EXPERIMENTAL INVESTIGATION OF WIND TURBINE PERFORMANCE CHARACTERSTICS FOR VARIOUS WIND SPEED

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ABSTRACT

The main aim of this project is to develop a domestic wind turbine which works at low wind speeds and which can be made available to the common man at a very low price Wind energy is one of the energy used to generate electric power. Which is environmental friendly, sustainable energy has promoted in this industrial world. The present global technological society is depended on the availability of energy. The development of industry, agriculture and transportation, etc. is totally depended on the availability of power. The cost of energy is increasing day by day due to the increase in the demand of power and depletion of the conventional energy resources, which are used in the generation of electricity.

Keywords: *wind turbine, generation of electricity*

1.INTRODUCTION

Wind energy is the indirect form of energy.in the world it is around 1% of solar energy is converted to wind energy. Wind is the kind of solar power that owes is origin to various environmental factors. The uneven earth's terrains get un equally heated by the sun rays. It makes some region of earth warmer than others. the hot air in the

warmer regions becomes less dense and thus it rises up. This upwardly movement of the hot air creates a vacuum which is immediately filled up by the cold air from the adjacent cooler realms.

Wind power is the conversion of wind energy into a useful form of energy such as using wind turbines to make electricity, windmills for mechanical power, wind pumps for water pumping or drainage or sails to propel ships. The total 0amount of economically extractable power available from the wind is considerably more than present human power use from all sources. Wind power as an alternative to fossil fuels is plentiful, renewable, widely distributed, clean and it produces no greenhouse gas emissions during operation and the cost per unit of energy produced is similar to the cost for coal and natural gas power production.

1.1. Origin of wind

Wind is produced by the uneven heating of the earthssurface by energy from the sun. The poles of the earth receive less energy from the sun than the equator, among these two the dry land heats up more quickly than sea. The differential heating driven a global atmospheric convection system reaching from earth's surface to the stratosphere which acts as a virtual ceiling. Since the earth's surface is made of different types of land and water, it absorbs sun's radiant energy at different rates. Much of this energy is converted into heat as it is absorbed by land areas, bodies of water and air over these formations, on a global scale, the non-uniform thermal effects combine with the dynamic effects from the earth's rotation to produce prevailing wind patterns.

These are minor changes in the flow of the air as a result of the differential heating of sea and land. The nature of terrain ranging from mountain and valleys to more local obstacles such as buildings and trees also has an important effect of the origin of wind.

1.2.Types of wind turbine

1. Horizontal axis wind turbine
2. Vertical axis wind turbine

1.2.1.Horizontal axis wind turbine

In horizontal axis turbines, the axis of rotation is horizontal with respect to the ground. In this case, the rotating shaft is parallel to the ground and the blades are perpendicular to the ground. Horizontal-axis or propeller type turbines are more common and highly develop than vertical axis turbines. A horizontal axis is simple in principle yet the design of complete system especially a large one that would produce electric power economically complex, it is of prime importance that the components such as rotor, transmission, generator and tower should not only be as efficient as possible but also they must function effectively in combination.

Horizontal axis wind turbines have the main rotor shaft and electrical generator at the top of a tower and it must be pointed into the wind. Small turbines are pointed by a simple wind vane while large tubines generally use a wind sensor coupled with a servo motor. Most of them have a gearbox which turns the blades slowly into a quicker rotation which is more suitable to drive an electrical generator.

1.2.2.Vertical axis wind turbine

In vertical axis wind turbines, the main rotor shaft arranged vertically and the axis of rotation is vertical with respect to the ground. The key advantage of this arrangement is that the turbine does not need to be pointed into the wind streams to be effective because their operation is independent of wind direction and these vertical axis machines are called panemones. It is an advantage on sites where the wind direction is highly variable. With a vertical axis turbine, the generator and gearbox can be placed near the ground so that tower does not need to support it and it is more accessible for maintenance. Drawbacks are that some designs produced pulsating torque

Aero turbines convert wind energy into rotary mechanical energy. A mechanical interface, consisting of a step-up gear and a suitable coupling transmits the energy to an electrical generator. The output of this generator is connected to the load or system grid. The controller senses the wind direction, wind speed, power output of the generator and other necessary performance quantities of the system and initiates appropriate control signals to take suitable corrective actions. The system should be protected from excessive temperature raise of the generator, electrical faults and extra wind conditions. The choice of an electrical generator and control method to be employed (if any) can be decided by consideration of the following three factors:

(i)The basis of operation i.e. either constant tip speed or constant tip speed ratio.

(ii)The wind-power rating of the turbine and

(iii)The type of load demand e.g. battery connection.

Aero turbines convert wind energy into rotary mechanical energy. A mechanical interface, consisting of a step-up gear and a suitable coupling transmits the energy to an electrical generator. The output of this generator is connected to the Battery or system grid. The battery is connected to the inverter. The inverter is used to convert DC voltages to AC voltages. The load is drawn current from the inverter. Wind result from air in motion. Air in motion arises from a pressure gradient. On a global basis one primary forcing function causing surface winds from the poles toward the equator is convective circulation. Solar radiation heats the air near the equator, and this low density heated air is buoyed up. At the surface it is displaced by cooler more dense higher pressure air flowing from the poles. In the upper atmosphere near the equator the air thus tend to flow back toward the poles and away from the equator. The net result is a global convective circulation with surface wins from north to south in the northern hemisphere.

It is clear from the above over simplified model that the wind is basically caused by the solar energy irradiating the earth. This is why wind utilization is considered a part of solar technology.It actuality the wind is much more complex

The above model ignores the earth's rotation which causes a coriolis force resulting in an easterly wind velocity component in the northern hemisphere. There is the further complication of boundary layer frictional effects between the moving air and the earth's rough surface. Mountains, trees, buildings, and similar obstructions impair stream line air flow. Turbulence results and the wind velocity in a horizontal direction markedly increase with altitude near the surface. Local winds are caused by two mechanisms. The first is differential hating of land and water. Solar isolation during the day is readily converted to sensible energy of the land surface but is partly absorbed in layers below the water surface and partly consume in evaporating some of that water. The land mass becomes hotter than the water, which causes the air above the land to heat up and become warmer than the air above water. The warmer lighter air above the land rises and the cooler heavier air above the water moves into replace it. This is the mechanism of shore breezes. At night, the direction of the breezes is reversed because the land mass cools to the sky more rapidly than the water, assuming a sky. The second mechanism of local winds is caused by hills and mountain sides. The air above the slopes heats up during the day and cools down at night, more rapidly than the air above the low lands. This causes heated air the day to rise along the slopes and relatively cool heavy air to flow down at night.

Wind turbines produce rotational motion; wind energy is readily converted into electrical energy by connecting the turbine to an electric generator. The combination of wind turbine and generator is some times referred as an aero generator. A step-up transmission is usually required to match the relatively slow speed of the wind rotor to the higher speed of an electric generator.

In Indian the interest in the windmills was shown in the last fifties and early sixties. A part from importing a few from outside, new designs was also developed, but it was not sustained. It is only in the last few years that development work is going on in many institutions. An important reason for this lack of interest in wind energy must be that wind, in India area relatively low and vary appreciably with the seasons. Data quoted by some scientists that for India wind speed value lies between 5 km/hr to 15-20 km/hr. these low and seasonal winds imply a high cost of exploitation of wind energy. Calculations based on the performance of a typical windmill have indicated that a unit of energy derived from a windmill will be at least several times more expensive than energy derivable fro electric distribution lines at the standard rates, provided such electrical energy is at all available at the windmill site. The above argument is not fully applicable in rural areas for several reasons. First electric power is not and will not be available in many such areas due to the high cost of generation and distribution to small dispersed users. Secondly there is possibility of reducing the cost of the windmills by suitable design. Lastly, on small scales, the total first cost for serving a felt need and low maintenance costs are more important than the unit cost of energy. The last point is illustrated easily: dry cells provide energy at the astronomical cost of about Rs.300 per kWh and yet they are in common use in both rural and urban areas.

2.LITERATURE SURVEY

1. Niranjana.S.J investigated the power generation by vertical axis wind turbine. In this paper the power is generated by fixing the wind mill on the road high ways .when the vehicle is passed through the road at high speed the turbine of the wind mill rotates and generates the power sources. This analysis indicates that the vertical axis wind turbine can be able to attain the air from all the direction and produces the power of 1 kilowatt for a movement of 25 m/s. The efficiency of vertical axis wind turbine can be increases by modifying the size and shape of the blade.

2. Abmjit N Roy et al. analyzed the design and fabrication of vertical axis economical wind mill. This paper indicates that vertical axis wind mill is one of the most important types of wind mill. In this main rotor shaft is connected to the wind turbine vertically with the generator and gear box which can be placed near the ground. Performance characteristics such as power output versus wind speed or versus angular velocity must be optimized in order to compete with other energy sources which make the process economically and eco-friendly. The experimental result shows that wind turbine is placed on the top of the building in an ideal position to produces electricity. The power generation becomes easy and it is used for various applications such as street light, domestic purpose, agriculture etc.

3. D.A. Nikam et al. analyzed the literature review on design and development of vertical axis wind turbine blade. This paper explains that the wind mill such as vertical and horizontal wind mill is widely used for energy production. The horizontal wind mill is highly used for large scale applications which require more space and huge investment. Whereas the vertical wind mill is suitable for domestic application at low cost. The generation of electricity is affected by the geometry and orientation of the blade in the wind turbine. To optimize this by setting the proper parameter for the blade design. The experimental result indicates that the blade plays critical role in the performance and energy production of the turbine. The optimized blade parameter and its specification can improve the generation of electricity.

2.1.Objective

The objective of this work is to develop a domestic wind turbine which works at wind speeds which can be made available to the common man. To generate power with by renewable source. Overall cost of power generation with low investment. Cost of the construction is low.

3. MATERIALS AND METHODS 3.1.Material selection

Material : ALUMINIUM ALLOY

Density : 2.70g/cm³

Tensile strength : 11MPA

Yield strength : 3.5MPA

Elastic modulus : 10GPA

3.2.Material composition

Aluminium :99.0-99.95%

Copper :0.05-0.20%

Iron :0.95%

Maganese :0.05%

Silicon :0.95%

3.3.PROBLEM IDENTIFICATION

The cost of energy is increasing day by day due to the increase in the demand of power and depletion of the conventional energy resources, which are used in the generation of electricity. So, it is very essential to make use of the non- conventional sources of energy

3.4. WORKING

The basic principle of the small wind mill power generation is that the same of the wind mill power generation. The wind mill blades or fan are connected to the shaft of the wind mill which rotates when the blades rotates through the force of the air pressure. The shaft of the generator is directly coupled with the shaft of the wind mill. When the shaft of the generator rotates some of the electric power can be produced inside the generator which can be transferred through the wires. The power produced can be transferred to the battery and can be stored inside them for the further usages. The battery in turn is connected to the inverter for the inversion of the power supply

3.4.1. Principle of wind energy conversion

The wind energy can be extracted form lift force alone or drag force alone or combination of lift and drag forces. It is known that the lift force acts perpendicular to the air flow direction and drag force acts parallel to the wind direction. The lift is produced by the change in velocity of air stream which speeds up the air flow thereby creating a pressure change in velocity of air stream lift surface from high pressure side to low pressure side of an aerofoil. If the air pressure increases on the low pressure side, enormous turbulence is produced which reduces the lift force and it leads to increase the drag significantly called stalling.

The basic features which characterize lift and drag are as follows.

1. Drag is in the direction of airflow.

2. Lift is perpendicular to the direction of airflow.

3. Generation of lift always causes a certain amount of drag to be developed.

4. With a good aerofoil as shown, the lift produced can be thirty times greater than the drag.

5. Lift devices are generally more efficient than drag devices.

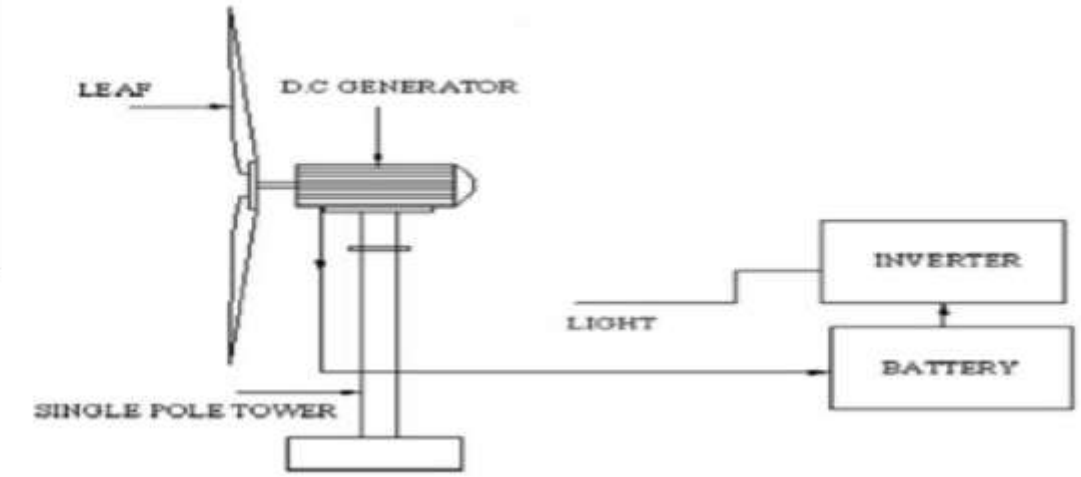

Fig.1. Block Diagram of wind turbine

3.5.NEED FOR PROJECT

The development of industry, agriculture and transportation, etc. is totally depended on the availability of power. The cost of energy is increasing day by day due to the increase in the demand of power and depletion of the conventional energy resources, which are used in the generation of electricity. So, it is very essential to make use of the non- conventional sources of energy like wind energy.

3.6.OBSERVATION TABLE

SPEED (m/sec)	OUTPUT CURRENT(A)	OUTPUT VOLT(V)	OUTPUT POWER(W)
12.7	1.3	9.1V	11.83
13.5	1.6	10V	16
12.3	1.1	8.9V	9.79
10.2	1	7.2V	7.2

Fig.2. Assembly view of wind mill

4.CONCLUSION

Thus the work of developing a domestic wind turbine which works at wind speeds and which can be made available to the common man at a very low price. Readings are taken by connecting the output of the dynamo with a multimeter with a purpose of measuring voltage. We took the readings 4 hrs the average wind speed were calculated using anemometer and power is stored in battery.

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