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Effect of the Length of the Input Pipe and the Diameter of the Waste Valve on the Performance of the Hydram Pump

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ABSTRACT: Water is one of the most important basic needs in human life and all living things that exist on this earth. To meet the availability of water is needed tool that can be easier, economical and efficient. Hydram pump is one type of water pumping equipment, it does not use fuel oil or electric power in its use. The purpose of this research is to know the influence of variation of input pipe length and diameter of waste valve to output discharge and efficiency of hydram pump. In this research the height of the sink (H) from the water source to the position of the pump holder is 2 meters while the output height (h) 5 meters. The size of a 1½-inch hydram pump designed by the researcher. Diameter input pipe 1 ½ inch, and output ½ inch, while for air tube diameter 3 inch with height 60 cm. As for the length of the input pipe varies from 2 meters, 4 meters, 6 meters, and 8 meters. In this research also used variation of the diameter of the waste valve hole, ie from ½ inch, ¾ inch, and 1 inch. The results of the research showed the largest output discharge at the length of the input pipe 6 meters and 8 meters with the diameter of the 1-inch waste valve hole. The best efficiency is 57.3% on the length of the 8 meter input pipe with the diameter of the 1-inch waste valve hole, while for the worst efficiency of 17.2% on the length of the 2 meter input pipe with the diameter of the ½ inch waste valve.

KEYWORDS: Hydram pump, Output discharge, Efficiency, Input pipe length, Head

I. INTRODUCTION

Water is one of the most important basic needs in human life and all living things on this earth. The need for water that is quite a lot often creates new problems, especially for people who live in areas far from water sources or springs that are lower than where they live, so to get it requires more effort because they have to be lifted from the road that goes down to uphill road.

[1]. This study uses a hydram pump with a compressor tube diameter of 3 inches and a height of 24 cm. The height of the waterfall is 2 meters with five variations of the angle of the pump are 45^o, 40^o, 31^o, 26^o and 22^o. The results showed that the best efficiency of the hydram pump with the Input-waste-compresor (ILK) arrange- ment was 22.3%, which was obtained at a waterfall angle of 26^o. Meanwhile, the input-compresor-waste (IKL) arrangement is 14.2%, which is obtained at a 45^o angle. The best debit is obtained at a 45^o waterfall in the ILK arrangement, the hydram pump discharge debit is 0.088 lt/second with a maximum discharge head of 30 meters, and for the IKL arrangement, the hydram pump discharge debit is 0.068 lt / second with a maximum head discharge of 25 meters.

[2]. Research on hydram pumps is to determine the effect of falling angle variations on hydraulic ram pump performance. The compressor tube used is a compressor tube with a diameter of 3 inches with a tube height of 60 cm. The waterfall height used is 1 m with a variation of the angle of 35^0, 40^0, 45^0, 50^0 and 55^0. The height of the water lift is varied, namely 3 meters, 3.5 meters, 4 meters, 4.5 meters and 5 meters. The results of this research show that the best output water discharge is at a waterfall angle of 35^0 that is 0.079 lt/s with a water lift of 3 meters, while the lowest output discharge is at a waterfall angle of 55^0 which is 0.01 lt/s at a height of 5 meters. The best efficiency at angle of waterfall 35^0 with a height of 3 meters of water lift is 6.1%, while the lowest efficiency is at angle of 55^0 with a height of 5 meters of water lift is 1.2%.

[3]. Research to determine the effect of waterfall height, air tube volume and discharge height on the performance of the hydram pump. The hydram pump used is a hydram pump that has an inlet pipe diameter of 1 inch and a draw pipe

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diameter of 0.5 inches. The height of the waterfall is varied, namely 1.5 meters, 1.75 meters, and 2 meters. While the variations in the volume of air used are 0.00024 m3, 0.0028 m3 and 0.0032 m3 and the variations in discharge height are 2.5 meters, 3 meters and 3.5 meters. The results showed that the most optimal results were at a height of 2 meters with a variation of the air tube volume of 0.0028 m3 and a discharge height of 2.5 meters, with a discharge capacity of 10.2 liters/minute, volumetric efficiency 49%, and pump efficiency 57 %. The results of the analysis in this study indicate that the higher the plunge, the higher the incoming energy, the balance between the incoming pressure and the pressure in the tube causes the delivery valve to open faster so that the discharge capacity also increases.

[4]. Research on the analysis of the effect of galvanic pipe length and valve opening diameter on the pump head of the hydraulic pump. By using the variable valve opening diameter and the variable length of the inlet pipe (input) on the hydram pump, it greatly affects the pump head on the hydram pump. This can be proven by the experiments carried out using variable valve opening diameters 0.065 meters, 0.08 meters and 0.1 meters and the length of the inlet pipe (input) 18 meters, 24 meters, and 30. The results obtained from the first experiment namely by using a valve opening diameter of 0.065 meters with three variables, namely the pipe length of 18 meters, 24 m and 30 m, resulting in the largest water flow rate of 6.44 lt / minute and a head pomp as high as 156 m, then with an experiment using the valve opening diameter. 0.08 m in the three variables resulted in a discharge of 6.59 lt / minute with a pomp head of 166 m, then with the third test using a valve opening diameter of 0.1 m with the three variables resulted in a water discharge of 6.68 lt / minute with a head pomp 173 m.

[5]. Hydraulic Ram Pump is a pump which does not require external energy as the power source. In this study, a hydram pump with an input diameter of 1.5 inches, an output diameter of 0.5 inches and a diameter of a compressor tube 3 inches with a height of 60 cm. The height variations in the waterfall used were 2.1 m, 2.6 m, 3.1 m, 3.6 m, and 4.1 m. As for variations in the position of the hydram pump arrangement with the installation position of input-waste-compressor (ILK) and input-compressor- waste (IKL). This study results that the highest output discharge is generated at a height of 4.1 meters with an ILK arrangement of 0.121 L/s. The highest maximum head is obtained at a height of 4.1 meters in the ILK arrangement of 16 meters. The greatest efficiency was obtained at a height of 3.1 meters with an ILK arrangement of 2.618%, while with the same height in the IKL arrangement an efficiency of 2.357% was obtained.

Hydram pump or an abbreviation of the word hydraulic ram which comes from the words hydro (water) and ram (blow / impact) so that it can be interpreted as water pressure. A pump is a type of device that is able to move liquid from a place to the desired place. One example of this liquid is water, oil and other liquids that are incompressible. Based on this definition, a hydram pump can be interpreted as a pump whose energy or driving force comes from the pressure or impact of water entering the pump through the input pipe. Therefore, the entry of water from the water source into the pump must run continuously so that the pump can continue to work. This tool is simple and effective to use in conditions that meet the conditions required for its operation.

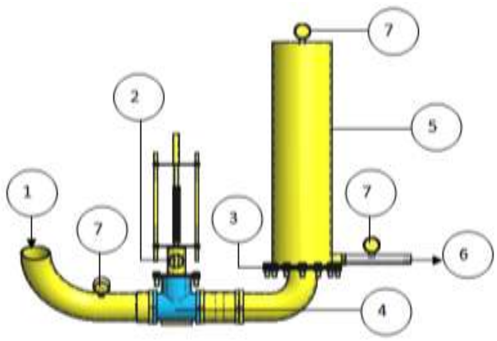

Figure 1. Hydram pump parts, 1. Input pipe, 2. Waste valve, 3. Introductory valve, 4.Pump body, 5.Air tube, 6.Output pipe, 7.pressure gauge.

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The amount of pressure in the fluid can be calculated using the formula:

$$P = \frac{F}{A} \quad \text{..} \quad (1)$$

where:

P = Fluid pressure (N/m^2)
F = Force (N)
A = Flow cross-sectional area (m^2)

The max head is the maximum pumping height the hydram pump can do.

$$h_{max} = \frac{P_{maks}}{\rho \times g} \quad \text{.........................} \quad (2)$$

where:

h_{max} = maximum pump head (m)
P_{max} = maximum fluid pressure (N/m^2)
ρ = density of fluid (kg/m^3)
g = Acceleration of gravity (m/s^2)

Discharge is a quantity that states the volume of fluid flowing per unit of time, then:

$$Q = \frac{V}{t} \quad \text{................................} \quad (3)$$

where :

Q = Discharge (m^3/s)
t = Time (s)
V = Volume (m^3)

The efficiency of a hydram pump is determined by various factors, in addition to the dimensions and materials used to make the pump, it also depends on the different characteristics of the hydram pump installation at each installation location. Efficiency according to D 'Aubuisson, namely:

$$\eta = \frac{Q_{out} \times h}{(Q_{limbah} + Q_{out})H} \times 100\% \text{..................} (4)$$

where :

η = Hydram pump efficiency (%)
Q_{input} = Discharge input (m^3/s)
Q_{limbah} = Waste discharge (m^3/s)
Q_{output} = Discharge output (m^3/s)
H = Fall height (m)
h = Output pipe height (m)

II. RESEARCH METHODS

The tools used in this research are: Flow meter, pressure gauge, measuring cup, pipe wrench, hammer, drilling machine, grinding machine, welding machine, file, scissors, Vise, Pliers, Thermometer, Meter, Tank, Weterpass, Laptop, Handpone, Screwdriver, Cutter, Water Pump, Matches, Grinders, Wrenches, Rulers.

The materials used in this study include: Bolts, Nuts, Ring, Seal tape, PVC pipe with a diameter of 1 ½ inch with a length of 8 m, PVC pipe with a diameter of ½ inch with a length of 5 m, pipe connection 1 ½ inch, pipe connection. ½ inch, Watermur 1 ½ inch, pipe glue, elastic hose 1 ½ inch, elastic hose ½ inch, silicon glue, iron glue, water tank with a capacity of 1100 m^3 (diameter 1080 mm with overall height of 1470 mm), Bucket, iron plate with thickness 5 mm, Welding wire, Isamu, Sandpaper, Galvanized pipe t connection with a diameter of ½ inch, ¾ inch, and 1 inch.

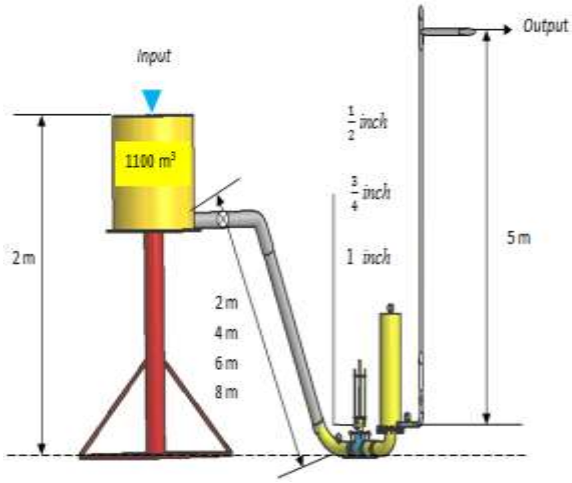

Figure 2. Research stage scheme

III. RESULTS AND DISCUSSION

In this study, the waterfall height (H) from the water source to the pump seat position is 2 meters, while the output height (h) is 5 meters. The size of the hydram pump used is 1 ½ inch designed by the researcher. The diameter of the input pipe is 1 ½ inch, and the output is ½ inch, while the air tube is 3 inches in diameter with a height of 60 cm. The length of the input pipe varies from 2 meters, 4 meters, 6 meters, and 8 meters. This research also used a variation of the diameter of the waste valve holes, namely from ½ inch, ¾ inch, and 1 inch with a waste valve stroke length of 1.5 centimeters. The process of data collection of output discharge, waste volume, input pressure, tube pressure, output pressure and maximum output pressure is carried out with three repetitions, of the 3 repetitions the average is taken for the results to be used in the calculation. Based on the research that has been done, several calculated data are obtained, such as waste discharge (Q_{limbah}), input discharge (Q_{input}), efficiency (η), and maximum pump head (h_{max}).

Pump performance that will be analyzed in this study is the output discharge (Q_{output}), efficiency (η), and maximum head (hmax) for all variations in the installation of input pipe lengths and variations in the diameter of the sewage valve.

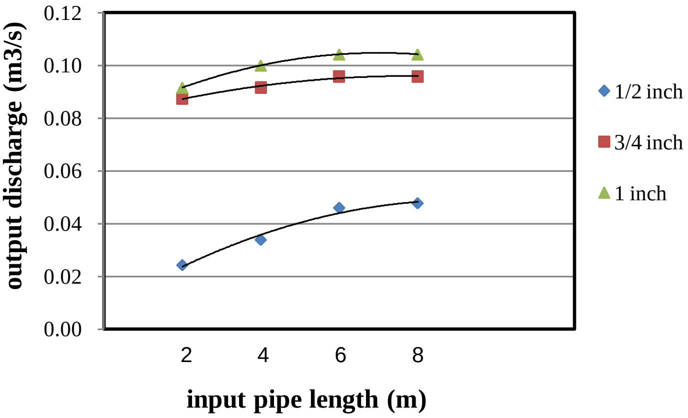

Figure 3. The relationship of the variation of the length of the input pipe on the variation of the diameter of the waste valve hole to the output discharge.

Research using variations in the length of the input pipe and variations in the diameter of the waste valve hole obtained data with the graph above. Figure 3 shows that from each variation of the installation of the input pipe length, the highest output discharge produced is at the input pipe length of 8 meters and 6 meters using a 1 inch waste valve hole diameter, and the smallest output discharge produced occurs in the long installation. 2 meter input pipe using inch waste valve hole diameter. The results of the analysis above can be concluded that the installation of input pipe lengths of 2 meters, 4 meters, 6 meters and 8 meters with a diameter of inch, inch, and 1 inch waste valve holes tends to increase the resulting output discharge.

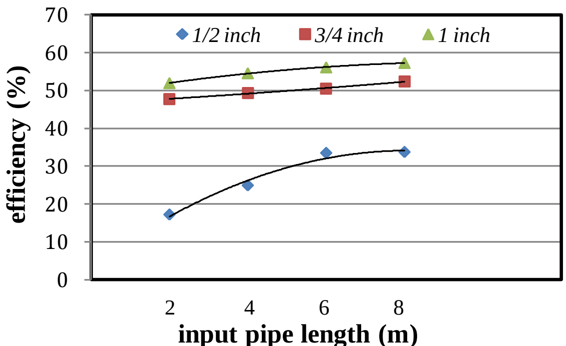

Figure 4. The relationship between variations in the length of the input pipe with variations in the diameter of the waste valve hole on efficiency.

Figure 4 shows that the greatest efficiency of 57.3% is produced by the input pipe length of 8 meters on the installation of a 1 inch waste valve hole diameter, while the smallest efficiency of 17.2% is obtained from the length of the 2 meter input pipe on the installation of the waste valve hole diameter inches. However, here it can be seen that the highest and lowest efficiency when viewed from the variation of the installation of the diameter of the waste valve hole is shown in the installation of the diameter of the waste valve hole of 1 inch, and inch in each variation of the installation of the length of the input pipe. The amount of efficiency generated at the input pipe length of 8 meters is due to the large output discharge produced. While the smallest efficiency is produced at the input pipe length of 2 meters, this is because the output discharge produced is decreasing. When viewed from the variation of the installation of the diameter of the waste valve hole, the greatest efficiency is found in the diameter of the waste valve hole 1 inch and the smallest is found in the diameter of the waste valve hole ½ inch from each variation of the length of the input pipe installation. The length of the input pipe and the diameter of the waste valve hole is directly proportional to the output discharge, meaning that the longer and larger the diameter of the waste valve hole in this study, the output discharge tends to increase so that the resulting efficiency will be greater. In accordance with the efficiency equation of the hydram pump installation. From the efficiency equation, it can be concluded that an increase in output discharge will result in better hydraulic ram pump efficiency, because the resulting output discharge is directly proportional to the hydram pump efficiency. the greater the output discharge produced, the efficiency of the hydram pump will increase, and vice versa.

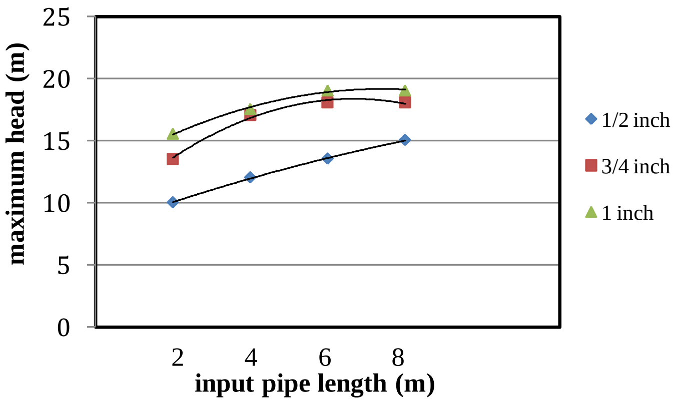

Figure 5. The relationship between variations in the length of the input pipe with variations in the diameter of the waste valve hole to the maximum head of the hydram pump.

In Figure 5 the relationship between the length of the input pipe and the diameter of the waste valve hole to the maximum head of the hydraulic ram pump shows that the maximum head is 19.07 meters at the input pipe length of 6 meters and 8 meters with a diameter of 1 inch of the waste valve hole, this is because by the output pressure on the 6 meter and 8 meter input pipe is greater than the 2 meter and 4 meter. The amount of pressure on the input pipe causes the pressure on the output pipe to increase as well. While the smallest maximum head is 10.04 meters at the input pipe length of 2 meters with a diameter of inch waste valve hole, this is because the pressure on the output pipe is 2 meters smaller than the length of the other input pipe. The small pressure on the input pipe causes the pressure on the output pipe to also be small. So it can be concluded that the installation of input pipe lengths of 2 meters, 4 meters, 6 meters and 8 meters with a diameter of inch, inch, and 1 inch waste valve holes is directly proportional to the maximum head (hmax). From the equation of the maximum head formula, it shows that the maximum output pressure is directly proportional to the maximum head (hmax). The maximum head (hmax) increases as the maximum output pressure increases.

IV. CONCLUSION

The relationship between the length of the input pipe and the diameter of the waste valve hole results in the largest output discharge being obtained at the input pipe length of 6 and 8 meters at the 1 inch diameter of the waste valve hole. The longer the input pipe and the larger the diameter of the waste valve hole, the higher the resulting efficiency. while the maximum head of the hydraulic ram pump results in the greatest maximum head at the input pipe length of 6 meters and 8 meters with a diameter of 1 inch waste valve hole, this is due to the pressure on the output pipe at the input pipe length of 6 meters and 8 meters using a hole diameter 1 inch waste valve is bigger than the input pipe length of 4 meters and 2 meters.

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