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Parametric Study for Evaluating Performance and Sizing of an Impeller Fan

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Abstract

Centrifugal fan plays an important role in heating application. Fans, due to their reliable and simple structure, are adopted widely in various industrial application, such as in HVAC, automobiles, ships, computer and electronic appliance units. A fan is typically a mechanical device causes a movement of air, vapour and gases in given different system. This study presents the study of important parameters of fan for best possible results. The effect of variation in these parameters is been discussed.

Under this project, testing of an impeller fan is done. This fan is used for heating purpose in the industry. Test rig has been made for the impeller fan. Testing has been carried out to evaluate the performance of an impeller fan by considering the key parameters such as flow, pressure, velocity, noise, power consumption, air temperature in various cases like considering resistance to flow with baffles and without baffles. And this results in variation in circulations per hour. From this, best possible results have been found out. After getting the best possible performance from the testing, criteria for sizing has been done as per requirement.

Keywords: Centrifugal Impeller Fan, Autoclave, Ducts, Pressure, Efficiency.

1. Introduction

Day by day heating applications have acquired more area of electrical industries. Whenever there is hig voltage in a transmission, we need transformer to withstand that voltage. While transforming the power from primary to secondary, we need proper insulation. But at ambient condition, this insulation contains moisture. This moisture reduces the resistivity, electric strength, and accelerates deterioration of solid insulation. We need heat to dry these insulation windings. This heating is done inside the vacuum chamber or it is also known as autoclave. This autoclave consists of radiators, baffles, job (any application) and inlet outlet ports for thermic fluid, processing oil required for the job.

Centrifugal fans will pump a constant volume of air rather than a constant mass at constant fan speed. Velocity of air in this fan is constant but mass flow rate is variable. Total pressure and efficiency are important parameters of fan performance. As autoclave consists of radiators, baffles .These radiators and baffles will act as a resistance to the air circulation so we should know how much percentage of the flow resistance is desirable to the air circulations. For that what changes should be made in the fan parameters & how these parameters will reduce the cost of fan and will give better efficiency of the fan. Means there are too many fans available in the market which can give same performance but from that that one will be cheaper than others so we will need to check why this is so and it would be very useful to get that fan which gives same performance as others but at lower cost.

So parametric study of fan is nothing but the checking the parameters like rpm, air circulations per hour, power requirement, noise & how does these parameters affect the operation of fan as well as motor which drives the fan. During the balancing of the fan we need precision balancing machines in order to handle the vibrations which are produce due to the imbalance. Sizing of the fan means company feels safe to work with fan at certain rpm, air circulations per hour, pressure, temperature and resistance to the flow. For that we need to adjust these parameters as per industry's requirement.

2. Concept of Heat circulation

The purpose of an impeller fan is to carry heat from radiators and discharge it to the required object in the heating oven or an autoclave. It does the work of forced convection. During heating there are constrains on the time and temperature. If we heat

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certain application more than enough time, it will burn. Considering these constrains we can increase the mass flow rate of air by increasing the rpm of fan. So in order to increase mass flow rate we need to increase circulations per hour. The difference between the surface temperature of the object and the air should be less so we can achieve this by increasing the mass flow rate. So we can heat the object with the same heat content in required time.

3. Schematic of Setup

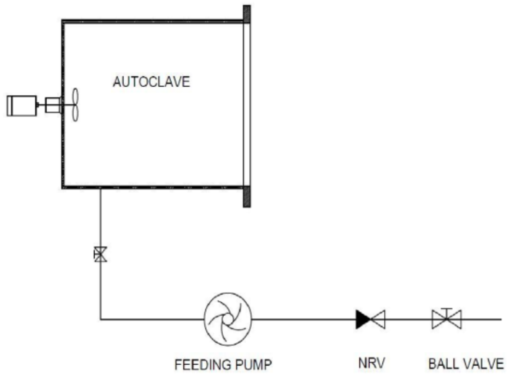

Fig.1.Schematic of Setup

3.1Testrig

Fig.2. Impeller Fan

Fig.3. Front view of testrig

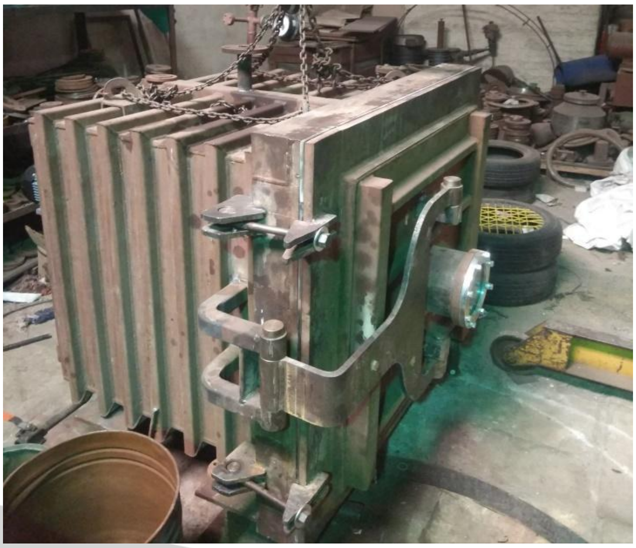

Fig.4. Test rig with door

3.2 Working of an Autoclave

Feeding pump will circulate thermic fluid through the coils surrounding the vessel. Then centrifugal fan which is located at the center of the autoclave will use the rotation of impeller to increase pressure of air. Due to impeller action, the air pressure at the outlet of fan will increase. After the air is discharged out, the air pressure at the center of the impeller will decrease. Due to this pressure drop across the impeller fan there will be air circulation in the vessel. This air circulation will carry heat from the radiator and discharge it to the application.

By using measuring instruments like anemometer, digital pressure gauge we will measure the flow rate and pressure inside the test rig. We will carry this testing by considering various cases like:

1) All ducts open

2) Upper ducts closed

4. Methodology and Implementation

The methodology for studying centrifugal fan will be of following steps:

a) Experimental validation

b) Results and Discussions

4.1. Experimental Investigation

The main particular parameters for this study of an impeller fan are pressure, speed, velocity, noise, flow. This study is about the performance of the fan in various cases such as with resistance to flow, without resistance to flow. Observing these parameters, we have to calculate circulations per hour in each case.

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5.Results and Discussions

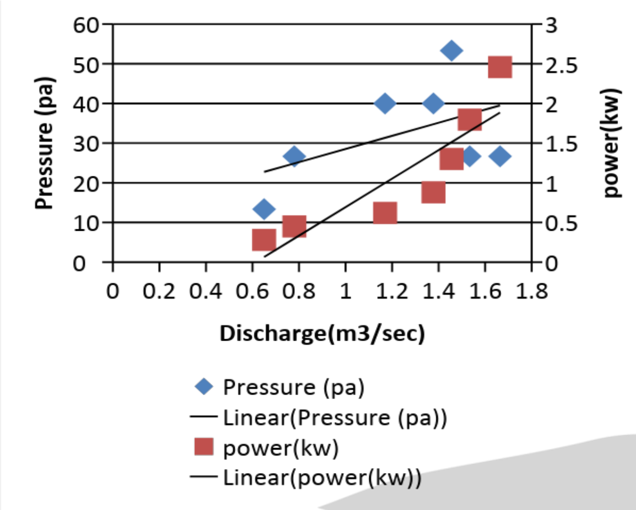

Fig. 5. All ducts open (40 NB radiater)

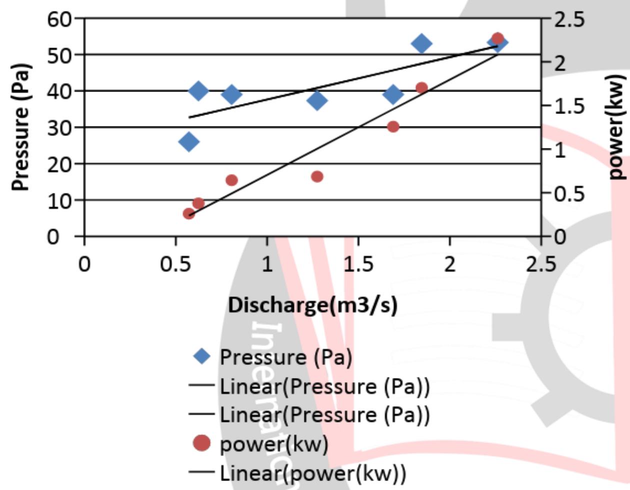

Fig.6. All ducts open (25 NB radiater)

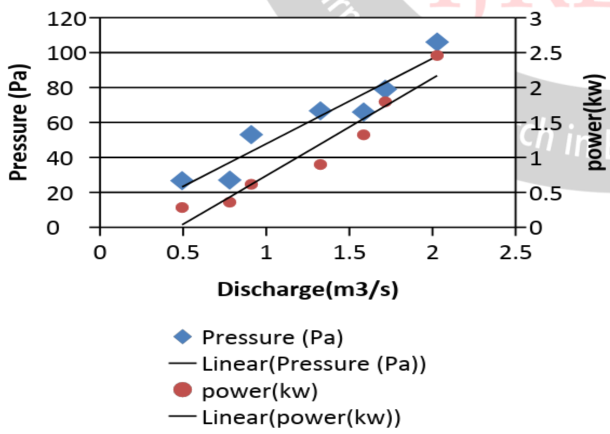

Fig. 7.Upper ducts closed

Trial 1

From above graph fig. 4.2.1 theoptimal point is at 1.45 m^3/s flow rate, the pressure is 53.238 Pa and power consumed is 1.323 kw.

Trial 2

From above graph fig. 4.2.2 the optimal point is at 1.486 m^3/s flow rate , the pressure is 53 Pa and power consumed is 1.702 kw.

Trial 3

From above graph fig. 4.2.3 the optimal point is at 2.028m^3/s flow rate, the pressure is 106 Pa and power consumed is 2.45kw.

6. Conclusions

1) After studying various parameters like pressure velocity speed in the heating oven, the results are found that, the circulations per hour increases with the rpm in each case.

2) Reducing the pipe diameter of radiator pipes, it is been observed that there is increase in circulations per hour.

3) It was found that for 40 NB pipe the circulations per hour was less than that of 25 NB diameter pipe case at same rpm.

4) Also power consumption increases with increase in rpm

5) In case of 40 NB pipe, the pressure is less than that of 25 NB pipe and the pressure is more if upper duct is closed.

6) From the study, it concludes that the mass flow rate is increased and the temperature difference is decreased, thus giving same content of heat, as we cannot increase the temperature beyond some limit for every object, the mass flow rate can be increased.

7. References

Aakash Pankaj, Hemang R. Dhameia, "*Analysis of centrifugal Fan Impeller*" 9 september 2015

Prof. Ajay Bangar, Prof. Rajan Sharma, Prof. H.P.Tripathi&AnandBhanpurkar, "Comparative Analysis of Moisture Removing Processes from Transformer which are Used to Increase its Efficiency", Global Journal of Researches in Engineering Mechanical and MechanicsEngineering, Volume 12 Issue 5 Version 1.0, Year 2012.

Osborne, W C Turner, C G(Eds.), Woods Practical Guide to Fan Engineering, Woods of Colchester

Madison, Richard D., fan Engineering, 5th Edition, Buffalo Forge Company

O. P. Singh1*, Rakesh Khilwani2 , T. Sreenivasulu1 , M. Kannan1, "Parametric study of Centrifugal fan performance: experiments and numerical simulation" International Journal of Advances in Engineering & Technology, May 2011. ©IJAET ISSN: 2231-1963

Keyur K. Patel, Prajesh M. Patel, "*Performance improvement of centrifugal fan by using CFD*" International Journal of Advanced Engineering research and studies, E-ISSN2249-8974.