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The effect of lamp loading variation on generator power on curved blades water wheel

Gerard Antonini Duma and Luther Sule

Department of Mechanical Engineering, Faculty of Engineering, Universitas Hasanuddin, Makassar, Indonesia

Email: gerardduma@unhas.ac.id

Abstract. Hydropower is the energy obtained from running water. The energy that is owned by water can be utilized and used in the form of mechanical and electrical energy. Utilization of water energy is mostly done by using water wheels or water turbines that utilize the presence of a waterfall or water flow in a river. This study aims to determine the effect of lamp loading on the generator power generated by the curved blade water wheel, carried out at the Fluid Engineering Laboratory of the Department of Mechanical Engineering, Universitas Hasanuddin. Methods of data collection is done directly by measuring voltage and electric current, water wheel rotation, the water debit, the water channel head. The results showed lamp loading is very influential on the generator power, if more lights are turned on will cause the generator power become smaller. The biggest generator power is obtained on debit of 0,0163 m³/s and load of one lamp with six blades is 9,275 watt, eight blades is 8,06 watt, ten blades is 4,16 watt

1. Introduction

Water turbines convert the potential energy of water into mechanical energy, by utilizing the difference between the surface of the air called the head. To use the energy required a special water building. The difference between the surface water is obtained by building a dam, where the water level will depend on the conditions and place by Himran [1] Water energy is the energy that is suitable and the most potential to be developed in Indonesia. The rate of growth of hydropower in Indonesia is very slow, whereas the potential of Indonesia's hydro power is quite large reach 75.000 MW. Utilization through the national electricity supply only reached 10.1% or 7,572 MW. Based on data from the Ministry of Energy and Mineral Resources, the potential of hydropower energy is spread by 15,600 MW in Sumatra, 4,200 MW in Java, 21,600 MW in Kalimantan, 10,200 MW in Sulawesi, 620 MW in Bali-NTT-NTB, 430 MW in Maluku and 22,350 MW in Papua. While in the world, the potential for water energy is estimated to reach 657 million HP or 489,924.8156 MW, but the utilization to 15% [2].

Sule [3] analyzed the water wheel with a flat plate blade by varying the number of blades, the result is the biggest efficiency found on six blades. Sule [4] analyzed the water wheel with savonious blade by varying the number of blades, the result is the biggest efficiency found on eight blades Sule analyzed the water wheel with bowl of blade by varying the number of blades, the result is the biggest efficiency found on six blades [5].



2. Research Methods

This research was conducted at the Fluid Machines Laboratory of Department of Mechanical Engineering, Universitas Hasanuddin.

The testing tools are water reservoirs, centrifugal pumps, reservoirs, pipes, installation channel, Curved Blades Waterwheel, waterwheel shaft, handy counter, stopwatch, 20 L bucket, amperemeter, voltmeter, 2.5v lamp, generator, thermometer, cable, pulley and belt, ruler 30 cm

a. Debit (Q)

$$Q = \frac{V}{t} \quad (1)$$

b. Cross-sectional area (A)

$$A = b \times h \quad (2)$$

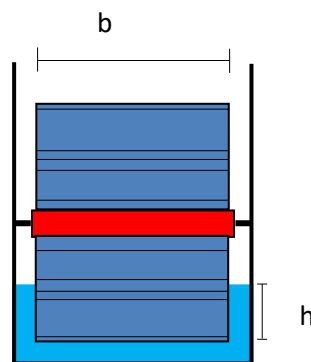


Figure 1. Cross-sectional area of blade

c. Water flow velocity (v)

$$Q = v \cdot A \quad (3)$$

d. Density (ρ)

In the testing, we get temperature of water is 30⁰C then ρ on the table A.1 is 996 kg/m³

e. Water Power (P_{air})

$$P_{air} = \frac{1}{2} \cdot \rho \cdot A \cdot v^3 \quad (4)$$

f. Electrical Power (P_{gen})

$$P_{gen} = V \cdot I \quad (5)$$

g. Total Efficiency (η_{ins})

$$\eta_{ins} = \frac{P_{gen}}{P_{air}} \times 100 \% \quad (6)$$

3. Results and discussions

From Figures 1-4 we can see that the generator power (P_{gen}) is greatly influenced by the number of lights which is called a load. If the load is turned on with a maximum amount is five lamps cause the generator power to decrease otherwise if the load is turned on only one lamp then the generator power becomes maximum. This is because the lamp have greatly influences the rotation of the water wheel,

if the load of the lamp is turned on more then the spinning wheel becomes slow because it produces a small electric power

The maximum power that can be generated by the generator is at the smallest load of 1 lamp, maximum debitf $0.0163 \text{ m}^3/\text{s}$ with blade variation of 6.8, and 10 respectively 9.275 watt, 8.06 watt, 4.16 watt

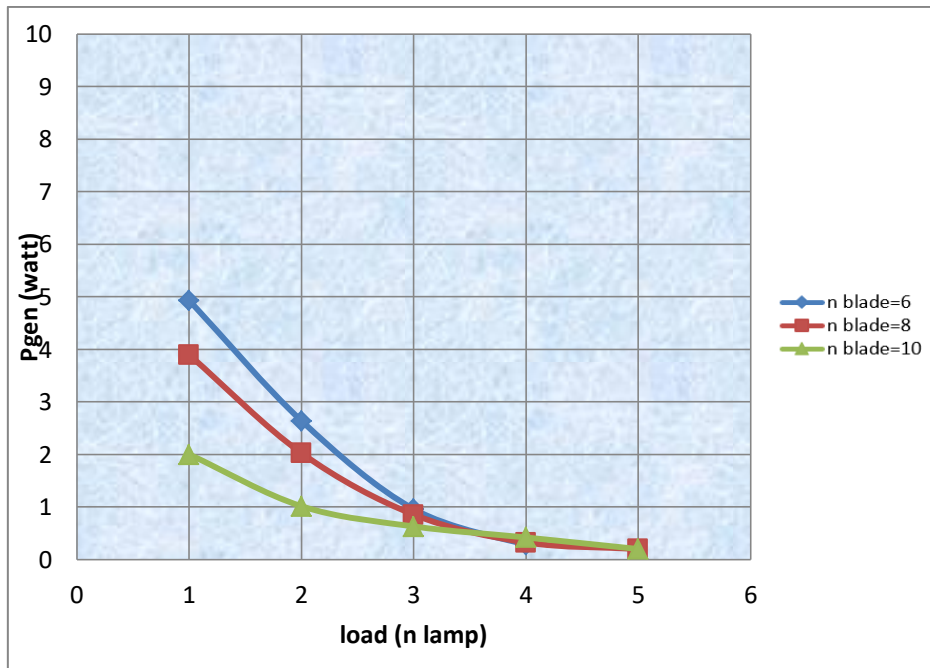


Figure 2. Relation between P_{gen} (watt) on loads (n lamp) for $Q = 0.0108 \text{ m}^3/\text{s}$

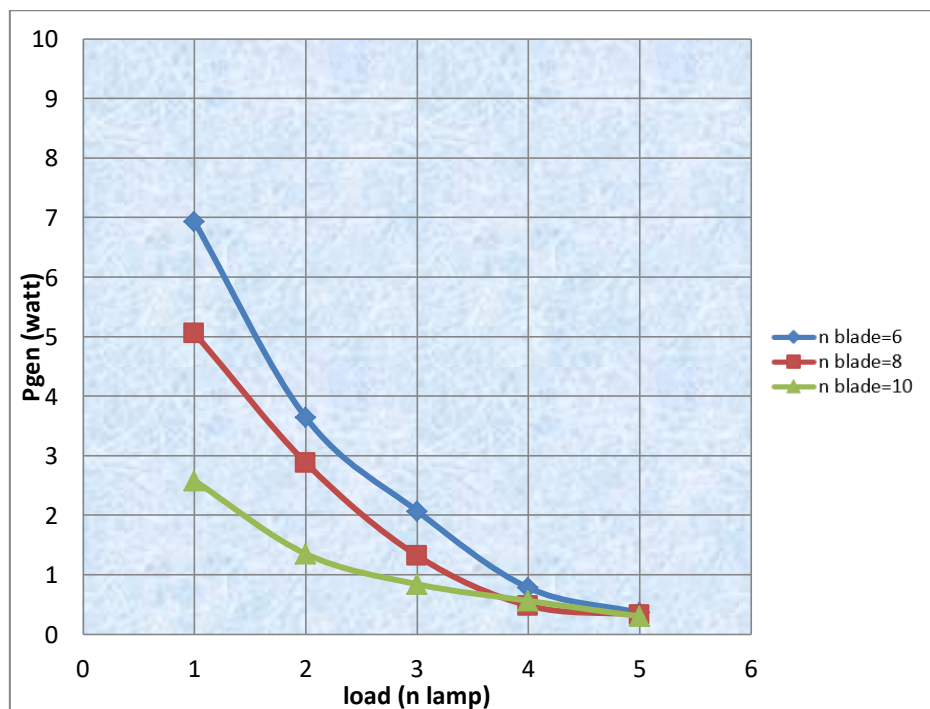


Figure 3. Relation between P_{gen} (watt) on load (n lamp) for $Q = 0.0124 \text{ m}^3/\text{s}$

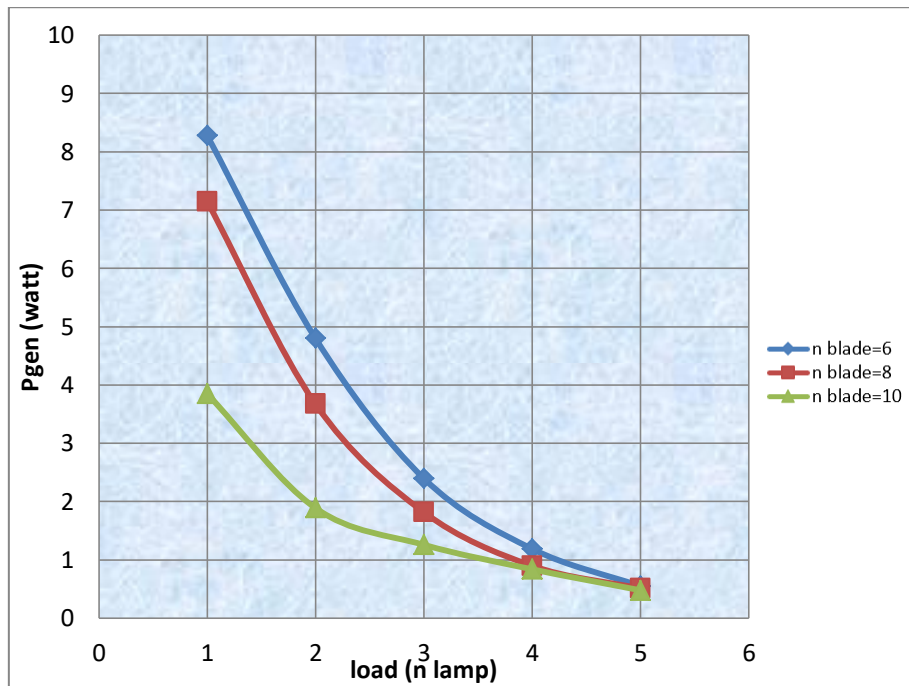


Figure 4. Relation between P_{gen} (watt) on load (n lamp) for Q = 0.0135 m³/s.

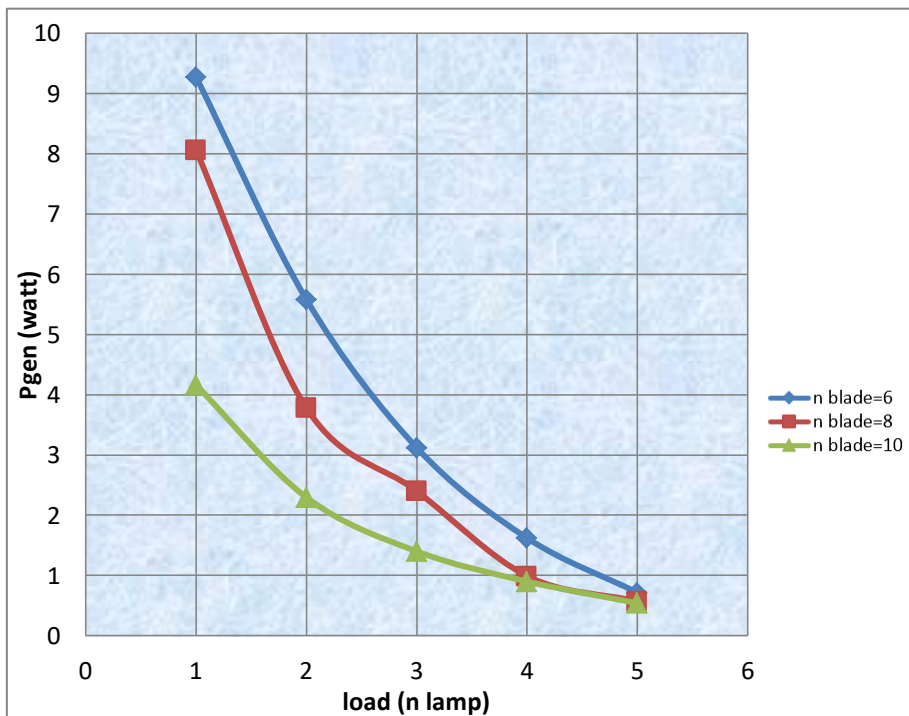


Figure 5. Relation between P_{gen} (watt) on load (n lamp) for Q = 0.0163 m³/s.

4. Conclusions

Lamp loading is very influential on the generator power, if more lights are turned on will cause the generator power to be smaller. This is because if more lights are turned on cause the water wheel rotation to slow down so that the electric power generated by the generator becomes less

The biggest generator power is obtained on debit $0.0163 \text{ m}^3/\text{s}$ and load of 1 lamp with six blades is 9.275 watt, eight blades is 8.06 watt, ten blades is 4.16 watt

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