THOMSON REUTERS ENDNOTE

[Rana* *et al.*, 6(1): January, 2017] ISSN: 2277-9655
IC™ Value: 3.00 Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

ANALYSIS AND SIMULATION OF COOLING TOWERFAN BLADE: AN OVERVIEW

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DOI: 10.5281/zenodo.246609

ABSTRACT

Cooling tower fan wings are the rotating surface with the chosen aerofoil sections. The efficiency as well as the performance of an fan mostly depends on the aerodynamic characteristics i.e. e.g. lift,drags,lifts to drag ratio ,etc of the blades besides many factors the effects of blade where are also crucial to cooling tower fan performance. This project represents the experimental investigation to explore better aerodynamic performance by increase radial velocity of fan. The aerofoil is tested in closed circuit wind tunnel. The static pressure at different angle of attack are measured from rapper and lower surface of the aerofoil through different pressure tapings by using a multi tube water manometer from the static pressure distribution, lift coefficient, drag coefficient and lift to drag ratio of aerofoil is analysed.

KEYWORDS: Cooling tower; aerofoil;wind tunnel.

INTRODUCTION

An airfoil or aerofoil is the profile of a wing or blade (of a propeller, rotor, or turbine) or go in a boat as seen in cross-section in figure.Body having airfoil formed moved through a fluid produces an aerodynamic force. The component of this force at a 90 degree angle to the direction of motion is known as lift. The part parallel to the direction of motion is known as drag. Subsonic flight airfoils have a feature shape with a rounded top edge, and have a sharp trailing edge, often with a symmetric curvature of upper and lower surface. Foils of similar reason designed with water as the working fluid are well-known as hydrofoils The lift on an airfoil is due to the result of its angle of attack and shape. When placed at a right angle, the airfoil deflects the nearing air, this resulting in a force on the airfoil in the direction opposite to the deflection. This force is called aerodynamic force and it can be resolved into two mechanismsnamely: lift and drag. Most foil shapes require a positive angle of attack to generate lift, but cambered airfoils can generate lift at zero angle of attack. This "turning" of the air in the locality of the

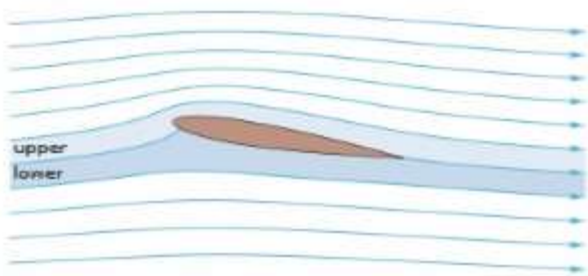

Figure 1: airfoil [1]

Airfoil creates curved streamline which results in lower pressure on one side and higher pressure on the other. This pressure difference is accompanied by a velocity difference, via Bernoulli's theory, so the resulting flow field about the airfoil has a higher usual velocity on the higher surface than on the lower surface. The lift force can be related directly to the average top/bottom velocity difference without computing the pressure by using the concept of circulation and the Kutta-Joukowski theorem.

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LITRETURE WORKS

STUDY ON THE EFFECT OF BLADE ANGLE THE PERFORMANCE OF A SMALL COOLING TOWER

This paper presents the effect of blade angles on the packing characteristic curves of a small cooling tower on the site experimental data. The volumetric heat transfer coefficient (KaV/L) can be illustrated graphically and varied with the water to air flow ratio (L/G) for the blade angles of 59°, 67 °,75°, and 83°, respectively. The curves can be constructed by the experimental data from the cooling tower testing in accordance with the procedure of CTI standard. It was found that the characteristic curves can be represented in the form of KaV/L = C (L/G)-n in the different range of L/G for each blade angle. Finally, it was found that the cooling tower can operate under all the given approaches (5°C, 6°C,7°C and 8°C) at the blade angle of 67° by maintaining the cooling range of 5°C, wet bulb temperature of 26°C, and water flow rate of 3.9 m3/h.

STUDY THE FACTORS ON WHICH EFFICIENCY OF COOLING TOWER CAN BE CRITICALLY ACCLAIMED

Water cooling is widely used in many industrial processes to control heat removal from a hot material surface. In order to control the temperature distributions, a deeper understanding more accurate estimation of spray heat transfer rates is needed. In a new technique combining experiment and computational modeling developed for water cooling. It is better to understand the heat transfer mechanisms from the combustion gases to the cooling water and then from the cooling water to the environment. To meet this need a logic tree is developed to provide guidance on how to balance and identify problems within cooling system and schedule appropriate maintenance. Fluid dynamics, Thermodynamics and Heat transfer are involved in developing a cooling system model and the operation is familiar to the general operating companies. There will be the comparison and parametric investigation of the cooling system model in the logic tree and the results are summarized as tables and charts. The objective is to identify the several ways of improving efficiency of cooling tower. In this study we are doing the comparison of some calculations regarding the cooling tower.

IMPROVING COOLING TOWER FAN SYSTEM EFFICIENCIES

After a look at the problem for air cooled heat exclaimers and cooling towers using axial fans, ways to improve system efficiencies in three m•eas are discussed: before the fim system design is finalized, improvements in the physical equipment as installed, and recognition of performance problems caused by adjacent equipment. Results of a full scale test illustrating fan system efficiency wntributions of various components are discussed.

COOLING TOWER FAN STACK REPLACEMENTTO INCREASE COOLING TOWER PERFORMANCE

Cooling Tower (CT) fan stack was designed with height of 6 feet and had relatively straight vertical panels which didn’t produce significant velocity recovery. In other hand, due to WayangWind Geothermal Plant is located in the mountain; the CT is exposed to swirling and shifting winds. These types of winds can force down the exiting plume (hot air) from the CT and drawn back into the CT which increases the entering wet bulb temperature. This phenomenon is called recirculation. The increasing of wet bulb temperature will impact to decreasing of CT performance. Star Energy Geothermal WayangWind Ltd. conducted an engineering study and recommended that CT performance can be improved by replacing the existing fan stack with higher fan stack (10 feet tall) which has a flared velocity recovery design. This new design fan stack will convert some of the wasted velocity pressure energy at the top of fan stack into useful work at the plane of the fan; therefore fan efficiency will be increased. By improving fan efficiency, additional motor power can be made available to further increase the air drawn through CT; thus, overall CT performance can be improved. In addition, this new design also reduces the effect of recirculation. The fan stack replacement work was completed in Dec 2011. CT performance test reveals data of decreasing of approach temperature as much as 1.44oC, an increasing of range temperature as much as 1.92oC, and increasing of CT effectiveness as much as 71.43% (from 66.26%). The impact is equivalent with generation improvement of 1.44 MW.

HYDRAULICALLY DRIVEN FAN SYSTEM FOR WATER COOLING TOWER

An energy conserving highly efficient hydraulically energized cooling tower fan system is provided having a rotary fan and hydraulic motor for operation thereof located at elevation within the upper portion of a cooling tower. An axial piston, variable displacement, pressure compensation hydraulic pump and its electric motor, together with a hydraulic fluid reservoir, hydraulic fluid filters and coolers arranged in closed loop assembly are located remotely from the hydraulic motor and fan assembly such as at ground level, to facilitate ease of maintenance and to minimized fire hazard and electrical hazard within the cooling tower itself. The rotational

speed of the cooling tower fan is within a predator mined infinitely variable range and is controlled responsive to the temperature sensed in the cool water basin of the cooling tower by a temperature sensor and control leer which controls the velocity of fluid output from the hydraulic pump. The hydraulic pump system is also equipped to reverse the characteristics of flow to the
Hydraulic motor to thereby reverse the operational rotation of the fan according to the temperature of water sensed within the water tower system.

HYBRID FAN COOLING TOWER

A cooling tower apparatus that extends along a vertical axis is provided. The cooling tower includes a first housing structure having an inlet and a first outlet located a first position along the vertical axis, wherein the housing structure includes a base and opposing side walls that extend along the vertical axis away from the base. The tower also includes a heat exchanger disposed in the housing structure, wherein the heat exchanger is positioned adjacent the first outlet and extends at least partially all the way across the first outlet. Finally the hybrid tower employs an air current generator positioned in a plane normal to the vertical axis and oriented to direct an air stream toward the base and through the heat exchanger and the first outlet.

COOLING TOWER FAN AIRFOILS

A family of airfoils for a blade of a cooling-tower fan, is provided wherein the blade has a root region and a tip region, the family of airfoils comprises an airfoil (30) in the root region of the blade having a Reynolds number of 500,000, and an airfoil (20) in the tip region of the blade having a Reynolds number of 1,000,000, and wherein each airfoil is characterized by a maximum lift coefficient that is largely insensitive to roughness effects

OBJECTIVES OF STUDY

From the detailed study of the above problem statement the following are the objectives that have been derived Most efficient angular velocity to be found at different angle of attack. Angle of attack v/s wind speed graphs Different air flow found at different angle of attack Lift and drag coefficient v/s angle of attack graphs Design of test section Manufacturing of the test section. Maintaining the fan speed but increasing the air flow by changing airfoils angle of attack.

CONCLUTION

Dimensional analysis concludes that the velocity of the air flow in cooling tower depends on the H (head causing flow), angle of attack, D (diameter of the tower fan), μ (co-efficient of viscosity), ρ (mass density), g (acc due to gravity).

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