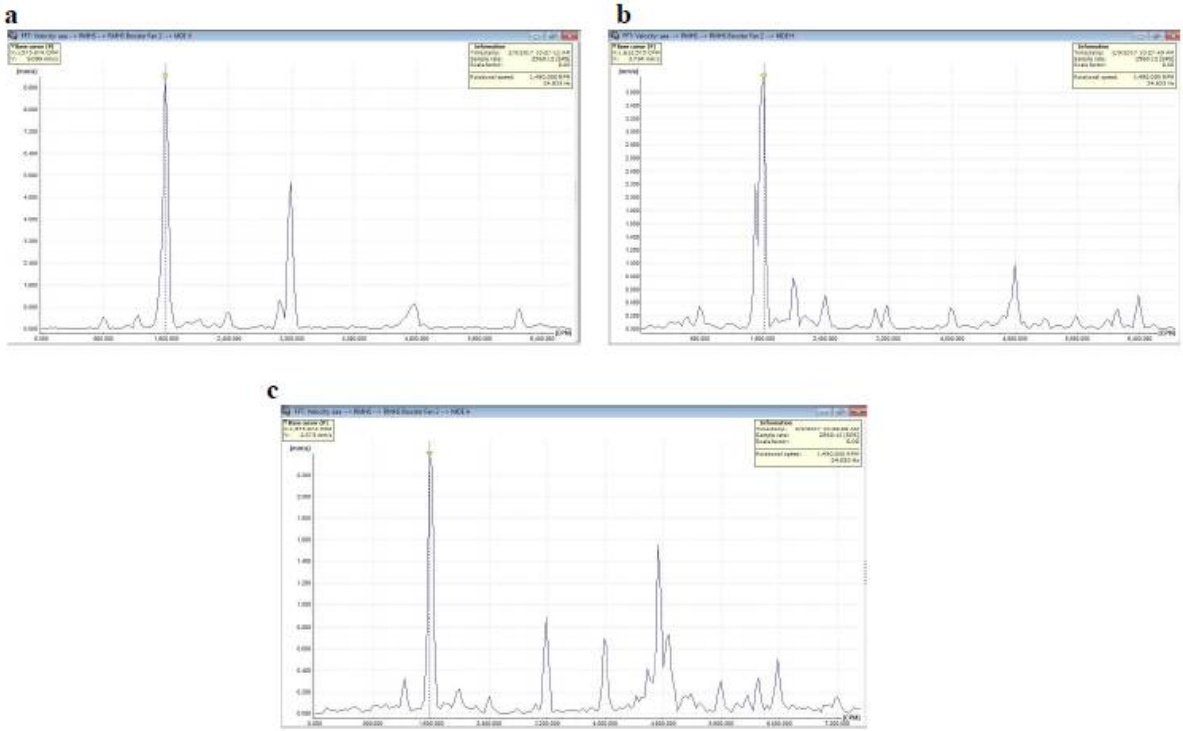


Fig 4: Spectrum of Motor Driver End (a) vertical, (b) horizontal, (c) axial

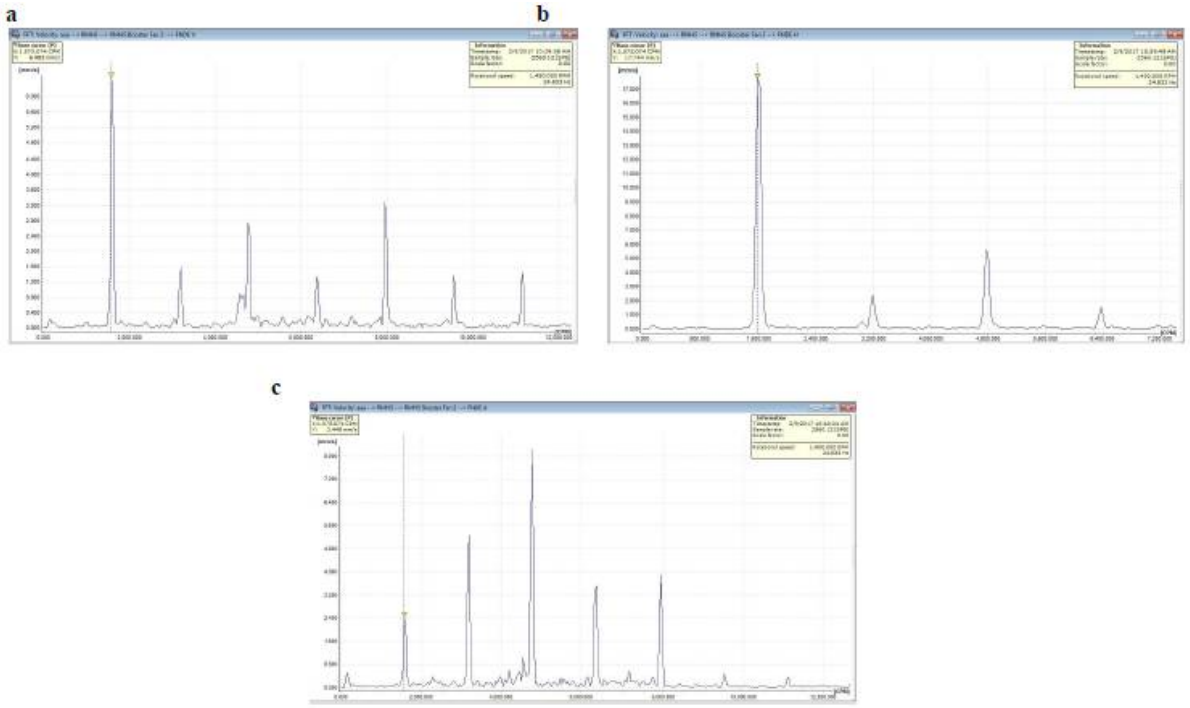


Fig5: Spectrum of Fan NonDriver End (a) vertical, (b) horizontal, (c) axial

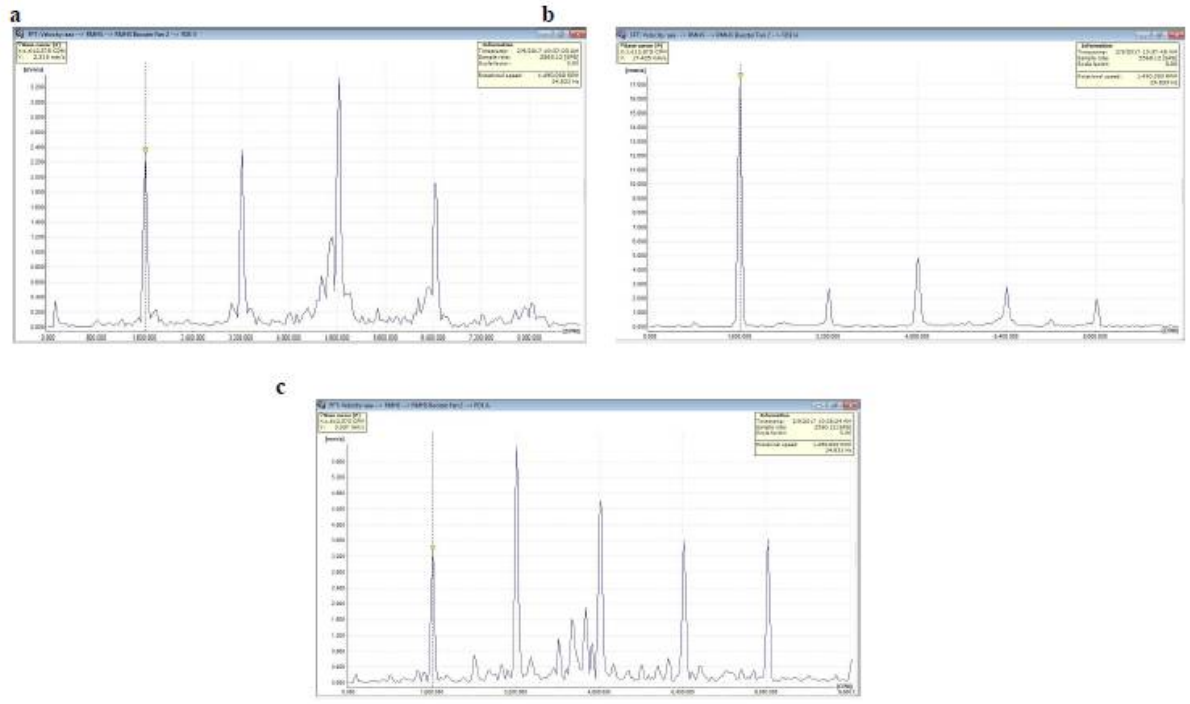


Fig6: Spectrum of Fan Driver End (a) vertical, (b) horizontal, (c) axial

CONCLUSION

From the above figure, we can see that in most of the cases the highest peak is approximately in 1x position. From the spectrum I came to a solution that there must be the following defects:

- Base looseness
- Balancing problem.

I did not consider the alignment problem as the fan was driven by motor with the help of belt and pulley system. By checking,I found no base looseness. So it came to the point of checking balancing problem.

For solving balancing problem, we have to clean the Fan first. Because accumulated dust may evolveunbalancing situation. And if it does not solve the vibration problem then we have to go for the Balancing solution.

Fortunately, after cleaning the fan properly, the vibration decreased to a reasonable limit.

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