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The Use of Solar Reflector for Heating Air Column in Cyclone Wind Turbine as Low Capacity Electrical Generator

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***Abstract*-- Indonesia has many islands which make the distribution of electricity difficult, especially in power cable network. This problem can be solved by independent electrical generator which must be easy to operate and maintenance. The use of cyclone turbine as low capacity electrical generator offer big potential to solve this problem.**

Normally cyclone wind turbine alone cannot generate sufficient speed to turn the generator to produce sufficient electrical power. But with the help of focused solar reflector we can heating up the air in the column bellow the cyclone turbine, so the hot air can produce thermal difference between air in the column with the air outside. With the thermal difference there be pressure difference also, that fasten the air flow through the cyclone turbine, which in the end can make the cyclone turbine produce enough speed to turn the generator so it can produce sufficient electrical power.

Our study shows that with the use of solar reflector the temperature in air column can reach 45^{o}C, the angular speed of cyclone turbine reach 120 rpm and thus generate electrical power.

***Keywords*- solar reflector, cyclone turbine, electrical power.**

I. INTRODUCTION

The world is old, so resources spreading thin especially fossil fuel, which are the main fuel in this world. We need to utilize other resources, which are abundant, continuous and cleaner. God provided us with such resources, like solar light and air around us. With the right way we can harness these resources to produce electrical current.

Our goal is to produce a device that can harness the solar light and air movement to generate electrical power, which much be easy to operate, maintenance and affordable to produce so it can be used in many part of our archipelagic country.

Our study consists of two parts, this one is the first part in which we try to set the basic needs and make sure the whole system works well. In the second part we will try to make it easier to operate and improving the overall efficiency so it can really easy to operate and produce quite amount of electrical power.

We believe that cheap and clean energy is not just a dream, with our mutual effort we can make this dream come true. Our study is just like a stone been thrown to the river, but we hope the ripple will reach far and wake the other which shares our dream.

II. BASIC PRINCIPLE

We relied to air movement to turn cyclone turbine to turn the generator to produce electrical power. So in this case the main issue is how to make the air movement large enough to turn the cyclone turbine.

In physics we learned that hot air has lighter weight than the cooler air and it make them tends to move upward. This was the main principle to our device.

Our device used 12 lenses (6 lenses in each side) with 90 to 100 mm in diameter, to heating up the air column. We adjust the lenses angle every 15 minutes to set their focus according to the movement of the sun.

Figure 1. Solar Reflector Cyclone Wind Turbine Generator

The hot air in the column will move upward, faster as the column temperature increase. Then the air movements turn the cyclone turbine and we got our electricity.

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III. METHODOLOGY

The data in this study was taken in two places, first in Adie's Workshop where we assembled our device, and in rooftop of B building in UNISMA where we conducted our field test.

The first set of data consist of measurement data of the relationship between the air temperature with angular speed of the shaft and the DC generator output.

The second set of data consist of the performance of our device in real condition.

IV. THE DEVICE

Our "thing" consists of several parts.

1. Air column
2. Cyclone turbine
3. Lenses
4. Gear box
5. DC generator

1. Air Column

Figure 2. Air column

The air column is box made of Zn plate, with 1 mm thickness, 400 mm x 400 mm cross area and 1200 mm in height.

It is the place where the air is heating up, where the hot air leave through the top and turn the cyclone turbine, and the cooler air from outside move in through its bottom side.

2. Cyclone Turbine

Figure 3. Cyclone turbine

It's a wind turbine, which works through the principle of air pressure difference. When the air inside the cyclone turbine is hotter than the air outside, the hotter air will move up and leave the turbine, it leaves the pressure drop in the air column under the cyclone turbine. The pressure drop will make the air outside to enter the air column, and the air circulation will turn the cyclone turbine.

3. Lenses

Figure 4. The lenses

Lenses used as heat collector from the sun light. Our first design used single lens with 400 mm in diameter in each side, but because of difficulties in its production, we changed it to multi lenses like we mentioned above.

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4. Gear Box

Figure 5. The shaft and gear box

We used gearbox to increase the rpm of the initial axis. The ratio is 1 : 2.

5. DC Generator

Figure 6. DC generator

Figure 7. DC generator specification.

V. DATA

Table 1.
Temperature in air column – Angular speed of shaft.

No	T (°C)	Rpm
1	29	0
2	40	16
3	50	77
4	60	280
5	70	620

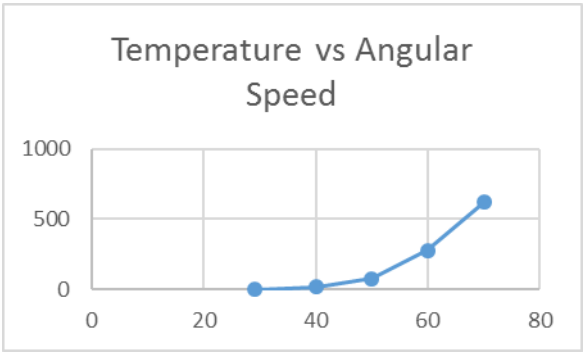

Figure 8, Temperature in air column – Angular speed of shaft.

Table 2.
Field Test Data

No	Time	T_1 (°C)	T_2 (°C)	Rpm	Voltage (Volt)
1	09.00	29	29	51	6
2	09.30	29	29,4	48	6
3	10.00	29	30,1	55	6
4	10.30	29	31	58	7
5	11.00	29	32,3	58	7
6	11.30	29	33,8	63	8
7	12.30	29	35,4	65	8
8	13.00	30	38,1	68	8
9	13.30	30	42,3	74	9
10	14.00	30	44,2	112	12
11	14.30	30	44,2	120	12
12	15.00	29	42,7	118	12

Time = time when the data collected
T_1 = Temperature outside the air column
T_2 = Temperature inside the air column
Rpm = Rotation speed in shaft
Voltage = Output voltage from DC generator

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VI. Discussion

Our field testing shows that the Solar Reflector Cyclone Wind Turbine works. The lenses can collect heat from the sun big enough to turn the cyclone wind turbine to turn the generator to produce electricity. But we still have a lot of issues that must be fixed.

Several problem we encountered in field test are focusing the lenses, heat loss due to the air column surface area and the strength of the shaft.

The used of many lens in our devices had showed us how impractical it is to maintain a set of lenses focus to follow the movement of the sun every 15 minutes.

More serious problem are the heat loss due to the large surface area of our air column. In our field test in the rooftop of 6^{th} floor building in B building where the wind speed is much higher so the heat loss is greater also. To minimize the heat loss we changed the material of our air column from Zn plate with 3 mm thick with glass in the side that faced the sun direction (east and west side) and laminated the other two sides with wooden panel.

The third problem we encountered was the hollow Aluminum shaft cannot take the load and bent. We changed the shaft with the solid one and improving the bearing that support the shaft.

VII. Conclusion

1. From our data showed in table 1 and figure 8, there are positive correlation between temperatures in air column with the shaft speed.
2. From our field test data in table 2, showed that the system works, though there are some issues that can be improved. The main problem in here is minimizing the heat loss from air column.

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