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A REVIEW ON VERTICAL AND HORIZONTAL AXIS WIND TURBINE

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Abstract - *Wind energy is one of the major forms of renewable energy resources found abundantly which is widely used as an alternative energy. Wind power is sustainable and the production of electricity using wind energy is increasing day by day due to lack of availability of fossil fuels. The energy can be converted into electricity by using vertical axis wind turbine (VAWT) and Horizontal axis wind turbine (HAWT). The vertical axis wind turbine is highly used for domestic applications where the volume of production is low and efficiency is optimal while the horizontal axis wind turbine is widely for larger volume of production requires huge investment and the efficiency is high. This paper focused on increasing the efficiency of using wind energy by producing large amount of electricity and reduces the space for installation. This can be done by combining the vertical axis wind turbine (VAWT) and horizontal axis wind turbine (HAWT) in a same tower. The combined vertical and horizontal axis wind turbine reduces the cost for larger volume of electricity generation.*

Key Words: Wind energy, VAWT, HAWT, combined vertical and horizontal axis wind turbine, high efficiency.

1. INTRODUCTION

Energy plays an important role in everyday life to carry out any task. The non-renewable energy resources such as oil, coal and gas are majorly used as energy nowadays. The main problem behind the non-renewable energy resources are not sustainable and create global warming which is hazardous to the environment. The renewable energy resources are best way to solve this issue. The renewable energy resources such as solar, wind, tidal and bio gas are available in abundant and sustainable which can be utilized for the requirement. Wind energy is the purest form of renewable energy which is available highly for the production of electricity. Wind is the natural resources which cannot affect the environment. Most of the countries including India understand the importance of wind energy and used as a primary source of renewable energy because of low cost compared to other renewable energy resources [6]. The wind energy is produced by converting the kinetic energy of atmospheric air into mechanical energy. The vertical axis wind turbine (VAWT) and horizontal axis wind turbine (HAWT) are the turbines used to convert the mechanical energy from the kinetic energy.

1.1 Vertical Axis Wind Turbine

The vertical axis wind turbine (VAWT) is used for domestic purpose and low volume of production. VAWT requires low cost investment and less space for the installation compared to HAWT [1]. The rotational axis of vertical axis wind turbine is perpendicular to the direction of wind. It can produce electricity at low wind speed. The maintenance of vertical axis wind turbine is quite easy compared to horizontal axis wind turbine. The efficiency of VAWT is optimal so it cannot be utilize for larger volume of production [3]. The main advantages of VAWT compared with HAWT are generation of electricity at ground level and the way of installation is simple.

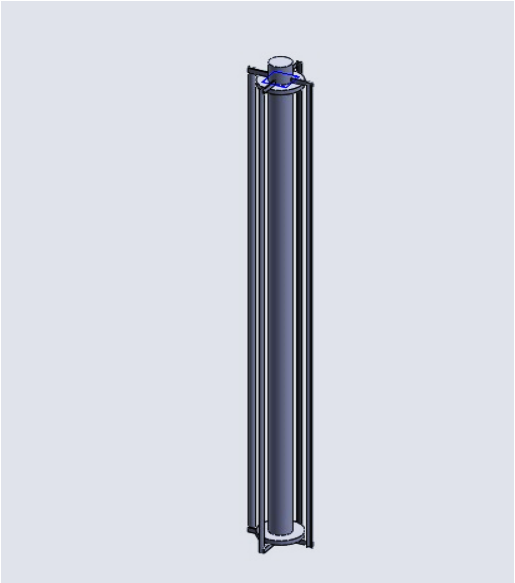

Fig-1: Vertical axis wind turbine

1.2 Horizontal Axis Wind Turbine

The horizontal axis wind turbine (HAWT) is widely used for higher volume of production which requires huge investment and occupies more space for the installation compared with vertical axis wind turbine (VAWT). The rotational axis of horizontal axis wind turbine is parallel towards the direction of wind in order to generate electricity [3]. It requires large tower and blade to install and the transportation cost is nearly 20% of the equipment of the cost. Highly skilled labors are required to install the horizontal axis wind turbine. The production cost is low

when generating higher volume of electricity. The efficiency of horizontal axis wind turbine is high than the vertical axis wind turbine. The horizontal axis wind turbines are most suitable for sea shores, hill tops etc.,

Fig-2: Horizontal axis wind turbine

1. LITERATURE REVIEW

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.

4. Altab Hossain et al. investigated the design and development of A 1/3 scale vertical axis wind turbine for electrical power generation. In this paper the electricity is produce from the wind mill by wind power and belt power transmission system. The blade and drag devices are designed in the ratio of 1:3 to the wind turbine. The experiment is conducted by different wind speed and the power produced by the windmill is calculated. The experimental result indicates that 567 W power produced at the speed of 20 m/s while 709 W power produced at the speed of 25 m/s. From this, the power production will increases when the velocity is high.

5. M. Abid et al. analyzed the design, development and testing of a savonius and darrieus vertical axis wind turbine. This paper shows that vertical axis wind mill is more efficient when compare to horizontal axis wind mill. The darrieus turbine consists of 3 blades which can start alone at low wind speed. When savonius turbine is attached on the top of existing wind mill which provide the self-start at low wind speed. The result indicates that the darrieus vertical axis wind turbine acts as a self-starter during the testing. The function required the starting mechanism which can be provided by the combination of NACA 0030 aerofoil and savonius turbine. The high blade thickness of the NACA 0030 aerofoil will improves the self-starting capability of the turbine.

6. ParthRathod et al. analyzed a review on combined vertical axis wind turbine. In this paper, the increased efficiency is achieved based on the characteristics such as aspect ratio, tip speed ratio, velocity and other geometry parameter. The experiment is conducted to increase the power production and efficiency of a wind turbine. The development of design is optimized by combining the blade structure and the flow performance. The result indicates that the efficiency of turbine is always based on the wind speed and climatic conditions. The lowest aspect ratio improves the power coefficient of the turbine. The power generation of combined rotor is high compare to the single savonius and darrieus rotor.

7. KunduruAkhil Reddy et al. investigated a brief research, study, design and analysis on wind turbine. This paper evaluates the aerodynamic performance of variable speed fixed pitch horizontal axis wind turbine blade using two and three dimensional computational fluid dynamics. The primary objective of the paper is to increases the aero dynamic efficiency of a wind turbine. The blades are designed using different type of airfoils which are associated with angle of attack. The blade design is responsible for the efficiency of the wind turbine. The design of the blade is done using Q- blade software. The result indicates that the power output is determined using blade elemental theory. The power output of designed blade design is higher when compare to existing design of the blade.

8. PiyushGulve et al. analyzed the design and construction of vertical axis wind turbine. This paper indicates that vertical axis wind turbine is more efficient than horizontal axis wind turbine because it requires compact space for producing same amount of electricity and less noise. The result of the paper indicates that the efficiency of wind turbine may reduce due to manufacturing error and frictional losses. It will be rectified by précising the design of the blade more aerodynamically.

From the above literature review, it is clearly understood that the efficiency of wind turbine is always based on the parameters such as design and size of the blade, aspect ratio, tip speed ratio, blade angles and velocity. The power production of combined vertical and horizontal wind mill is high compare to vertical axis wind turbine and horizontal axis wind turbine. It requires less space for high generation of electricity.

3. CONCLUSION

The combined vertical and horizontal axis wind turbine increases the efficiency and production volume while compared with separate vertical and horizontal axis wind turbine. This will reduces the area required for the installation of wind turbine by fixing the vertical and horizontal wind turbines in a single tower. It will accumulate more number of wind towers at less area compared to VAWT and HAWT. The implementation of combined vertical and horizontal axis wind turbine will solve the issue on the usage of fossil fuels and highly helpful for the environment to safeguard from global warming.

REFERENCES

[1] Niranjana.S.J, "Power Generation by Vertical Axis Wind Turbine", International Journal of Emerging Research in Management &Technology ISSN: 2278-9359, Volume-4, Issue-7, 2015.

[2] Mr.Abhijit N Roy, Mr.SyedMohiuddin, "Design and Fabrication of Vertical Axis Economical wind mill", International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, Volume: 3 Issue: 2, 133 – 139, 2015.

[3] D. A. Nikam, S. M. Kherde, "Literature review on design and development of vertical axis wind turbine blade", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, 156-161, 2015.

[4] Altab Hossain, A.K.M.P. Iqbal, Ataur Rahman, M. Arifin, M. Mazian, "Design and Development of A 1/3 Scale Vertical Axis Wind Turbine for Electrical Power Generation", Journal of Urban and Environmental Engineering (JUEE), ISSN 1982-3932, volume: 1 Issue:2, 53-60, 2007.

[5] M. Abid, K. S. Karimov, H. A. Wajid, F. Farooq, H. Ahmed, O. H. Khan, " Design, Development and Testing of a Combined Savonius and Darrieus Vertical Axis Wind Turbine", Iranica Journal of Energy and Environment, ISSN: 2079-2115, volume: 6, Issue:1, 1-4, 2015.

[6] ParthRathod, KapilKhatik, Ketul Shah , Het Desai , Jay Shah, "A Review on Combined Vertical Axis Wind Turbine", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2347-6710, volume: 5, Issue:4, 5748-5754, 2016.

[7] B.O.Omijeh, C. S. Nmom, E. Nlewem, " Modeling of a Vertical Axis Wind Turbine with Permanent Magnet Synchronous Generator for Nigeria", International Journal of Engineering and Technology, ISSN: 2049-3444, volume: 3. Issue: 2, 212-220, 2013.

[8]KunduruAkhil Reddy, KalyanDagamoori, ArimalaParamasivamSruthi, SaiApurva.N,Nimmala Naga Maha Lakshmi Naidu, A.Vamsi Krishna Reddy, Beri Rajesh, KudaKiran Kumar, ChithaluriShivasri, SumamaYaqub Ali, "A Brief Research, Study, Design and Analysis on Wind turbine", International journal of modern Engineering research(IJMER), ISSN: 2249–6645, volume: 5, Issue: 10, 5-30, 2015.

[9] PiyushGulve, Dr. S.B.Barve, "Design and Construction of Vertical Axis Wind Turbine", International Journal of Mechanical Engineering and Technology (IJMET), ISSN 0976 – 6340, volume: 5, Issue: 10, 148-155, 2014.

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