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Research paper

Design and Modeling of Modified Savonius Highway Wind Turbine

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Abstract

Abstract— in this paper, the design and modeling of highway wind mill using savonius wind turbine has been done. The highway wind mill is nothing but the wind mill kept in the mid of the road so that , this wind mill utilize the fast moving wind which is produced from fast moving vehicles travels in the high way. In this work the required wind data have been collected in highways and based on these values the design and fabrication have been made. The output of the wind turbine has been given to the power converter in order to get the constant power output.

Keywords: *modified savonius wind turbine, boost power converter, highway wind mill, computational fluid dynamics, curtain*.

1. Introduction

In the beginning of 21st century we are in the search of non-renewable energy since fast depletion of fossil fuels and pollution. In the highway areas, energy consumers are getting power from only diesel generators as an energy source. This energy source has drawbacks related to economics and pollution. To overcome these drawbacks and to improve the power accessibility, generate electricity from the Renewable Energy Sources (RESs), which are preferably available locally and environmentally friendly such as wind, solar and hydropower. Owing to the specific advantages, particularly clean, sustainability, the solar energy and wind energy are promising renewable energies among all other renewable energy sources.

This research work mainly concentrates on unused energy which is generated by vehicles running at high speed in the high way. By placing the modified savonius wind turbine in the middle of the high way it acquires wind from all the direction so the wasted energy can be utilized in the effective way. The advantage of modified savonius wind turbine is that, it is a Omni-directional wind turbine, low cost. This system which consists of two curtain arrangements to focus wind on one direction. The modified savonius wind turbine which converts wind energy into mechanical energy. Then the output from turbine is converted into to electrical energy with help of Generator and it is stored in the battery with the help of bidirectional converter.

2. Data collection

Wind velocity with and without vehicle movement is measured using wind anemometer, Vehicle velocity is measured (for both heavy and light vehicle), Wind sustain time is measured. The collected wind data is shown in table.1.

Table.1. Wind Data Collection

S.No	Actual wind velocity without vehicle	Light vehicles			Heavy vehicles		
		Wind speed (m/s)	Wind sustain time (sec)	Vehicle velocity (km/hr)	Wind speed (m/s)	Wind sustain time (sec)	Vehicle velocity (m/s)
1	4.7	5.4	15	60	7.4	30	50
2	6.2	8.8	12	90	8.0	35	65
3	4.5	5.0	15	50	8.2	25	70
4	6	9.2	20	95	7.7	30	60
5	5.1	7.4	18	70	7.5	27	58
6	6.5	7.8	10	80	9.5	32	75
7	9	11	17	110	10.2	29	80

3. Performance Characteristics of Wind Turbine

The performance curve of modified savonius wind turbine is shown in Fig.1 and the calculated theoretical wind power at various wind velocities is shown in table.2.

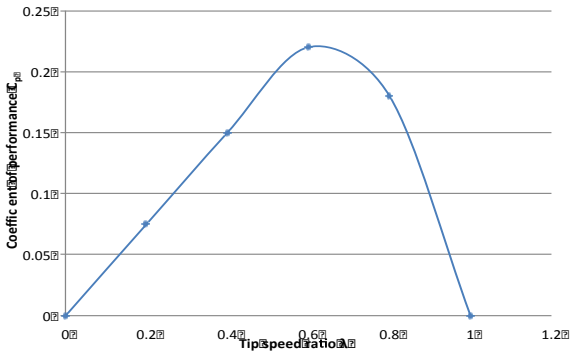

Fig.1. Tip speed Ratio v/s Cp

Table.2. Calculation of theoretical wind power at various wind velocity

Wind speed (km/hr)	Wind speed (m/s)	Calculated mechanical power in watt	Electrical power = 0.4×mech.power watt
0	0	0	0
5	1.385	0.089	0.035
10	2.770	0.715	0.286
15	4.155	2.410	0.966
20	5.540	5.720	2.290
25	6.925	11.180	4.470
30	8.310	19.320	7.730
35	9.695	30.690	12.270
40	11.080	45.810	18.320
45	12.465	65.230	26.090

4. Results and Discussions

The 2D view of modified savonius blade is shown in Fig.2. The output voltage from the generator is varying according to variable wind velocity but constant input of 12V is given to the battery. For giving constant input to the battery power converter circuit is required. The power converter circuit which is used here is boost converter for step up the voltage. According to design the DC-DC power converter is modeled in MATLAB as shown in Fig.3. and the hardware implementation of the power converter circuit is shown in Fig.4.

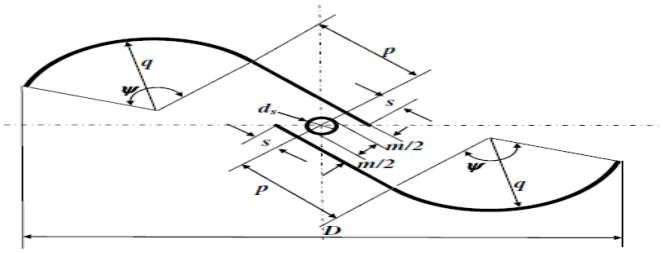

Fig.2. 2D view of savonius blade

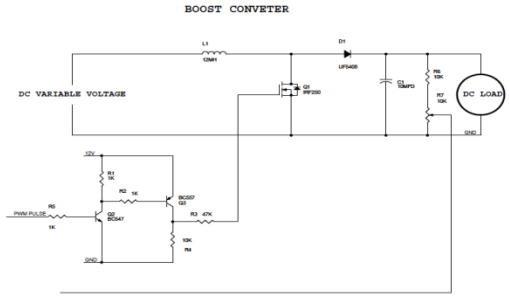

Fig.3. DC to DC power converter

Fig.4. Power converter circuit board

5. Conclusion

In this paper, implementation of vertical axis wind turbine on road dividers which provides effective output operation were analyzed. It can be installed on any highway with the width being the only constraint. The hardware is implemented for electrical energy conversion system. Since the battery is portable we can use it in some other location for any low voltage purpose. It will provide effective solution for the boom of the electrical energy by the society. In this work the required wind data have been collected in highways and based on these values the design and fabrication have been made. The output of the wind turbine has been given to the power converter in order to get the constant power output.

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