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ORIGINAL ARTICLE

CONDITION MONITORING AND FAULT DIAGNOSIS OF A COMBUSTION FAN – AN EXPERT SYSTEM APPROACH

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Abstract:

The act of condition monitoring has actually been practiced by plant engineers for generating or estimating, how long a part of the equipment can continue in service until it needs to be shut down for repair using traditional touch, see and hear methods. The applications of computers, electronic measuring and detecting systems have provided a new approach to condition monitoring. The analysis of the information provided by the sensor output is done by using established techniques and interpretation of evaluated output, is then used to establish what actions are to be taken. The use of vibration signals is quite common in the field of condition monitoring of rotating machinery. In this paper, an attempt has been made to monitor the condition of a combustion air fan located at Wire Rod Mill Department in Visakhapatnam Steel Plant, India. The fan unit is supported by four Plummer blocks, two at motor end and the other two at fan end. Using the accelerometer, the velocities at the bearings are recorded and analyzed using ISO 2372 codes for identification of fault/ faults. The fault diagnosis had been supplemented with signatures recorded. Remedial measures are suggested to bring down the intensity of offensive signal. Fault diagnosis has been taken up with the help of an expert system developed in C#.net

KEY WORDS:

Condition Monitoring, Expert system

INTRODUCTION

Maintenance is a set of organized activities that are carried out in order to keep an item in its best operational condition with minimum cost.

Now-a-days, fault detection and diagnosis of rotating machinery is a major requirement in automation processes since the faults may cause the machine to break down and decrease its efficiency and performance. Therefore, in order to keep machine performance at its best condition and avoid malfunction, different methods of fault diagnosis have been developed and used to detect the system failure at an early stage. Maintenance has been considered as an essential activity to keep the production process goes on. For maintenance planning, some tools such as Total Productive Maintenance (TPM), Reliability Centered Maintenance (RCM) and Condition Based Monitoring (CBM)/Condition Monitoring (CM) are in practice.
Condition Monitoring (CM) is the process of monitoring an operating parameter of a machine, such that a significant change in it is indicative of developing failure. It is the major component of predictive

maintenance .The use of condition monitoring allows maintenance to be scheduled or the actions to be taken to avoid failure, well in advance.

In a continuous growing global market, productivity is playing a key role to stay competitive. For any manufacturing company, productivity can be achieved through availability. This can be achieved through adopting efficient methods like Condition Based Monitoring (CBM). It mainly uses non destructive techniques, visual inspection and performance data to assess the machine condition.

Benefits compared with other methods, Vibration analysis is by far the most prevalent method for machine condition monitoring because it has a number of advantages compared with the other methods. It reacts immediately to a change and can therefore be used for permanent as well as intermittent monitoring. Vibration severity is directly related to the energy level of machine and thus is a good indicator of the destructive forces acting on the machine.

There are hundreds of mechanical and operational problems that can result in machinery vibration. Each type of problem generates vibration in a unique way. Through the study of the resultant vibration characteristics one can reduce the number of possibilities to a root cause.

Not only can specific vibration problems be recognized by their specific frequency characteristics, but in many cases by the direction in which the vibration occurs. This is why it is necessary to record data in horizontal, vertical and axial directions for further analysis. "Stacking" the horizontal, vertical and axial data for a particular bearing on the same sheet greatly simplifies the comparison.

2. CASE STUDY

The present investigation has been carried out on combustion air fan as shown in Fig.1. It is used in Wire Rod Mill (WRM) unit of a large utility steel plant.

Combustion air fan is used for combusting process. It is used for combustion along with gas. A combustion air fan is the main component of a furnace system that forces air into furnace where heated air is needed. A furnace fan, also known as a combustion air fan can be used to force air into furnace. Fig.2 shows the schematic diagram of combustion air fan.

Details of Combustion Air Fan

Fan type	:	Backward curved
Medium	:	Air
Flow NM^3/hr	:	110000
Inlet temperature	:	36 0c
Static pressure	:	1200 bar
Efficiency	:	85%
Fan RPM	:	1500
Motor power	:	560 kw
Plummer Block	:	SNA 520
Bearing or adapter sleeve	:	22220 k/H320
Coupling	:	winel EX 9T

Fig 1: Combustion Air Fan in Wire Rod Mill Department (VSP).

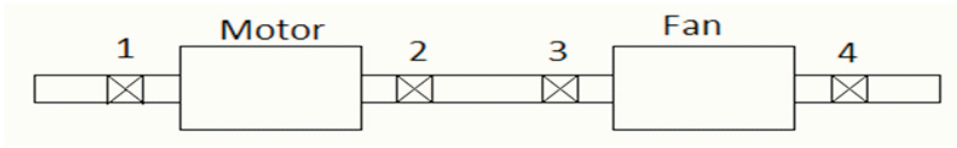

Fig.2 Schematic diagram of Combustion Air Fan

KEY POINT	LEGEND
1	Motor Non Driving End (MNDE)
2	Motor Driving End (MDE)
3	Fan Driving End (FDE)
4	Fan Non Driving End (FNDE)

3. EXPERIMENTATION

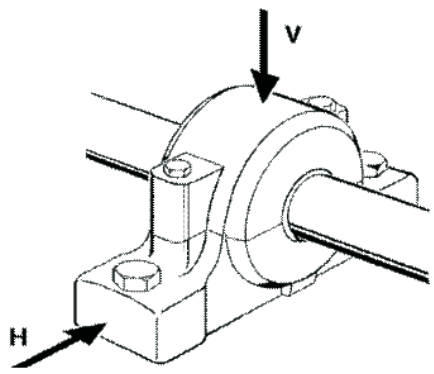

Fig.3: Tri-axial directions

4. RESULT AND DISCUSSION

Table.1 shows the Tri-Axial measurements recorded.
Station: Wire Rod Mill

Table.1 Conclusions on Measurements

Key point	Velocity (mm/sec)			Observation
	H	V	A	
MNDE	2.916	2.757	3.572	A > H > V
MDE	2.848	2.876	2.699	V > H > A
FDE	4.181	4.320	9.492	A > V > H
FNDE	4.274	5.020	6.399	A > V >H

Tri-Axial measurements are compared. According to the ISO standards, for a speed of 1500 RPM the allowable velocity is 7.72 mm/sec. From observation, the velocity at FDE in axial direction is exceeding the standard value. Now it is confirmed that the problem is at FDE. At this bearing, Horizontal, Vertical and Axial values are compared to the ISO standards and we got the comparison A > V > H, which is an indication of soft footing.

The signature obtained at FDE in axial direction is shown in Fig 4. The maximum peak value is observed at 2 X – RPM.

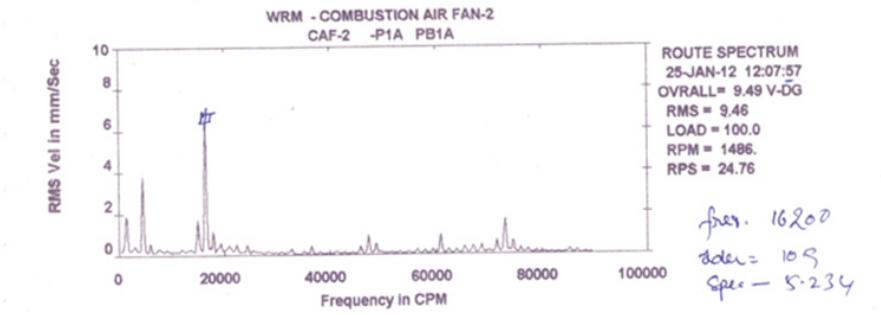

Fig.4 Signature obtained at FDE (Axial)

5. CONCLUSION

In this paper an attempt has been made to diagnose the fault in combustion air fan located at Visakhapatnam Steel Plant, India. The fan is coupled to the motor by a shaft and the shaft is supported by four bearings. Vibration data recorded clearly indicated that the FDE bearing is subjected to excessive vibrations in axial direction, whose intensity is 9.49 mm/sec. Whereas, the standard value is only 7.72 mm/sec .With the help of an expert system, it is concluded that the fault is due to Soft Footing. It is recommended to check for (I) Distortion of base frame of the bearing and (II) Distortion of foundation during next immediate maintenance schedule to bring down the intensity of offensive vibrations.

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