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Abstract

Generally, Regions of Indonesia is potential to buildmicro hydro power plant, because it relatively easy and environmental friendly, therefore the research about micro hydro power plant is needed. The University of Indonesia (UI) lake area has good potential source to buildmicro hydro power plant. For that reason, observation and built micro hydro powerplant in UI lake area also needed to do.

The methodology of this research begins withanalyzing potential sourceto buildmicro hydro power plant inUI lake area, then builtit, afterward, testing the turbine propeller to get maximum performance. The type of turbine propeller used is turbine propeller 125.

The result is micro hydro power'smaximum performance with turbine propeller 125 and generator, yield the electricity 121.5 watt, and efficiency 30%, at head, H ≅ 2 meter and flow rate, Q ≅ 22 liter/s.

Key words: micro hydro power plant, performance, maximum, turbine propeller

1. INTRODUCTION

Asset out in theNational Electricity General Plan (2004-2013) is increasing the supply of electricity torural area sthrough the expansion of existing networks, or for areas not reached by PLN also the fact that the Bogor district electrification ratio reached 50.96%, which means that there areap proximately 49.14% of family heads who do not have electricity, especially in villages in accessible by electricity network. **(RPJP/long developing plan Bogor District 2005-2025)**

There is an option to meet the electricity consumption in areas far from the reach of the grid, by utilizing there sourcesof small hydropower in rural areas known as micro hydro power which has a power generation capacity of 1 to 100 kW. Micro hydro power is very well developed to support the electric program that is easy, cheap and affordable.

Micro hydro power construction can be done by utilizing the existing water sources. It is possible to see the condition of the University of Indonesia lake area micro hydro power constructi on there.

Therefore,the construction of micro hydro power at UI lake area – Depok becomes important because it can be use das a place to learn, to research and to develop micro hydro power. Obviously, the results ofthis study will be used for the installation of micro hydro power in Bogor district, which is expected to increase the electrification ratio in Bogor district government which can certainly help in this regard PLN, in improving the supply of electricity to rural communities.

2. THEORY

Micro hydro power is a tool that generates electricity using hydro-electric sources. Micro indicate the size of the generating capacity up to100kW (Wibowo, C. 2005)

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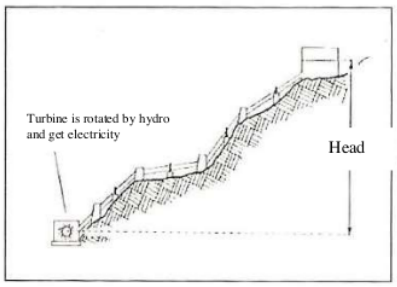

Figure 1. How It WorksInSimple Micro Hydro Power Plant

How it works is simple micro hydro power isa certain amount of water being dropped from a certain height, to drive a turbinewheel that is on micro hydro power. Then round the turbine is used to drive a generator, to produce electricity, as shown in Figure1below

So, micro hydro power changing dynamicsde rived from water into electricity.

When the amount of water flowing along the Q difference in height H in the direction of gravity every second, then the water do the work every second, or carry output (work per second) Ph. So make the equations.

$Ph = \gamma.Q.H$..... (Pudjanarsa, A. and Nursuhud, D. 2006.)

when :

Ph = hydraulic power of water (watt)
γ = density of water (N/m^3)
Q = flow rate (l/s , or m3/s)
H = head (m)

If the calculated turbine efficiency (η_t), the turbine generated poweris:

$Pt = \eta_t.\gamma.Q.H$ ..... (Wibowo, C. 2005)

when :

Pt = turbine power (watt)
η_t = turbine efficiency (%)

Thus, the power turbine is strongly influenced by the amount of water flow (flow rate) and height difference (head), sobefore choosing amicro hydro power construction site, first check the amount of water flow and the locations where the height difference.

3. METHODOLOGY

Methodology of this research begins by examining themicro-hydro potentialin the University of Indonesia lake area. Site selectionwas based on the height difference (head), $H \geq 2$ meter and amount of water flowing (flow rate), $Q \geq 15$ liter/s.
The next stepisto buildthe micro hydro power at that location and test the performance of the turbine and generator, so that the generator produces electricity with a maximum power.
So, methodology of research is more detail can be seen in Figure 2 below

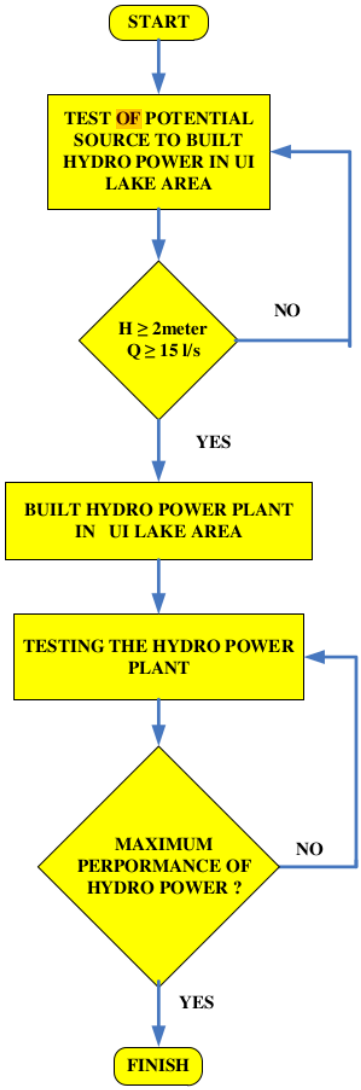

Figure 2. Methodology of Research Flow chart.

4. ANALYSIS AND DISCUSSION

Testing water potentialin order tobuild micro hydro power plantin University of Indonesia lake area, start of survey locations that have different heights, H ≥ 2m and measurement of water flow, Q ≥15 l/s.

From the results of the survey and measurement of water potential, obtained three (3) locations corresponding built micro hydro power plant, the data can be seen in the table below.

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Table 1. Testing of potential of water in 3 locations of UI lake area

Location	*Head (m)*	*Volume (liter)*	*Time (sec)*	*Flow rate (liter/sec)*	*Average Flow rate (liter/sec)*
I	*7*	*312*	*4.44*	*70.3*	*55.6*
		280.8	*5.25*	*53.51*	
		249.6	*5.81*	*43*	
II	*2*	*1,575.6*	*5.57*	*282.6*	*454.4*
		2,706.8	*4.32*	*626.28*	
III	*2.75*	*20,000*	*5.92*	*3,389.83*	*3,358.81*
		20,000	*6.01*	*3,327.79*	

From all locations, location I and II ever experienced a drought in the dry season, so chosen location III. Area III is acollection of some of the lake drains the lake in the UI, so that the discharge water is also highest.

Figure 3. These threelocationof potentialmicro hydro powerplant in UI lake area

Once selected location III, then the next build and test the performance of micro hydro powerplant at that location, as shown in Figure4 below.

Figure 4. DevelopmentandTestingMicro Hydro PowerPlant at location III

Micro hydro powerplant performance testingresults at location III, can be seenin Table2 below.

From table 2, on height difference, H ≅ 2 meter and flow rate, Q ≅ 22 liter/s, maximum of performance micro hydro powerplant with propeller 125 turbine and generator generates electricity at 121.5 watts and efficiency 30%.

Table 2. Micro Hydro PowerPlant Performance Testing at location III

No.	Load (watt)	γ (N/liter)	H (m)	Q (liter/sec)	V (volt)	I (ampere)	Ph (watt)	Pl (watt)	η
1	25	9,81	1,86	21,86	216	0,11	398,87	23,76	6%
2	50	9,81	1,86	21,86	216	0,22	398,87	47,52	12%
3	75	9,81	1,86	21,86	216	0,30	398,87	64,80	16%
4	100	9,81	1,86	21,86	210	0,40	398,87	84,00	21%
5	125	9,81	1,86	21,86	210	0,47	398,87	98,70	25%
6	150	9,81	1,86	21,86	204	0,55	398,87	112,20	28%
7	175	9,81	1,86	21,86	180	0,63	398,87	113,40	28%
8	200	9,81	1,86	21,86	165	0,70	398,87	115,50	29%
9	225	9,81	1,86	21,86	153	0,77	398,87	117,81	30%
10	230	9,81	1,86	21,86	150	0,81	398,87	121,50	30%
11	250	9,81	1,86	21,86	140	0,84	398,87	117,60	29%
12	260	9,81	1,86	21,86	135	0,86	398,87	116,10	29%
13	275	9,81	1,86	21,86	120	0,96	398,87	115,20	29%

5. CONCLUSION

Conclusion of this research are:

1. Micro hydro power plant location is at Mahonilake (location III) which located at University of Indonesia lake area.
2. On Head, H ≅ 2 meter and flow rate, Q ≅ 22 liter/s, maximum performance with propeller 125 turbine generator generates electricity at 121.5 watts and efficiency 30%.

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