Design and Experiment Vortex Gravitation Turbine Model Laboratory Scale

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Abstract. The vortex gravity system has a main component consisting of a tube which later produces a whirlpool, and a water tank as the main source of water storage. When flowing water into the tube, the water flow into the outlet hole in the tube and formed a whirlpool which is continued back through the pipe to the water tank below. The outlet holes in the tubes have 4 sizes, 12, 9, 6, 3 cm in each tube size. The size of the tube has 3 sizes namely 35, 30, 25 cm. This research is based on experimental tests to determine the performance of the flow at the diameter of the tube outlet against the formation of a vortex on the vortex tube. From several studies that have existed the type of outlet hole in this tube has not been thoroughly examined. From the results of the expansion can be seen differences in the results of each size of the outlet hole in the tube. So it can be seen from the test results that changing the size of the tube outlet, the performance obtained is different. Given this problem, this study was conducted with the aim of obtaining performance and efficiency in the vortex air outlet tube. The vortex system on a laboratory scale, looking at previous studies varying the diameter of the vortex tube and the outlet tube of the tube, this study examines the effect of the difference (ratio) on the diameter of the vortex tube and the outlet hole of the tube. Experimental results show that the velocity has increased in the 35 cm diameter tubes and fluctuations in the 30 cm and 25 cm diameter tubes. The ups and downs in the velocity are caused by the available energy in the flow of water being extracted after hitting an outlet hole in the vortex tube. The velocity graph in the test shows that the highest velocity occurs in the 30 cm diameter tube

Keywords: Vortex tube diameter, tube outlet hole, whirlpool.

Introduction

The Vortex Water Gravity Power Plant (GWVPP) is a generating system that generates electricity from a low-altitude vortex water turbine and low flow rate. In the gravitational vortex water turbine the main component consists of a propeller which later produces a whirlpool, in the tube and the water tank as the main source of water storage (Hudan Achmad K, 2017). When flowing water into the tube, the flow of water that hits the tube to form a whirlpool that falls into the bottom tangka will be passed back through the pipe to the upper water tank. Despite the fact that the outlet holes in the tubes have different sizes, so the formation of perfect vortex can occur at certain tube sizes. From several studies that have existed various sizes in the tube and the outlet tube of this tube have not been thoroughly examined. To increase velocity and the formation of whirlpools, a study of open channel flow is needed to determine the sizing characteristics of the tube and tube otlet holes.

Given this background, this study aims to be able to design tools and conduct flow model experiments on vortex gravity and determine the effect of vortex tube diameter ratios and vortex tube outlets on the height and velocity of vortex flow. Next, examining the whirlpools generated around the outlet tubes of the tubes required a simulation experiment using the Iventor software as a visual representation of a laboratory scale model of the vortex gravity system.

Hydroelectric power generation is currently one of the choices utilizing renewable energy sources, but its utilization is still on a small scale and uses simple technology, meaning that this power plant can only meet the required electrical energy. This type of hydroelectric power plant is often called microhydro or often also called picohydro depending on the electricity output generated by the generator. Microhydro which usually utilizes waterfalls with high water fall. As for the low fall height is not maximally utilized. This is a reference for utilizing river flow by changing to vortex flow.

A German researcher Viktor Schauberger develops vortex flow technology to be applied to water turbine modeling. Vortex flow which is also known as pulsating flow or vortex can occur in a fluid that flows in a channel that changes suddenly. The phenomenon of vortex flow is often found in aircraft wing modeling, vortex flow tends to be considered as a loss in a fluid flow. Based on the above conditions, it is necessary to conduct research to see the effect of the tube and discharge dimensions on the formation of vortex.

Research (Javed Ahmad Chattha, 2019) The Vortex Turbine Water Generator determines that the performance of the propeller rotor is positioned higher than the rotor located below, thus showing that undistorted surface vortexs have more energy available for electricity generation. To build multi-staging in GWVT, this study recommends using the same propeller and optimal distance settings.

Overall design

1 Open Channel

Open channel is a channel where water flows with free water level. In open channels, for example rivers (natural channels) the flow variable is very irregular with respect to space and time. These variables are channel cross-section, roughness, base slope, flowrate bends and so on (Triatmodjo, 2015).

According to Maryono (2007) in Wardani (2018), the complexity of the river system can be seen from the various components of the river composition, for example the shape of the river channel and branching, river bed formations, river morphology, and river morphology. ecosystem). River branching will resemble river trees starting from the first order river to the n-order. Riverbed formations at a glance are very difficult to identify and characterize. The shape of the meander groove is influenced by the longitudinal slope of the landscape, the type of riverbed material, and the vegetation in the area concerned.

The river as an open channel will be very free in adjusting the morphology, in reaction to changes in the hydraulic conditions of the flow. River morphology is the science that studies the geometry, types, properties and behavior of rivers with all aspects of their changes in the dimensions of space and time, thus concerning the dynamic nature of rivers and their environment which are often related (SNI 2400.1: 2016).

2.2 Classification of flow

According to Triatmodjo (2015) water flow can be divided into several types of flow according to several reviews.

1) Flow in terms of time

a) Permanent flow, i.e. flow, which is constant or unchanged at all times (depth, velocity and flow).

b) The flow is not permanent, that is, the flow that over time the variables (depth, velocity and flow) are not constant or change.

2) Flow in terms of flow direction

a) Uniform flow is the flow along the lengthwise direction of the variables (depth, velocity and flowrate) constant or unchanged.

b) Non-uniform flow that is the flow along the lengthwise direction of the variables (depth, speed and flowrate) is not constant or changes.

3) Flow in terms of the value of the Reynold number (Re)

Reynold numbers are numbers that represent the ratio between average speed and kinematic viscosity. flow is divided into several types as in Table 2.1.

Table 2.1 Classification of Flow Based on Reynold

No	Type of	Bil Reynold	Flow Sketch
1	Laminer	<500	
2	Turbulent	>1000	
3	Transition	500 <Re <1000	

The design reference is taken from a previous study conducted by Widiyatmoko, 2012. The steps undertaken in the design process are the creation of a part image to the merging process. The results of the design can be seen in Figure 4.1. The simulation of parameters and dimensions using an Iventor was first carried out by modeling the equipment used in the assembly tool of the vortex gravity turbine system.

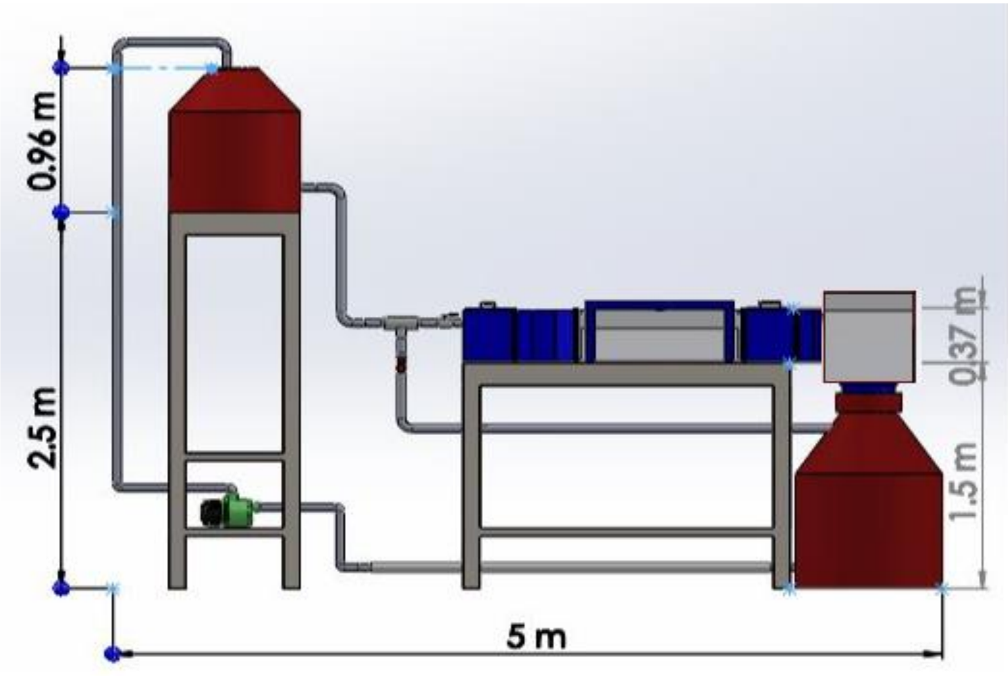
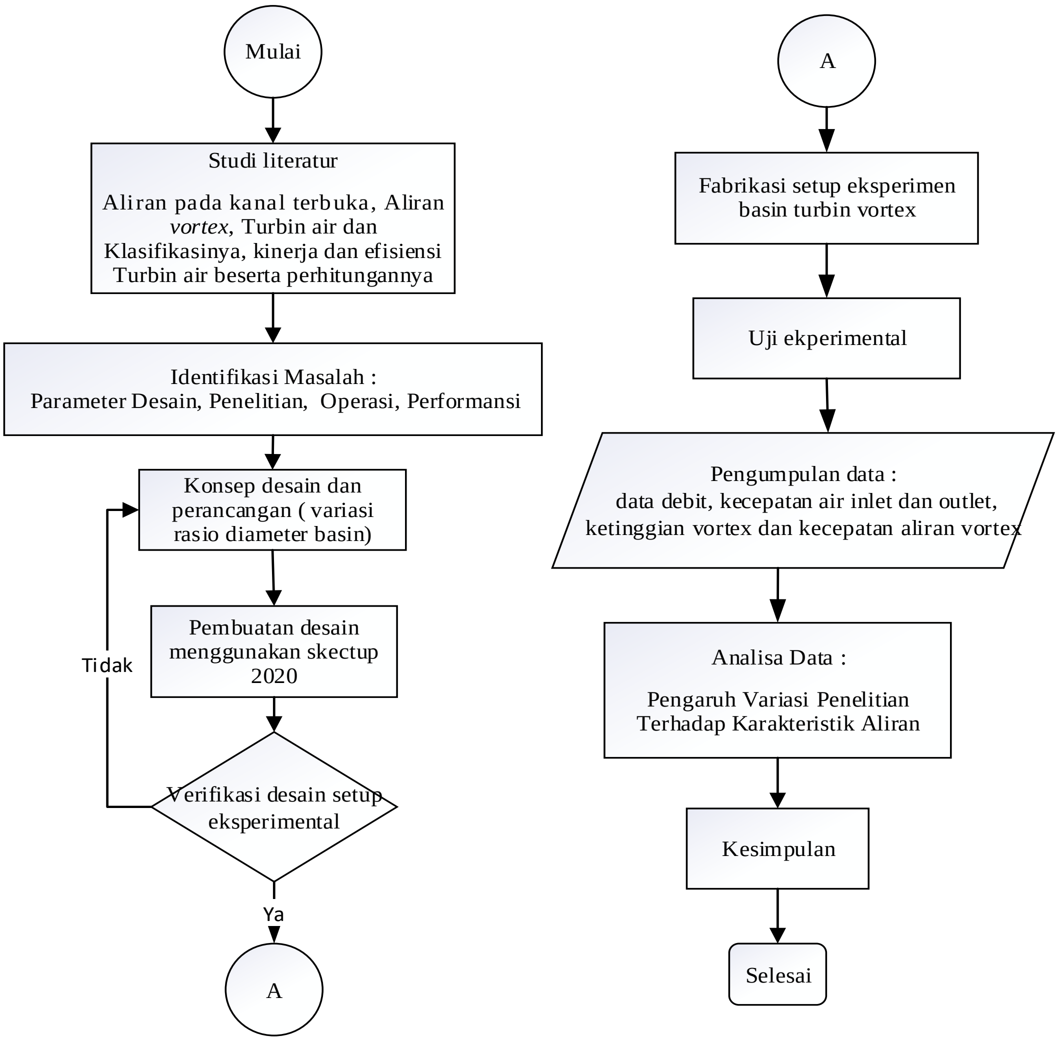


Figure 2.1 The vortex system scheme looks sideways using iventor software

Method



3.6 Block diagrams, schematics and dimensions of the vortex gravity turbine system

To facilitate the understanding of the parts of the vortex turbine test equipment, see Figure 3.2 and 3.3.

Figure 3.2 Block Diagram of the Vortex Gravity Turbine System

Information :

1. Storage Tank 1
2. Water Pump
3. Valve
4. Flow Meter
5. Votex Generator Tube (Basin)
6. Load Cell
7. Storage Tank

Result and discussion

1 Average measurement of the vortex tube outlet diameter

From the results of measurements that have been taken, 4 data collection will be carried out which will be on average so that it can be used as a comparison chart. The average results obtained from the results of data collection can be seen in table 4.5 and graph 4.12.

Table 4.5 Average measurements of vortex tube outlet diameters

Diameter (cm)	**D outlet tabung 12 (m/s)**	**D outlet tabung 9 (m/s)**	**D outlet tabung 6 (m/s)**	**D outlet tabung 3 (m/s)**
35	0.6	0.65	0.7	0.8
30	1.35	1.1	1.375	0.625
25	0.85	0.9	0.65	0.55

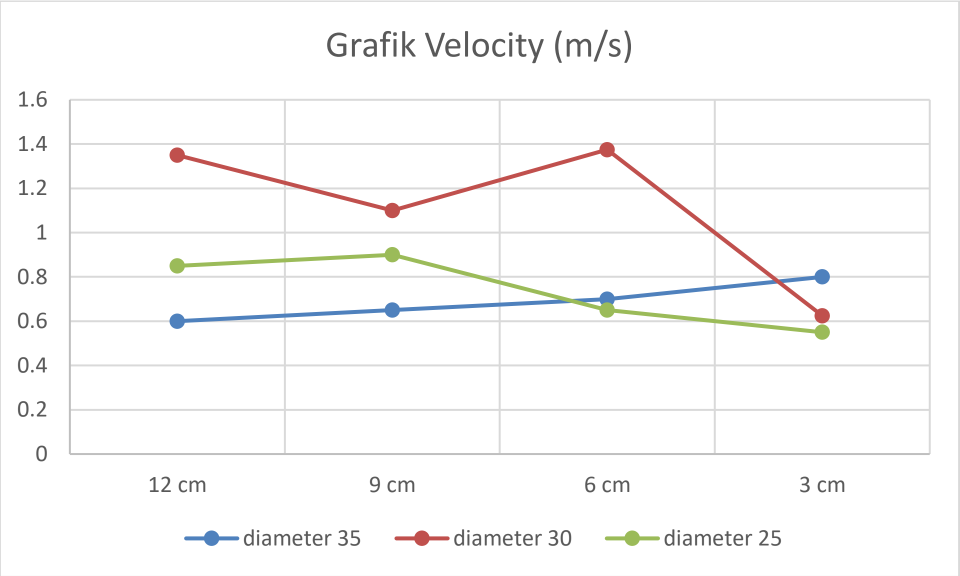


Figure 4.12 Velocity graph on vortex system testing

After 3 data retrieval can be concluded with the average results shown in Figure 4.11. The forces acting on the flow of water on the diameter of the vortex tube outlet cause a whirlpool in the tube. Figure 4.12 shows that the pressure has increased in the 35 cm diameter tubes and fluctuations in the 30 cm and 25 cm diameter tubes. The ups and downs in pressure are caused by the available energy in the water flow being extracted after hitting an outlet hole in the vortex tube. The velocity graph in the test shows that the highest pressure occurs in the 30 cm diameter tube.

Conclusions

Based on the results of research and analysis that has been done, it can be concluded that:

1. A miniature vortex channel system has been created and has been tested using a variety of variations that have been determined

2. From the test results the variation in the vortex tube outlet diameter of 3 cm results in a longer and perfectly formed whirlpool.

3. A variation in the diameter of the 9 cm vortex tube outlet results in faster and more imperfect whirlpools.

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