Analysis Of Variation Of Paddle Wheel Photovoltaic Wheel Form In Microalgae Cultivation On Electricity Consumption

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Abstract.
The main problem that is often found in the failure of microalgae production is poor water quality during the maintenance period. One of the causes of deteriorating water quality is the lack of oxygen which endangers microalgae which can inhibit cell growth so that it can reduce its productivity. On this basis, efforts are needed to refresh the water or aeration to help increase the dissolved oxygen (DO) level in the microalgae growth container using a paddle wheel. The development of an aerator blade design that has optimum efficiency is needed to reduce high electricity consumption and see more effective cell growth. For these problems, in this study, variations of the paddle wheel will be analyzed. Variations in the shape of the wheel used, namely straight and curved with the available aerators, are expected to have an optimum speed, area coverage and increase the amount of dissolved oxygen (DO). The method used is the experimental method . Based on this research, it was found that an increase in the value of cell growth occurred in variations in the shape of a straight paddle wheel of 122 cells/ml .

Keywords: *Bivalvia, bray-curtis, cannonical correspondence analysis, density, and gastropoda.*

I. INTRODUCTION

The condition of the world is hit by a crisis in the fields of energy, food and water. The energy crisis encourages the use of surrounding energy and renewable energy to anticipate the scarcity. Microalgae is believed to be able to provide food and energy stocks in a short time, microalgae technology requires a land that is not too large and easy to apply in everyday life. Microalgae are a kind of unicellular living things measuring 1 micrometer to hundreds of micrometers and have chlorophyll, live in fresh water or sea water, require carbon dioxide, and nutrients and light for photosynthesis. In microalgae cultivation aims to increase or increase the number of microalgae cells so that biomass is obtained in accordance with the desired goal. Some microalgae cultivation systems that are often used are: open pond, and close pond. Paddle Wheel is a mixing process, and the mixing process is no less important in making raceway ponds in microalgae cultivation which is useful for stirring nutrients and stirring parts of microalgae cells to get uniform sunlight and mixing fresh air more quickly diffused in the media. The problem that occurs in microalgae cultivation is the mixing process using electrical energy. Electrical energy currently uses fossil energy in the form of fuel oil which has experienced a crisis. The use of energy to create energy is not a solution. The next problem that occurs is that it is not yet known which form of windmill is efficient for the consumption of electrical energy for the growth of microalgae. The purpose of the first year of research is to predict the shape and number of blades that are effective in the long and medium term based on theoretical concepts according to the equations of each variable and the use of solar cells to drive the paddle wheel. The purpose of the second year of research is to use a solar cell as a heater for drying microalgae at the production stage.

The analytical method in this study uses experimental analysis by making curved and straight blades of paddle wheel solar cells on the electrical power used. The results of the research are expected to find the shape of the paddle wheel blade with an efficient solar cell.The development of renewable energy research is currently growing rapidly. to tackle the energy crisis. So that efforts to provide alternative fuels are very important, namely through biofuels. The development of biofuels has been carried out such as the use of CPO (Crude Palm Oil), soybean, canola, coconut, and microalgae. One of the raw materials that has the most potential and is safe for the environment is microalgae. Microalgae research in Indonesia continues to be carried out through the Ministry of Research and Technology, the Ministry of Energy and Mineral

Resources, LIPI, as well as several universities in Indonesia.Microalgae is called third generation energy because it has the potential as raw material for energy production, Microalgae does not produce waste that has a negative impact on the environment so that the quality of water and air is not affected for the life of living things.The potential of microalgae is the raw material for producing renewable energy. Microalgae growth is faster than some other oil-producing plants such as palm oil, sunflower, soybean, and corn. Microalgae culture conditions greatly affect the production of lipids to be produced. Lipid production is highly dependent on limiting factors such as nutrients, pH, light, salinity, etc. This study utilizes the above conditions, where the cultivation system applied is the open raceway ponds cultivation system [1]. The Open raceway ponds cultivation method is very appropriate so that the utilization of sunlight in photosynthetic activities is optimal, coupled with the use of a paddle wheel machine that functions to mix and create a flow rate in the cultivation media for the purpose of distributing nutrients and aeration is expected to change the process. biosynthesis in producing lipid content so as to provide maximum results and in accordance with the expected target. One of the derivatives of microalgae bioenergy products is biodiesel, bioethanol, biobuthanol, and SVO (Straight Vegetable Oil). Biomass produced by microalgae is directly used for modified diesel engines.

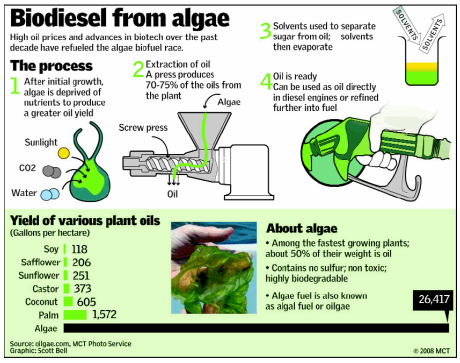

Fig 1. The process of making biodiesel from microalgae by pressing

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Microalgae is one of the best solutions to become alternative energy raw materials (biofuels). The microalgae Nannochloropsis sp. is a species of microalgae that has a high lipid content. The problem currently being faced is the mass-scale cultivation system, such as the open raceway pond cultivation system, where operational costs are still high, especially the need for electrical energy, while productivity is still low. The use of paddle wheels in stirring aims to avoid sedimentation and generate currents in the cultivation media so that nutrients and aeration are expected to be optimal [2].The main problem in this research is the use of electrical energy to drive the paddle wheel for the growth of microalgae. The specific objective of the first year of research was to analyze the effect of the shape of the paddle wheel blade on the growth rate and lipid production. The second objective is to analyze the level of electrical energy efficiency on the paddle wheel machine and determine the operational time of the paddle wheel. The urgency of this research is very important, where it is found that the paddle wheel propulsion with photovoltaic microalgae mixing process and efficient variations of the shape of the wheel during cultivation to the production of renewable energy sources (microalgae).This research has relevance to RIRN 2017-2045 in the field of Energy. On the theme of renewable energy, smart grid systems and energy conservation management. Then in accordance with PRN 2020-2024 on the theme of environmentally friendly energy. This research is an umbrella research in accordance with the roadmap of researchers, namely energy conversion.

1.1 Microalgae

In general, microalgae are a group of small-sized plants that must be optimized considering that their abundance in Indonesian waters is very limited.

1.2 Cultivation of Microalgae

Cultivation is a technique to grow microalgae in a certain controlled environment. Cultivation aims to provide a single species in the mass culture of microalgae for the harvesting stage. Cultivation development is carried out starting from the laboratory scale to the application carried out in industry.

Microalgae cultivation is divided into two, open pond and closed pond photobioreactor. In this study using the Open Pond method. At each level of maintenance ranging from semi-outdoor to open raceway ponds, the volume of microalgae strain is 1:10 of the total volume. For

1.3 Waterwheel (Paddle Wheel)

Waterwheel (paddle wheel) is included in one type of aerator that uses an electric-powered motor that applies surface aeration techniques. This waterwheel is a wheel that is usually used in ponds or fishing ponds to produce stable air currents and waves in the water. The shape of the wheel in this study is straight and curved.

1.4 Analysis of Paddle Wheel Usage

When the wheel moves the fluid the fluid velocity occurs, lower power consumption is required to achieve the energy saving target. Therefore, the term mill efficiency was introduced to represent the economic and energy characteristics for the mill. The mill efficiency is the most complicated parameter to estimate. The mills used must have the ability to aerate and circulate water in rearing and cultivation.

1.5 Photovoltaic(PV)

Photovoltaic (PV) renewable energy systems offer consumers a new alternative to how power can be provided. PV systems react to light by converting some of the radiant energy into electricity. Photovoltaics require no fuel to operate, produce no pollution, require little maintenance, and are modular. Other advantages of PV systems include: unlimited solar energy input.

II. METHODS

This research was conducted at the Mechanical Engineering Laboratory of the University of HKBP Nommensen Pematangsiantar on Jalan Sangnawaluh No.4 District. East Siantar. The length of the research planned is 12 months.

2.1 Tools and Materials

3.2.1 Tools

The tools used in this research:

1. Photovoltaic 100 WP
2. Dissolved oxygen
3. Solar Charge Controller
4. Voltmeter
5. DC Motor

2.2 Material

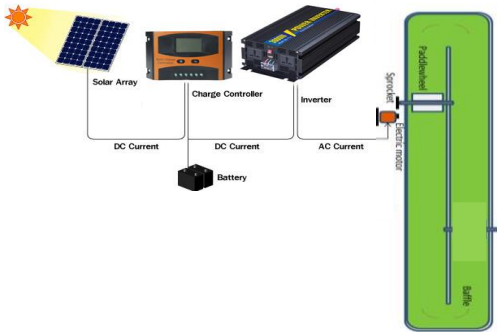
The materials used are as follows:

1. Glass 10 mm 2 pieces
2. Microalgae Strains (Nannoclhoropsissp.)
3. Walne Fertilizer
4. Fertilizer (N,P,K)
5. Chlorine
6. Methanol
7. Silica gel
8. NaOH
9. Guillard
10. Alcohol
11. Lugol
12. quads
13. Welding Wire
14. Silicon Glue 7 bottles
15. Hollow iron 6 rods
16. 1 roll cable
17. 2 cans of black paint

18. 12 Volt Car Battery
19. Solid Iron 1 stick
20. Welding transformer 1 piece

2.3 Design of paddle wheel blade shape and number of blades with solar cell

After assembling the paddle wheel engine components with solar cells, it will look like Figure 3.1. The schematic of this paddle wheel machine with solar cell clearly illustrates the process in the growth of microalgae.



III. RESULT AND DISCUSSION

Dynamo Paddle Wheel Load

The load of this portable solar powered paddle wheel dynamo is 125 watts. Shown in the following specification table :

Table 3.1. PLTS Usage Load

Load Type	Amount	Voltage	Power (Watt)	Load (Ampere)	Time (Jam)
Paddle whell Dynamo	1	200	15 Watt	01.03	11

Calculating Solar Panel Voltage and Current

Calculating the results of Voltage (V) and Current (A) from panel measurements for 11 hours periodically with sunny weather in the rice fields at HKBP Nommensen University, Pemtangsiantar.

Table 3.2. Results of Voltage and Current in Solar Panels

Time	Intensity (Lux) meter	Voltage (Volt)	(Ampere)
09.00	407	12,10	3
10.00	518	18,40	3,3
11.00	592	20,64	3,9
12.00	612	21,50	4,5
13.00	578	20,07	3,9
14.00	554	19,71	3,9
15.00	511	19,20	4,2
16.00	500	18,92	4,2
17.00	400	18,40	3,9
18.00	350	13,00	3,3

Information:

1. The voltage increases at 09.00 - 12.00 WIB and begins to decrease at 13.00 - 18.00 WIB.
2. The highest solar panel voltage and current at 12.00 WIB reached 21.50 V and 4.5 A.

To find out how much energy can be stored, it is necessary to convert Ah to Wh or power per hour (Watt-Hours). So you can find out the capacity of the existing battery.
By using the battery specifications 12V - 7Ah. Power can be found by:
P = I x V
P = 7 Ah x 12 V
P = 84 Wh
Note: P = Power per hour (Wh)
I = Hourly current (Ah) V = Battery voltage (V)
Determining Solar Panel Capacity
For PV mini-grid systems with power below 1000 Watt, a factor of 20% must be added to the load to compensate for system losses and for a safety factor (Dunlop, 1997). Therefore the specified load ampere-hour is multiplied by 1.20 so that.
ET = EB x Loss and safety factor
= EB x 1.20
= 15 wh x 1.20
= 18 wh
Information :
EB = Load energy 15 Wh (watt hours per day) ET = Total load energy (watt hours per day) Loss and safety factor = 1.20
Sunlight and Temperature Data Retrieval
This data collection aims to serve as a reference in determining the effectiveness of the use of PLTS in the rice fields at a time of 10 hours in sunny conditions by measuring the amount of light intensity (Lux) adjusted to the local BMKG weather forecast and temperature determination.

Table 3.3. Data on the amount of sunlight intensity and temperature

No	Sun Condition	Time	Lux	Temperature ^{0}C
1	Bright	09:00	407	27
2	Bright	10:00	518	28
3	Bright	11:00	592	29
4	Bright	12:00	600	32
5	Bright	13:00	568	31
6	Bright	14:00	554	28
7	Bright	15:00	511	27
8	Bright	16:00	500	26
9	Bright	17:00	490	25,80
10	Bright	18:00	300	25,70

The Effectiveness of Using Paddle Wheel Dynamo with Variation of Windmills on Microalgae Development,The results of the measurement for 10 hours have obtained a graph of the results of the load voltage and current as the application of PLTS with a portable paddle wheel dynamo.

Table 3.4. Experimental Results Using Curved Wheels
Measurement Data At The Last Time Of Testing And Growth

Day	Density (Cell/ml)	Water quality		
		Temperature	Do	pH
1	16	25.6	2.6	6.2
2	27	26	2.6	6
3	41	25	1	6.2
4	63	27	1.1	6.2
5	85	26	1.1	6.1
6	95	27	2	6
7	118	27	2	5

Fig 3.4. Density vs Day Graph on Curved Wheel

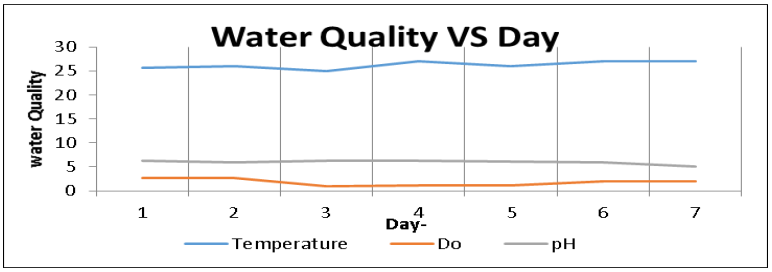


Fig 3.5. Graph of Water Quality vs. Days on the Curved Wheel

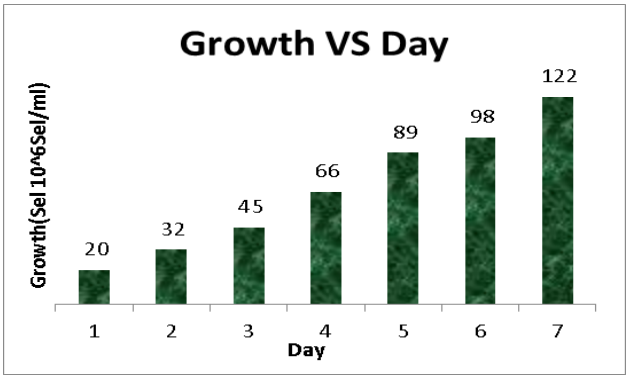


Fig 3.6. Density vs Day Graph on Straight Wheel

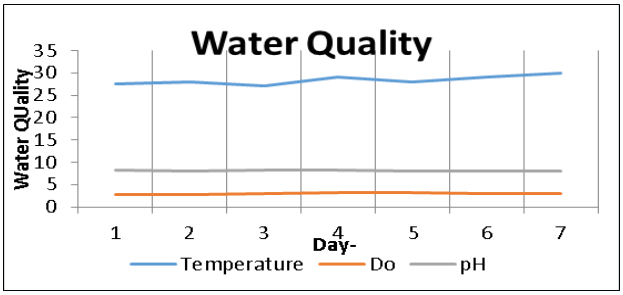


Fig 3.7. Graph of Water Quality vs. Days on Curved Wheel

IV. CONCLUSION

After testing for variations in the shape of the paddle wheel on electrical energy consumption, several conclusions can be drawn, namely:

1. The power in the battery used is: 84 Wh and the largest solar intensity data occurs at 12.00 WIB
2. We can find out the value of the battery voltage on the solar collector to turn on the load
3. We can see how long AKI can last when the power source from the Solar Panel (Sunlight) is gone
4. The size of the growth of microalgae with variations of the wheel is found in the wheel with the Straight model, which is 122 cells/ml with a temperature of 300C and a water pH of 8

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