Development of Energy Regenerative System from Air Conditioner Waste

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ABSTRACT – Nowadays, the global energy consumption is increased rapidly especially in the developing countries. This is due to the high of the population and economic growth that lead to higher demands of the energy that only can make it in a critical situation. Thus, it has to be conserved in good ways so that these non-renewable energy sources would not be depleted in the future. Hence, the aim of this project is to develop an energy regenerative system from air conditioner waste. Wind turbine mechanism is been applied throughout this project. And the objective are to design and develop a prototype of Waste Kinetic Energy Recovery System (WKERS) and analyze the performance of prototype with the experimental test.

1. INTRODUCTION

The idea of using the renewable energy technology is steadily increased for the past few years in order to meet the requirement of the energy demands. The usage of this energy sources is better in performance and economic aspect. Besides that, it is not limited but is highly depend on the geographical conditions.

A process of regenerate or recover the waste air into wind energy is known as Waste Kinematic Energy Recovery System (WKERS). Therefore, the wind turbine is needed as a mechanism to regenerate or recover the discharged air to the environment. This function is to create power from the wasted air that been released to the atmosphere. The wind energy does not contaminate the air like a power plant that fully depends on the burning of fossil fuels, for example, coal or natural gas. Besides that, the turbines are encompassed by fenced in areas to enhance the performance as well as the wind stream of the ventilation system. Chong et al. (2013) used wind tunnel measurement of small scale turbine models to concentrate turbulent properties of a horizontally staggered wind energy. They found that turbulence in the horizontally staggered wind farm looks like that in the wake of a single turbine, which is substantially not quite the same as that in an aligned configuration The electricity that been generated from this system can be utilized to power up the power consumption of the small appliances such as LED lamps.

2. METHODOLOGY

The detailed design of the prototype of the project used SolidWorks software. Figure 1 shows the process flow of the project.

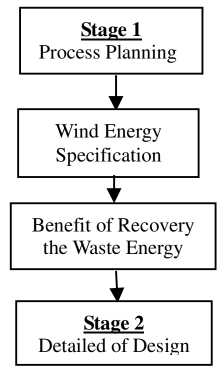

Figure 1.0: The process flow

Hence, the first blade type sort S809 which was produced by National Renewable Energy Laboratory (NREL). The outline NREL blade are portrayed by utilizing SOLIDWORKS in view of their genuine measurements individually. At that point, the scaling procedure into wanted cutting blade measurements of the (WKERS) wind turbine model is done and additionally the means of planning blades too. Next, the second type of the blade which called swept. Swept blade likewise called "Swept back" is broadly utilized for fly fueled air ship, for example, Hawker Hunter. Swept blade will make the aircraft perform less drag and can make the speed becomes faster when it speed reaches in the range of speed of sound (Mach 0.8 to1.0) or in other word transonic. In any case, Swept blade requires a higher driving velocity to give lift than straight wing.

2.1 Preliminary Test

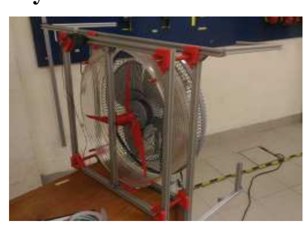

Figure 2: Preliminary Set Up

In the preliminary test, the small scaled of wind turbine prototype is tested with 5.2 m/s average wind speed source from a stand fan. The test carried out by collecting the turbine rotation (rpm) and wind speed (m/s) with a constant distance of the wind turbine prototype with the fan. The result are shown in Table 1 and 2.

Table 1: The results for the Swept and NREL blades in the preliminary test

Wind Speed (m/s)		Turbine Rotation (rpm)	
Swept	NREL	Swept	NREL
2.3m/s		890	900
2.3m/s		982	950
2.3m/s		900	1008
2.3m/s		1002	890
2.3m/s		801	860

3. EXPERIMENTAL TEST AND ANALYSIS

The test setup is the method on how the test will be conducted. The setup will be the same as a previous test. Then the electric board is been connected with the source of energy layout to the wind turbine by using the connecting wires. From the previous experiment, the reading of voltage output and revolution per minutes (rpm) of the blade to rotate is been taken hence, for this test is mostly like the same but with actual air conditioner system waste energy to collect the same data as preliminary test. Both types of blades which is NREL and Swept show better performance when the wind turbine is closer to the air conditioner condenser which is 2.5cm in this project compared to the further distance which is 6.5cm. The faster the blade rotation, the more the output voltage is obtained. Meanwhile, the further distance of the wind turbine may cause the disturbance and cause slightly unstable for the wind turbine to be rotate.

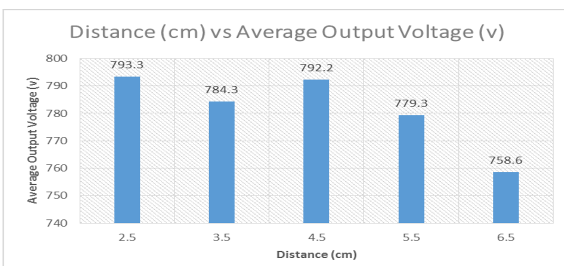

Figure 3: Graph of Distance against Average Output Voltage of NREL blade.

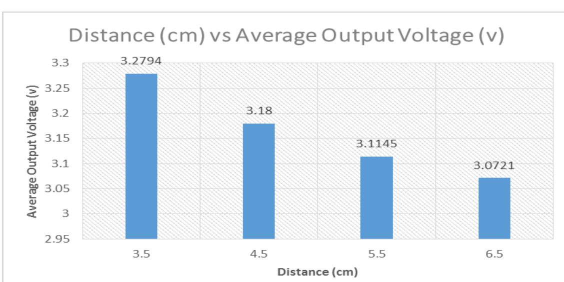

Figure 4: Graph of Distance against Average Output Voltage of Swept blade.

Based on Figure 5 and 6, the performance of each type of blade is different due to its detailed of design of aero foil. Besides that, the surface area of the blade also affect the wind flow. Both blades, the performance is good due to its smaller surface area that block the wind flow. From the exterior structure, NREL design is purposely to increase the aspect ratio at the blade's tip. In the other word, a long and thin shape blade shape can generate more voltage power and rpm compared to short and thick Swept blade shape.

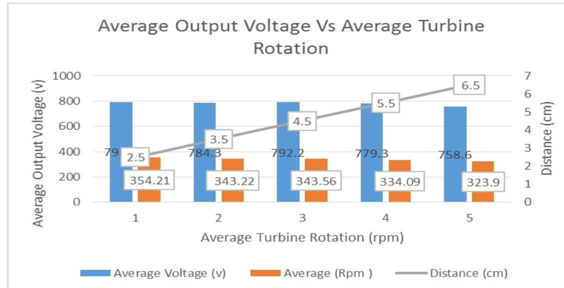

Figure 5: The average output voltage against Average Turbine Rotation for NREL blade

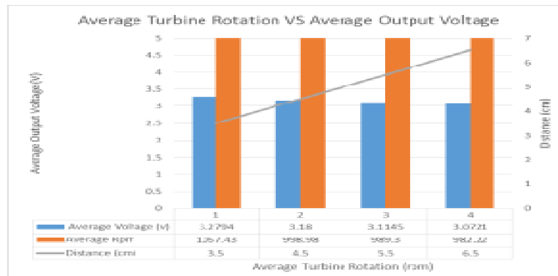

Figure 6: The average output voltage against Average Turbine Rotation for Swept blade

4. CONCLUSIONS

There are two objective of this study which is to design and develop a prototype of Waste Kinetic Energy Recovery System (WKERS) for generating the electricity from air conditioner waste. Next, to analyze the performance of (WKERS) prototype. A small scaled of wind turbine prototype is produced and proven that the design is functional and been tested with the average wind speed from air conditioner condenser of 6.2 m/s from frame distance of 3 cm from the condenser. Overall, the test shows that the further distance of the wind turbine from the condenser, the less the output voltage and turbine rotation (rpm) is obtained, thus the turbine blade should be as closer as possible to the condenser.

REFERENCES

[1] Chong, W., Poh, S., Fazlizan, A., Yip, S., Chang, C., & Hew, W. (2013). Early development of an energy recovery wind turbine generator for exhaust air system. Applied Energy, 1 12, 568-575.

[2] Syahputra, R., Robandi, I., & Ashari, M. (2014). Performance Analysis of Wind Turbine as a Distributed Generation Unit. International Journal of Computer Science and Information Technology, 6(3), 40-41.

[3] B. M. Nagai, B. M., Ameku K. and Roy J. N., Performance of A 3 kW Wind Turbine Generator with Control System, Applied Energy, 2009, 86:1774-178