FEASIBILITY STUDY OF ELECTRIC GENERATION FROM WASTE WIND COOLED

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Abstract

This research presents a feasibility study of electrical generation from waste wind cooled in Pibulsongkram Rajabhat University. Designed wind turbine for electrical power generation was 24 VAC 110 VA at 6.5 m/s of waste wind cooled speed of air conditioner and It was charged to battery, 24 V 100Ah 2 Cells. Conversion of direct current into alternating current was made by inverter size 1 kW for supplied to electrical load. The experiment reveals that there is a relation of output voltage and a charging period of battery. At 6.5 m/s of waste wind cooled speed, the result indicates that blade speed was 600 rpm, generated alternating current voltage at 24 V and a charging period of battery was 6 hours and supplied to car park lighting with 15 units of 36 W fluorescent lamps. The result showed that 10 % of electrical cost was saved when the system was connected with the electrical generation system.

Keyword: Wind power, Wind turbine, Renewable energy

1. Introduction

Wind is caused by the difference in atmospheric pressure, temperature and the force due to rotation of the earth, which cause the wind speed. The power of wind was generally accepted as the source of free energy which can be used for generating work and power. It can reduce energy cost and can be used extensively. It is also a renewable energy.

Wind turbine is the machine for conversion of kinetic energy from wind into mechanical energy which it can be used directly or indirectly. Wind turbine can be separated by blade position as follows;

1. Vertical Axis Turbine, VAWT. The center of rotation and blade are perpendicular with horizontal wind stream (see fig. 1).

2. Horizontal Axis Turbine, HAWT. The center of rotation and blade are parallel with wind stream in horizontal (see fig. 2).

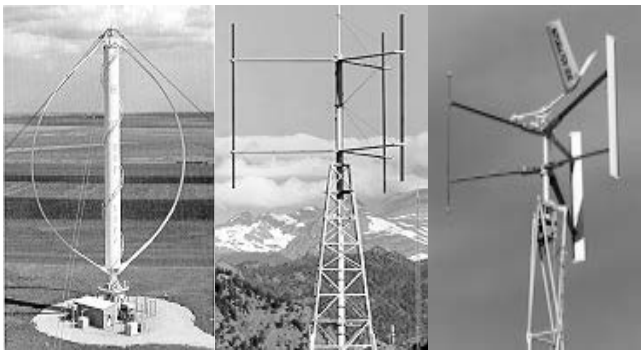

Figure 1 Types of vertical axis turbine

Figure 2 Type of horizontal axis turbine

Wind turbine for generating electrical energy is used in form of kinetic energy into mechanical energy then it is transferred to generator. Presently, the use of small or large wind turbine is based on wind speed of each area. Fig. 3 shows the example of small wind turbine.

Figure 3 Small Wind turbine to generate electrical energy

Electrical current by generator generally produces alternating current. Electrical current is generated by coil cut through magnetic field (see. fig. 4 and fig. 5).

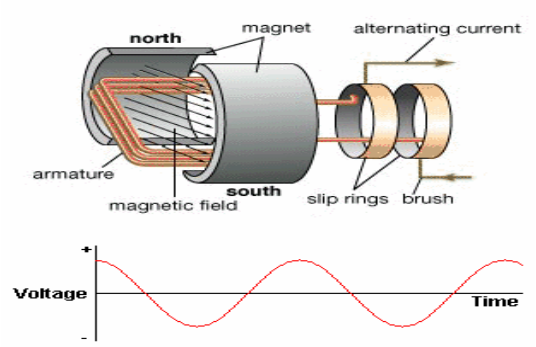

Figure 4 Principle of generator

Figure 5 Placement of coil and magnetic

Air conditioners use refrigeration to chill indoor air, taking advantage of a remarkable physical law: When a liquid converts to a gas (in a process called **phase conversion**), it absorbs heat. Air conditioners exploit this feature of phase conversion by forcing special chemical compounds to evaporate and condense over and over again in a closed system of coils.

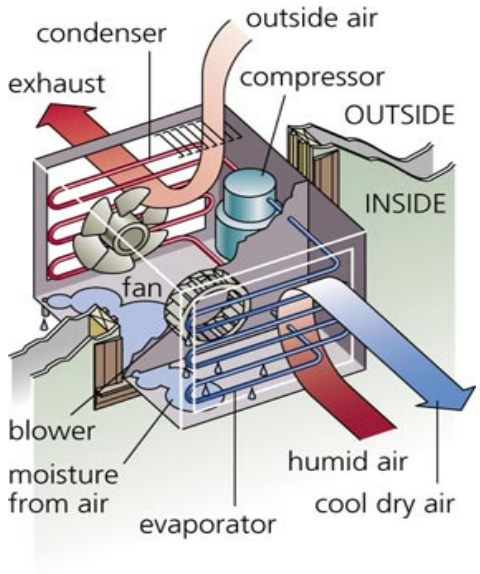

Figure 6 Basic of Air conditioners System

The compounds involved are refrigerants that have properties enabling them to change at relatively low temperatures. Air conditioners also contain fans that move warm interior air over these cold, refrigerant-filled coils. In fact, central air conditioners have a whole system of ducts designed to funnel air to and from these serpentine, air-chilling coils.

When hot air flows over the cold, low-pressure evaporator coils, the refrigerant inside absorbs heat as it changes from a liquid to a gaseous state. To keep cooling efficiently, the air conditioner has to convert the refrigerant gas back to a liquid again. To do that, a compressor puts the gas under high pressure, a process that creates unwanted heat. All the extra heat created by compressing the gas is then evacuated to the outdoors with the help of a second set of coils called condenser coils, and a second fan. As the gas cools, it changes back to a liquid, and the process starts all over again. Think of it as an endless, elegant cycle: liquid refrigerant, phase conversion to a gas/ heat absorption, compression and phase transition back to a liquid again.

Experimental setup

Outside air flows as waste wind cooled (see. fig. 6). The wind turbine to generate electrical energy for this research was shown in fig. 7. The wind turbine consists of AC generator capacity 24 VAC 110 VA at waste wind cooled speed 6.5 m/s and is installed at 10 centi-meters of length. Produced electricity will be paid to battery, 24V 100Ah 2

Cells, by conversion from direct current voltage into alternating current voltage by inverter size 1kW after that it will be supplied to electrical load to figure out the efficiency of electrical generating system of wind turbine.

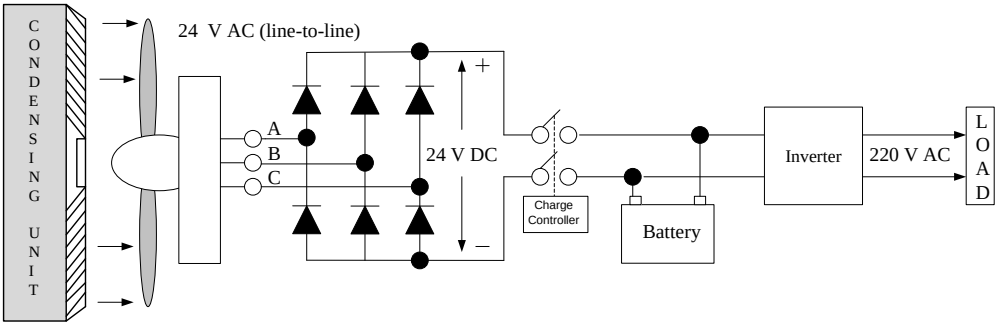

Figure 7 Schematic of the experimental setup

Table 1 Waste wind cooled speed

BTU of Air Conditions	Diameter of cooled fans	Waste wind cooled speed (m/s)
12,000 BTU	16”	3
25,000 BTU	16”	3.5
30,000 BTU	18”	5.7
33,000 BTU	18”	6.5

Waste wind cooled at installation area of wind turbine will be measured and recorded during the experiment. After that the data will be used for the design of wind turbine to appropriate with wind speed at installation area to maximize efficiency of system. Waste wind cooled speed from data was about 6.5 m/s on 33,000 BTU of air conditions then design sizing of wind turbine was 110 VA. The formula for calculating the sizing of wind turbine is shown below:

$$Watt\_of\_Wind\_Turbine(W) = 0.15x(d)^2 x(Wind\_Speed)^3 \quad (1)$$

Hence, calculated wind turbine sizing was 54 centi-meters in diameter. Selected type of wind turbine was HAWT. The calculated wind turbine was built and installed at

Pibulsongkram Rajabhat University. The formula for calculating blade speed of wind turbine at average wind speed is shown below:

$$rpm = waste\_wind\_speedx[(TSRx60)/((22/7)xd))] \quad (2)$$

Electrical voltage from wind turbine will be tested by calculation for blade speed at waste wind cooled speed 6.5 m/s, blade speed of wind turbine as calculated was 600 rpm. Blade speed will be controlled and output voltage will be measured by oscilloscope (see. fig. 8).

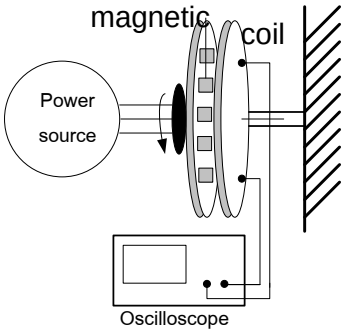

Figure 8 Schematic of electrical voltage testing

The testing of voltage charging period to battery will be tested by measuring electrical voltage and electrical current output from wind turbine by installing the charging controller to control electrical charging and recording of charging period (see. fig. 9).

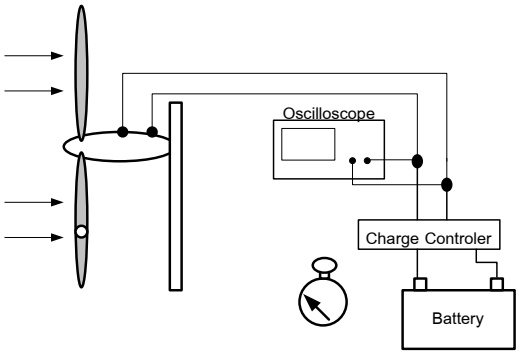

Figure 9 Schematic of charging controller installation

Measured data will be recorded during wind turbine operation, such as wind speed, blade speed, and output voltage. Then they will be used to analyze the relationship of each value to improve wind turbine (see fig. 10).

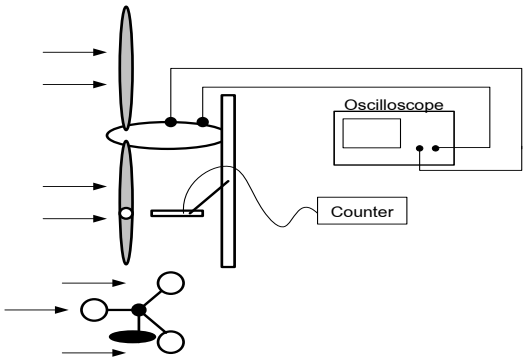

Figure 10 Schematic of equipments installation

Wind turbine will be tested during the operation by installing inverter size 1kW for converting direct current voltage to alternating current voltage and supplied to car park lighting that consists of fluorescent lamp 36 W total 15 units. At the same time, wind speed will be measured and recorded, together with output voltage of charging to battery and voltage supplied to load. The period of testing was 1 month then the recorded data will be used for analyzing to improve the system continually (see fig. 11).

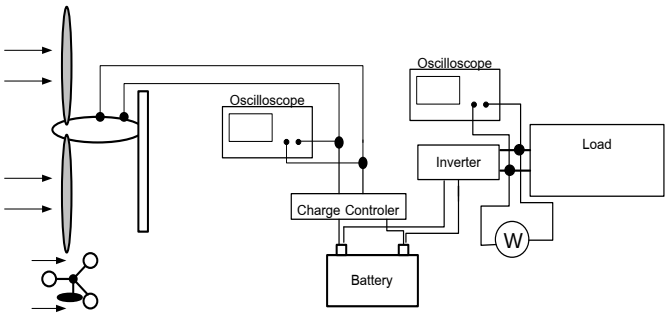

Figure 11 Schematic of operation testing

2. Result and discussion

The testing for electrical voltage from wind turbine at blade speed 600 rpm. found that electrical voltage was 24 V and frequency 36 Hz. The wave shown at oscilloscope was sine wave (see fig. 12).

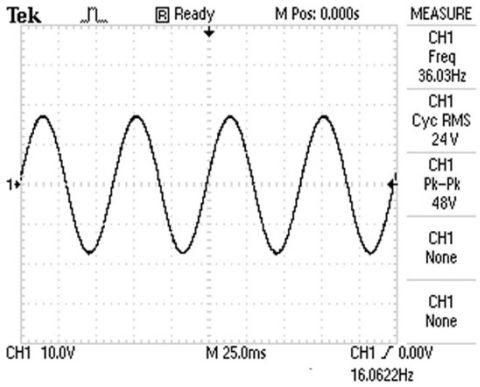

Figure 12 Voltage from wind turbine

Charging period for each type of battery was shown in fig. 13. The proper battery for this research was 100Ah 2 Cells and the charging period was about 6 hours at 25°C room temperature and outside temperature at 32°C.

The result of testing during the operation was shown in fig. 14. The output voltage from inverter can be supplied to fluorescent lamps without winking. The result showed that 10 % of electrical cost was saved when the system was connected with the electrical generation system.

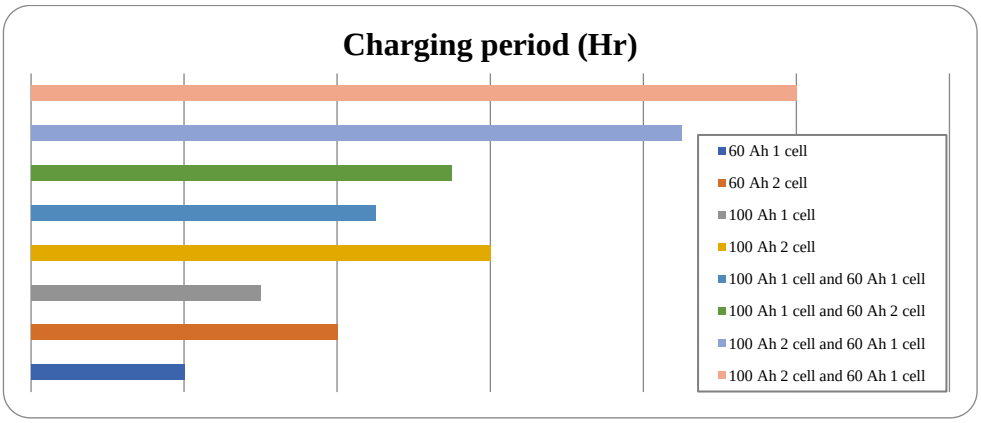

Figure 13 Charging period for each size of battery

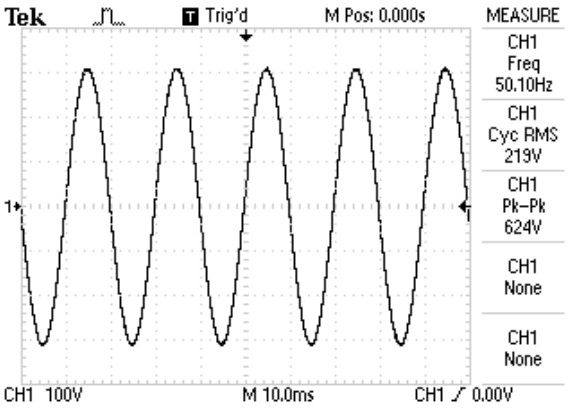

Figure 14 Output voltage from inverter

3. Conclusion

The designed wind turbine, which is installed at Pibulsongkram Rajabhat University, Phitsanulok province, has the potential to develop but it still has some drawbacks which need to be improved. Therefore, multiple wind turbines should be installed in order to improve the system. In addition, the use of another renewable energy, such as solar energy, combined with this wind turbine is recommended. Thus, this experiment found that the project not to interest.

4. Acknowledgement

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