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Parameter Affecting the Performance of Axial Fan Performance

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Abstract

In this paper study has been carried out on the different parameter which is affecting the performance of axial fan. For that Pitching angle, Number of blade, Tip clearance, Duct Leakage, Blade chord angle, Erosion and corrosion parameters have been considered

1. Introduction

This paper represent the factor affecting the performance of axial fan. Basic parameters affecting the performance of axial fan are listed below.

1) Pitching angle
2) Numbers of blade effecting the blower design
3) Tip clearance
4) Duct leakage
5) Location of maximum thickness
6) Blade chord angle
7) Erosion and corrosion of blade

2. Pitching Angle

[(1)]The variation pitch angles of the impeller improving flow and static pressure of were analyzed to improve the flow rate and the static pressure of a turbo fan. After we analyzed effect of the pitch angle variation on the flow rate and static pressure, we reached the following conclusion.

1) By comparing the flow rate of 1,175 CMH, 1,270 CMH,1,340 CMH, and 800 CMH of the each pitch angle of 44°, 54°, 59°, and 64° respectively, the largest flow rate can be obtained by the pitch angle of 59°.

2) The static pressure difference between the impeller by the pitch angle variations of 44°, 54°, 59°, and 64° were, 120 Pa, 214 Pa, 242 Pa, and 60 Pa, respectively. The pitch angle 59° showed the highest static pressure.

3) In order to increase the flow rate and the static pressure of the axial flow turbo fan, the 59° of pitch angle should be adopted.

3. Numbers of Blade Affecting the Blower Design

[(2)]For large commercial machines, the upwind, three-bladed rotor is the industry-accepted configuration. Virtually all large machines installed during the last several years are of this configuration. The three-bladed rotor offers the following advantages over the two-bladed configuration. Although the upwind choice is based largely on noise considerations, it also results in lower blade fatigue. Tower-shadow noise and impulsive blade loading for an upwind rotor are less than for a downwind rotor that passes through the tower wake. For an upwind rotor, the blade-number choice is then a balance among blade stiffness for tower clearance, aerodynamic efficiency, and tower-shadow impulsive noise. The three-bladed rotor configuration appears to provide the best balance. For a given radius and airfoil thickness, more blades result in lower blade flap stiffness. With three blades, adequate flap stiffness is still achievable to avoid tower strikes and the blade loading is low enough to avoid annoying impulsive noise. Aerodynamic efficiency increases with increasing blade number[2] with diminishing return (see Figure 1). Increasing the number of blades from one to two results in a six-percent increase in aerodynamic efficiency, whereas increasing the number from two to three yields only an additional three-percent. Further increases in blade number sacrifice too much blade stiffness for a minimal increase in aerodynamic efficiency. For small machines, the aerodynamic-efficiency increase resulting from more blades for a constant solidity rotor is diminished somewhat by the lower Reynolds numbers.

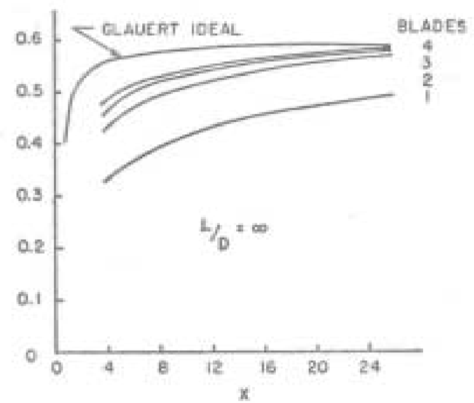

Figure 1. Aerodynamic efficiency versus tip-speed ratio as affected by blade

4 Tip Clearance

[3]An efficient numerical method was employed to investigate the effects of different rotor blade tip gap shapes on aerodynamic performance of an axial compressor stage under the compressor design speed. From computational results of flow parameters and compressor efficiency, the following conclusions can be drawn:

1. The rotor blade with zero gap has higher efficiency and higher pressure ratio.
2. With increase in tip clearance both efficiency and pressure ratio is decrease.

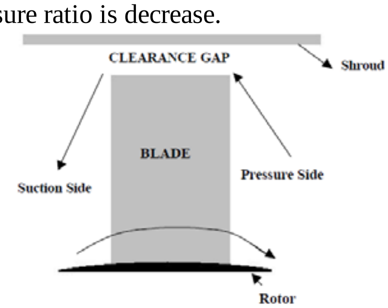

Figure 2. Clearance gap between rotor and shroud

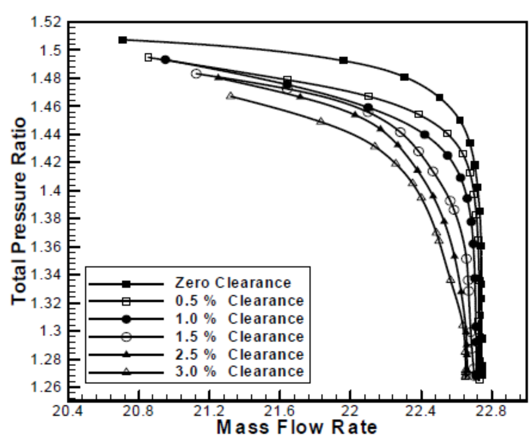

Figure 3. Total pressure ratio to the mass flow rate

The gap between this stationary casing and the blade tip is called clearance gap. The clearance gap is the region of the lower area of cross-section. The concave side of the blade is called the pressure side and the convex side is called suction side. Now figure clearly explain if the tip distance between the rotor tip and shroud is decreases then the mass flow rate increases.

5 Duct Leakage

Blower ducts are the extension pipes which carry the air from the fan to the required place. In the chemical industry and in the atmosphere where there is moisture in the nature at those places there is a chance of erosion of duct surfaces due to the corrosion. This corrosion of the duct will have holes in the duct. Due to duct leakage the air will leaked out and the discharge rate will reduce so directly the efficiency of fan reduces.

6 Location Of Maximum Thickness

As shown in the figure shock facing surface have the more stress as compare to the other portion of the blade. so as compare to other portion of to the blade the shock facing (leading edge)surface must have the higher thickness as compare to other portion and thickness reduces towards the trailing edge.

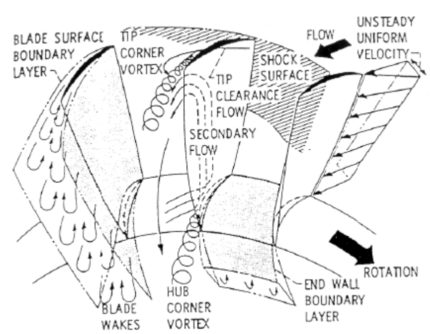

Figure 4. shock facing surface of blade

7 Blade Chord Angle

[4]If a fan continues to operate outside of the stall region of its performance curve, air flow will continue to increase as the chord angle is increased from about 20° to 60°. Many existing fan systems are operating in unknown areas of their performance curve and a change in chord angle gives unpredictable results. As shown in the figure it is clear that on increasing the chord angle the flow rate also increases

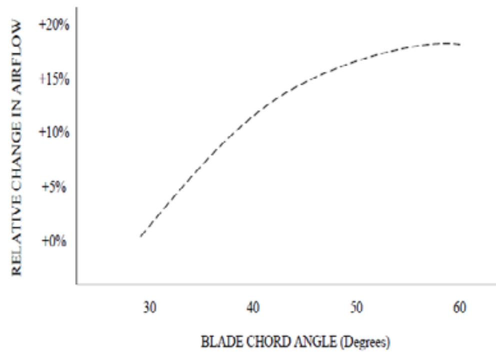

Figure 5 Effect of blade chord angle on the air flow

7 Erosion And Corrosion of Blade

By the practical observations and by the customer complains it is found that after some time due to the moisture effect the surface of the blade get affected due to the corrosion. Corrosion causes the surface rough in the nature. As the air flow strikes to the rough surface the flow of air will be deflected, this deflected air will not follow the aerodynamic shape of the blade and will strike to the casing. This striking of the air causes the vibration and that will affect the design as well.

8 Conclusion:

- By changing pitching angle of the blade from 44^o,54^o ,59^o ,64^o respectively we get the 1175CMH,1270 CMH,1340CMH & 800CMH so will get maximum discharge at an angle 59^o so to increase flow rate should blade pitching angle 59^o should be adopted.
- Increasing in the number of blade from one to two results in six percent increase in aerodynamic efficiency.
- By reducing the air gap between rotor tip and casing we can reduces the air losses and performance can be increase.
- Location of maximum thickness should be kept at the shock facing surface.
- In place of flat blades the aerofoil shape will hence smooth flow of air.
- By making the surface smooth the turbulence will reduce.

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