Research Based Learning

INVESTIGATORY STUDY

On the topic

"Harnessing Wind Energy for Electricity Generation in Highways"

By Mast Yatharth Choubey and Mast. Naman Mehta

Learning Objective:

- ***To develop the scientific temperament of the students and to think of their scientific contribution to the society (Value based development)***
- ***Team Work***
- ***To relate the topic with the chapter sources of energy – Class X – Physics as per the CBSE curriculum***
- ***Implementation of theoretical topic in practical manner***

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Harnessing Wind Energy for Electricity Generation in Highways

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Abstract: Wind energy is one of the non- conventional forms of energy and it is available in affluence. Electricity can be generated with the help of wind turbine. This projects aims of utilizing this wind energy in most effective manner to get the maximum electric output, and therefore harnessing selected highway as our installation site where we can take the advantage of the moving vehicles on both the sides of the road. In the present work, turbine is design and fabricated as per the specifications, the blades used are semi-circular shape and are connected to the disc which is connected to shaft. Shaft is then coupled with pulley with the help of bearing, and then pulley is connected to the alternator, which generates the power. The power developed is stored in battery and then can be used for street light, signal or toll. In this project a small model has been made for demonstration purpose. This project also aims for maximum output with minimum cost indulges.

1. Introduction

Wind is caused due to uneven heating of earth's surface, atmosphere, irregularities of earth's surface and rotation of the earth about its own axis. The amount of wind flow depends on various factors such as earth's rotation speed and difference in temperature of places. Energy produced by this blowing wind is called as wind energy.

Electricity plays and vital role for development of the country, so the production of electricity is one of the main aims of the country. About 68% of the production of electric energy is based on thermal power plant, where fossil fuels, coals, diesel are used for power generation and which is very less available and this fuels also creates pollution, greenhouse effect and global warming. Therefore power generation with the help of non-conventional resource such as wind is increasing day by day and this type of power generation is very clean and safe. The wind turbines are basically of two types 1)

Horizontal axis wind turbine (HAWT). 2) Vertical axis wind turbine (VAWT). HAWT has successfully evolved in making of electricity from wind. However, recently working on VAWT has also been started due to its additional advantage over HAWT such as it does not require yaw mechanism because it can produce power independent of wind direction. VAWT can be produced at low cost then HAWT and also affordable maintenance cost.

VAWT are further classified as

1) Savonious vertical axis wind turbine 2) Darrieus vertical axis wind turbine 3) Giro mill.

The aim of the project is to utilize the maximum amount of wind energy and hence highway is selected as the installation site. The wind turbine will be placed in divider so that the tangential acting airflow from both sides of the road due to moving vehicle will help the turbine to rotate.

2. Scientific Principle Involved and Theoretical Calculation of Power

The wind mill works on principle of converting kinetic energy of the wind in to mechanical energy. The k.E. of any particle is equal to the one half of its mass times the square of its velocity, or ½ mv2.

K.E. =½ mv2 .....(1)

K.E = kinetic energy m = mass

v = velocity,

M is equal to Volume multiplied by its density ρ of air,

Mass = ρ AV ..... (2)

Substituting eqn (2) in eqn (1) We had got,

K E = ½ ρ AV^3 watts ρ = density of air (1.225 kg/m^3)

A = l*b (Sq.m) D = diameter of the blade

A = l*b

A = 0.3 Sq.

Available wind power Pa = (½ ρ π D^2 V^3)/4 P = 1/8 ρ π D^2 V^3

CASE: 1

FOR VELOCITY 4.5m/s

Pa = (½ ρ π D^2 V^3)/4

Pa = (½*1.225*π*0.4*0.4 *4.5^3)/4

Pa = 7.1watt

CASE: 2

FOR VELOCITY 5.5m/s

Pa = (½ ρ π D^2 V^3)/4

Pa = (½*1.225*π*0.4*0.4 *5.5^3)/4

Pa = 15.1watt

CASE: 3

FOR VELOCITY 7.5m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½*1.225*π*0.4*0.4 *7.5^3)/4

Pa = 33 watt

CASE: 4

FOR VELOCITY 10m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½*1.225*π*0.4*0.4 *10^3)/4

Pa = 77watt

3. Selection of the Road

India, world's second largest road network has a total National Highways length of 1,00,087 km and State High- ways 1,31,899 km. In particular, the state of Madhya Pradesh has National Highways crossing the length of 3,714 kand State Highways for a length of 8,728 km. The increasing traffic will generate winds to create drag forces. High- way roads have been laid in all the directions: South to North, West to East, South to West to North to East, and vice versa. Every year, the country receives two monsoons namely South-West monsoon and North-East monsoon [29]. The wind direction also changes to South-West to North-East direction during South-West monsoon and North-East to South-West direction during North-East monsoon. Therefore, while placing the SWT on the roads, the monsoon of the country should be considered to harness maximum amount of wind energy. If the SWT is placed in such a way that the direction of the road and the monsoon wind directions are parallel, maximum amount of energy can be harnessed.

4. Conclusion

In this work, a wind turbine was designed for electricity generation in the highways for rural household applications, which may increase the contribution of utilization of renewable energy in Madhyapradesh.

5. References

[1] Yogesh Popat, Sourabh Shrivastava, Harshit Saxena, Current Scenario and Future Scope of Solar energy in India, SAR Journal. Volume 1, Issue 2, Pages 57-66, ISSN 2619-9955, DOI: 10.18421/SAR12-05, June 2018.

[2] Ministry of New and Renewable Energy (MNRE). Annual Report; 2003– 2004.

[3] Ministry of New and Renewable Energy (MNRE), www.mnes.nic.in.

6. Demonstration of Practical application through Simple module

Both the students have tried to implement it practically through a model and got significant working results. The model has been presented in Interschool Science Exhibition competition.


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