5th International Conference on Science, Technology and Management
India International Centre, New Delhi (ICSTM-16)
30th July 2016, www.conferenceworld.in ISBN: 978-93-86171-00-9

HYBRID MAGLEV WIND MILL

Sujata Huddar[1], Mahantesh Tanodi[2]

[1]*Dept of Electrical and Electronics Engg, Hirasugar Institute of Technology Nidasoshi, (India)*

[2] *Dept of Mechanical Engineering, Hirasugar Institute of Technology Nidasoshi, (India)*

ABSTRACT

Wind is a non-conventional source of energy, by which the electricity can be obtained by converting kinetic energy of wind into electrical energy by using wind turbine. There are two types of wind turbine, one is conventional wind turbine and other is maglev wind turbine, but generation of electricity using maglev technology is now becoming more competitive. It works on the principle of electromagnetism. It has colossal structure. It has several advantages over conventional wind turbine and has certain applications. Magnetic levitation, maglev, or magnetic suspension is a method by which an object is suspended with no support other than magnetic fields. Magnetic pressure is used to counteract the effects of the gravitational and any other accelerations. The principal advantage of a maglev windmill from a conventional is, as the rotor is floating in the air due to levitation, mechanical friction is totally eliminated. That makes the rotation possible in very low wind speeds. Maglev wind turbines have several advantages over conventional wind turbines. For instance, they're able to use winds with starting speeds as low as 1.5 meters per second (m/s). Also, they could operate in winds exceeding 40 m/s. Currently the largest wind turbines in the world produce only five MW of power while, one large maglev wind turbine could generate one GW of power.

Keywords—Renewable Energy, Wind Energy, Magnetic Levitation, Power Generation, Magnets

I. INTRODUCTION

Renewable energy is generally electricity supplied from sources, such as wind power, solar power, geothermal energy, hydropower and various forms of biomass. These sources have been coined renewable due to there continuous replenishment and availability for use over and over again [1] [13]. This paper focuses on the utilization of wind energy as a renewable source. The aim is to design and implement a magnetically levitated vertical axis wind turbine system that has the ability too operate in both high and low wind speed conditions. Our choice for this model is to showcase its efficiency in varying wind conditions as compared to the traditional horizontal axis wind turbine and contribute to its steady growing popularity for the purpose of mass utilization in the near future as a reliable source of power generation. Unlike the traditional horizontal axis wind turbine, this design is levitated via magnetic levitation vertically on a rotor shaft. This maglev technology, which will be looked at in great detail , serves as an efficient replacement for ball bearings used on the conventional wind turbine and is usually implemented with permanent magnets. This levitation will be used between the rotating shaft of the turbine blades and the base of the whole wind turbine system [3]. The conceptual design also entails the usage of spiral shaped blades and with continuing effective research into the functioning of sails in varying wind speeds and other factors, an efficient shape and size will be determined for a suitable turbine blade for the project.

II. PRINCIPLE

The basic working principle of a wind turbine is when air moves quickly, in the form of wind, the kinetic energy is captured by the turbine blades. The blades start to rotate and spin a shaft that leads from the hub of the rotor to a generator and produce electricity. The high speed shaft drives the generator to produce electricity. The low speed shaft of wind turbine is connected to shaft of high speed drives through gears to increase their rotational speed during operation [2]. Using the effects of magnetic repulsion, spiral shaped wind turbine blades will be fitted on a rod for stability during rotation and suspended on magnets as a replacement for ball bearings which are normally used on conventional wind turbines. The energy that can be extracted from the wind is directly proportional to the cube of the wind speed. We can then calculate the power converted from the wind into rotational energy in the turbine using equation[4].

$$P_{avail}=0.5\ \rho\ Av3Cp$$

where

P_{avail} is output power available in watts.

ρ is density of air in kg/m3.

A is area swept by blades.

V is velocity of wind.

C_p is the power coefficient called Betz limit

C_{pmax}= 0.59

Fig: 1 Hybrid wind turbine

Magnetic Levitation also known as Maglev, this phenomenon operates on the repulsion characteristics of permanent magnets. This technology has been predominantly utilized in the rail industry in the Far East to provide very fast and reliable transformation on maglev trains and with ongoing research its popularity is increasingly attaining new heights. Using a pair of permanent magnets like neodymium magnets and substantial support magnetic levitation can easily be experienced. By placing these two magnets on top of each other with like polarities facing each other, the magnetic repulsion will be strong enough to keep both magnets at a distance away from each other[5]. The force created as a result of this repulsion can be used for suspension purposes and is strong enough to balance the weight of an object depending on the threshold of the magnets. In this project, we expect to implement this technology for the purpose of achieving vertical orientation with our rotors as well as the axial flux generator.

Fig.2 Composite Blades

A turbine is used in order to harness the power of the wind into the mechanical power of electricity. The term wind energy is the process of converting wind into a valuable power source. The wind turbine is designed to take the kinetic energy of the wind and turn it into pure mechanical power. The power of the wind can be used in many different ways. The kinetic energy of the wind can be used on a farm for pumping water or grinding grain. When the natural energy of the wind is transferred to a generator the power is used as electricity for businesses, homes and schools etc. A wind turbine resembles the propeller blades. The propeller blades of the turbine rotate because of the moving air. The rotation of the propellers powers an electric generator and then generator supplies a home with electric current. To simplify the process the wind rotates the blades, the rotation causes a shaft to spin, and the shaft connects to a generator to make electricity. Maglev wind turbine has several advantages over conventional wind turbine. For instant they are able to use winds with starting speed as low as 1.5m/s, also they could operate in winds exceeding 40 m/s. currently the largest conventional wind turbines in the world produce only 5 MW of power. However, one large maglev wind turbine could generate 1 GW of clean power, enough to supply energy to 7,50,000 homes. It also increases generator capacity by 20% over conventional wind turbine and decreases operational cost by 50%. The maglev wind turbine will be operated for about 500 years, but the wind will blow only intermittently and unpredictably. Therefore, it is necessary to store the electricity produced when the wind is blowing and then release it at a steady rate to maintain a steady supply of electricity to the consumers hence for this purpose it s can also be used in conjunction with hydroelectricity. An area may have some water but not enough to generate a large amount of electricity continuously. Maglev wind turbines can be installed to pump the water from the lower level reservoir to the upper level reservoir during the night so that there will be enough water to activate the electric generators during the day. Such combination of wind turbine and hydroelectric generation could supply electricity to many towns and cities.

III. RESULTS AND DISCUSSIONS

As per the experimental work, there are three different velocity of air found in our area, i.e. from 11 km/hr to 34 km/hr and the performance of turbine discussed as follows. For 11 km/hr : Due to minimum air velocity is required to run the turbine i.e 11 km/hr velocity of air is chosen and for this speed, the force 7.149N is required to generate the power 9.1794 Watt with lifting coefficient 1.664. For 26 km/hr : We have chosen this is a medium velocity of air in our area and for this; the force 39.93 N is required to generate the power 121.22 Watt with lifting coefficient 0.2978. For 34 km/hr : We have chosen this is a maximum velocity of air in our area and for this speed, the force 68.37N is required to generate the power 271.07 Watt with lifting coefficient 0.1741.

As the velocity of air changes from minimum to maximum the speed of the blade changes from 30 to 109rpm. Hence speed of blade directly proportional to power output of turbine. As the speed of turbine increases from 30rpm to 109rpm, the lift coefficient decreases from 1.6640 to 0.1741 due to increase in lift force from 0.5958N to 1.8465N. and mass of air also increases from 2.34kg/s to 7.24kg/s, hence increase in output power from 9.1794watt to 271.07watt[13].

Sl.No	*Turbine speed in rpm*	*Output voltage in Volts*
1	100	9.9
2	150	12
3	200	16
4	250	22
5	300	25
6	350	28

IV. CONCLUSION

Our work and the results obtained so far are very encouraging and reinforce the conviction that vertical axis wind energy conversion systems are practical and potentially very contributive to the production of clean renewable electricity from the wind even under less than ideal sitting conditions. It is hoped that they may be constructed used high-strength, low-weight materials for deployment in more developed nations and settings of with very low tech local materials and local skills in less developed countries. The savonius wind turbine designed is ideal to be located on top of a bridge or bridges to generate electricity, powered by wind. The elevated altitude gives it an advantage for more wind opportunity. With the idea on top of a bridge, it will power up street light and or commercial use. In most cities lighting, bridges are a faster route for everyday commute and in need of constant lighting makes this an efficient way to produce natural energy. At the end of the project, the magnetically levitated vertical axis Wind turbine was a success. The rotors that were designed harnessed enough air to rotate at low and high wind speeds while keeping the centre of mass closer to the base yielding stability. The wind turbine rotor levitated properly using permanent magnets, which allowed for a smooth rotation with negligible friction. Generator satisfied the specifications needed to supply the LED load. An output ranging from 40V to 45V was obtained from the magnetic levitated vertical axis wind turbine prototype. A modified design of savonius model Wind turbine blade was used in the construction of the model. An aluminum shaft was used to avoid the wobbling movement of the rotor. Overall, the magnetic levitation wind turbine was a successful model.

REFERENCES

[1] Santosh Jiladar, and Mahesh Modhukar, “Maglev Wind Generator,” 3rd The International Conference on Renewable Energy Research and Applications, 19-22 Oct 2014 Milwakuee-USA

[2] Ashwin Josoph, and Suraj Chavan, “Wind Turbine using Magnetic Levitation,”IJRMET, vol. 6, issue 1, Nov 2015-April 2016.

[3] Dinesh N Nagarkarand Dr. Z. J. Khan, “Wind Power Plant Using Magnetic Levitation Wind Turbine”,International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue1, July 2013

[4] Dr. Aravind CV, Dr. Rajparthiban, Prof. Rajprasad R,"A Novel Magnetic Levitation Assisted Vertical Axis Wind Turbine–Design Procedure and Analysis", 8th International Colloquium on Signal Processing and its Applications, (IEEE) in 2014.

[5] Dr. Bittumon, Dr. Amith Raju, Dr. Harish Abraham Mammen, Dr. Abhy Thamby, Dr. Aby K Abraham,"Design and Analysis of Maglev Vertical Axis Wind Turbine", International Journal of Emerging Technology and Advanced Engineering, Vol. 4, Issue 4, April 2014.

[6] Minu John, Rohit John, Syamily P.S, MAGLEV WINDMILL “International Journal of Research in Engineering and Technology” Vol. 3, Issue 5, May 2014

[7] Vishal Dhareppgoaland Maheshwari Konagutty,” REGENEDYNE Maglev Wind Power Generation”, SARC IRAJ International Conference, 16th June 2013, Pune, India, ISBN: 978-81-92747-8-3.

[8] Dr. Aravind CV, Dr. JagadeeswaranA, Dr. RN Firdaus, "Design Analysis of MAGLEV-VAWT with Modified Magnetic Circuit Generator", 2nd International Conference on Electrical Energy Systems, (ASME).

[9] M. A. Mueller and A. S. McDonald,”A light weight low speed permanent magnet electrical generator for direct Drive wind turbines”, Institute for Energy Systems, Institute for Energy Systems,Edinburgh University, Edinburgh University, Edinburgh, UK

[10] Chinnu Sara, Dhanya Varghese,“ Magnetically Levitated Wind Turbine for Power Generation”, National Conference on Recent Advances in Electrical & Electronics Engineering, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 5, Issue 3, March 2016.

[11] Dr. Dinesh N Nagarkar, Dr. Z. J. Khan,“Wind Power Plant Using Magnetic Levitation Wind Turbine”, International Journal of Engineering and Innovative Technology (IJEIT), Vol. 3, Issue 1, July 2013.

[12] Vishal D Dhargol, Maheshri M Konagtti, ‘’Maglev Wind Power Generation’’, International Journal of Electrical, Electronics and Data Communication Volume-2, Issue-5

[13] S K Halli , S J Hittalamani , N G Meti , M M Dandinavar ,’’Design And Development Of Low Cost And More Efficient Magnetically Levitated Wind Turbines’’