Chapter 1 Introduction

1.1 Introduction

In different type of industries there are few equipment which are common and only their sizes vary as per the specific need of the industry. Equipment like pumps, fans , blowers , air compressors ,cooling towers are common to all type of industries like steel plants , mines , petroleum refineries, castings ,foundries etc. and these equipment are generally known as utility equipment. Utility equipment are very vital to industry as they provide the basic input to the process machineries and any type of malfunctioning or failure of these equipment hamper the total production schedule of the plant. Of the above mentioned utility equipment blowers and fans are one of the most common equipment to industry and in this project work our primary area of work is on the vibration problem of some type of these blower units.

1.2 Industrial Blowers and Fans:

Often, the terms fan and blower are used interchangeably, and are considered synonyms of each other. Although, both are similar in terms of circulating and supplying air, technically they are quite different from each other. The main difference between a fan and a blower is based on how the air is circulated. [1]

Generally, a fan is an electrical device that moves air, whereas a blower is a mechanical device that consists of a fan, and which channels the air from the fan and directs it to a specific location or point. Also, a fan circulates the air around an entire room or a large area, while a blower is only positioned to a specific direction or point.

American Society of Mechanical Engineers (ASME) makes the specific ratio –the ratio of discharge pressure over the suction pressure –is used for defining the fans and blowers as per Table: 1

Table: 1 Pressure Ration for Fans & Blowers

Difference between fans and blowers	
Equipment	Pressure Ration
Fan	Up to 1.1
Blower	1.1 to 1.2

As this project work is on industrial blowers and vibration problems related to it, so discussions will be restricted to industrial blowers only.

1.3 Industrial Blowers:

Blowers are broadly of two types. (a) Positive displacement blowers and (b) Centrifugal blowers. [2].

1.3.1 Positive Displacement Blowers

A positive displacement blower utilizes positive displacement technology by trapping a certain volume of air then discharging it or forcing it out against system pressure. [3] To put it simply, positive displacement blowers trap and then release the air.

Positive displacement blowers maintain a constant speed and flow regardless of changes in pressure. These blowers move both air and neutral gases.

In this project however the basic work is with centrifugal blowers and its related vibration problem.

1.3.2 Centrifugal Blowers:

Centrifugal blowers are the most common blowers used in any industry at such areas as boilers, chimneys, ventilation and cooling units. They're also used to transport gas and control air pollution.

When an air stream passes through this blower's rotating impellers, it increases in both speed and volume. Centrifugal blowers actually change the airflow's direction as well. The air or gas enters the fan wheel, turns 90 degrees, and speeds up before exiting the blower.

A centrifugal blower is an ideal tool to maintain a continual gas transfer. When gas passes through a centrifugal blower, it increases in kinetic energy. When the gas exits the centrifugal blower, new gas enters to normalize the gas pressure.[4] In the industry centrifugal blowers are used as induced and forced draft blowers at chimneys and blowers , as air combustion fans in burners and host of other areas.

The centrifugal blowers has been classified broadly on two aspects (a) orientation of their impeller blades (b) type of drives/

1.3.3 Classification of Centrifugal Blowers:

Centrifugal blowers have four basic impeller blade orientations, each with its specific purpose. They are radial, forward curve, backward curve & airfoil. [4]. they are also classified by their drives (a) direct drives (b) belt drives. Direct drives are of two types (a) motor driving the impeller through a shaft and coupling (b) blower directly mounted on the motor's rotor shaft. The motor mounted blowers are normally smaller blowers with advantages as fewer components to assemble, greater efficiency (no drive losses), reduced maintenance (no separate bearings or belts and greater reliability. At the plant where this project had developed there are about 80 centrifugal blowers in operation of which 20 blowers were directly mounted on the motor. The motor ratings of these motor mounted blowers ranged from 9.3 kW to 37 kW and installed at furnaces as induced draft fans, forced draft fans, combustion air fans etc.

1.4 Performance of the Motor Mounted Centrifugal Blowers:

The motor mounted centrifugal blowers ,though small in size , are installed in vital areas such as furnace burners , furnace induced and forced draft fans, furnace air curtain blowers and hence failures of these blowers would lead to plant stoppages. To ensure reliable performance of these motor mounted blowers a regular vibration monitoring schedule is in place and monitored by the plant condition monitoring team.Two such sample monitoring reports are enclosed in Appendix F

The centrifugal blowers similarly like the motor mounted ones also have a vibration monitoring schedule in place with vibration trending (Rend report enclosed in Appendix F) .While scrutinizing these vibration trends over a period of time a strange phenomenon was observed. The larger size centrifugal blowers after commissioning had a very steady vibration trend (Fig: 1.1) but the motor mounted blowers' vibration trends were constantly fluctuating (Fig: 1.2) and needed frequent corrective actions to reduce vibration amplitude with plant stoppages.

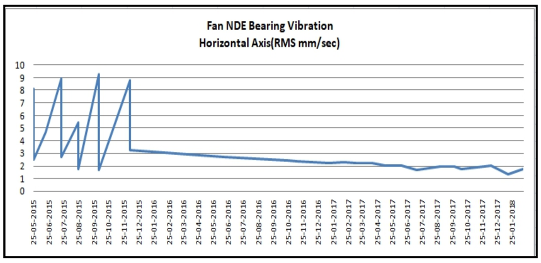

Fig: 1.1Vibration trend graph of 1120kW motor centrifugal blower

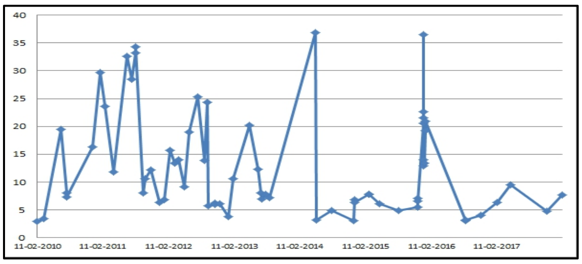

Fig: 1.2Vibration trend graph of 9.3 kW motor mounted centrifugal blower

These motor mounted blowers, as stated earlier, were installed in vital areas like furnaces, hence stoppages to rectify the faults to reduce vibration was affecting production rate.

To study and investigate the fluctuating vibration phenomenon of the small sized motor mounted variable speed centrifugal blowers became the objective of this thesis as to solve this vibration problem became a surmount necessity as it was affecting the plant's overall equipment efficiency (OEE).

1.5 Organisation of the Thesis:

Chapter: 1 This chapter introduces to the types of centrifugal blowers are being used in the industries and about the specific type of motor mounted variable speed centrifugal blowers that were operating with fluctuating vibration trend causing disruption to production schedule .To investigate and solve the problem became the objective of the thesis work.

Chapter: 2 this chapter mentions of the detailed overview of the literature survey during the investigation work to check whether similar problem has been investigated and solved in similar industries with these motor mounted centrifugal blowers. Detailed survey has also been made of failures in large type of centrifugal blowers to correlate any relation between the two types of failures. The chapter also mentions the objectives of the present research work.

Chapter 3: This chapter shows how the vibration problem of the motor mounted blowers had been identified through five specific case studies. After identifying the problem the root cause analysis had been done which led to the methodology to be adapted to find a solution to the problem.

Chapter 4: This is the most important chapter as the detailed experimentation has been shown which leads to a conclusive result. Once the result has been indicated it has been validated by the statistical method of regression analysis and also by the method of finite element analysis.

Chapter :5 This is also an important chapter as after the two successful validation of the result obtained through experimentation led to the next final step of direct application at the plant level to confirm the result obtained through experimentation and validation.

Chapter 6: This chapter concludes the thesis and indicates the scope of the future work that research scholar can do to further validate the findings of the experimentation by mathematical solution.