International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 682-685 www.ijaem.net ISSN: 2395-5252

Analysis of Hydraulic Ram Pump Performance against Variation of the Inlet Elevation above Pump

Rudy Sutanto[1], Sujita[2]

[1,2] *Departmen of Mechanical Engineering, Faculty of Engineering, Mataram University, Mataram, Indonesia.*

Submitted: 05-08-2022 Revised: 11-08-2022 Accepted: 15-08-2022

ABSTRACT: Human needs for water are very high, without water humans cannot carry out their activities. With the development of technology, the idea arises of creating appropriate technology to overcome the problem of water that is friendly to the environment. This research will try to further develop the hydram pump by making the output at the bottom of the compressor tube by varying the inlet elevation above the pump. The hydraulic ram pump used has the following specifications with an input diameter of 1.5 inches, an output diameter of 0.5 inches and a compressor tube diameter of 3 inches with a height of 60 cm. The inlet elevation above pump variations used are 1, 1.25, 1.5, 1.75, 2, 2.25 and 2.5 meters. The results show that for every 0.25 meter increase in the inlet elevation above the pump, the delivery flow rate will increase by an average of 12.7%, the waste flow rate will decrease by an average of 1.3%, the drive power will increase by an average of 15.2. % and pumping power will increase by an average of 13.6%. The largest delivery flow rate is generated at the inlet elevation above the pump 2.5 meters at 1.78 LPM. The highest pumping power is obtained at the inlet elevation above the pump 2.5 meters at 1.5 watts, while with the inlet elevation above the pump, the drive power is 3.5 watts.

KEYWORDS: hydram, the inlet elevation above pump , power, debit.

I. INTRODUCTION

Water is an important means in the life of humans and animals and plants. In addition, water is also a source of energy provided by nature that can be used as a mechanical power generator. The fact has shown that many areas in rural areas have difficulty providing water, both for household needs and for agricultural activities. To solve this problem, a pump that does not require external energy as the main driving force can be used. Hydraulic Ram pump is a pump that does not require external energy as the main driving force.

In this study, we will try to further develop the hydram pump by making the output at the bottom of the compressor tube and varying the inlet elevation above the pump in order to obtain better efficiency.

A hydraulic ram pump is a pump whose energy or driving force comes from the pressure or blow of water entering the pump through a pipe. The entry of water from various water sources into the pump must run continuously or continuously. This tool is simple and effective to use under conditions that meet the conditions necessary for its operation. In the work of this tool, it produces dynamic pressure that allows water to flow from a low place to a higher place. The use of hydram is not only limited to providing water for household needs, but can also be used for agriculture, livestock, and fishery.

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, while the output discharge was mined to the length of the 2 meter input pipe with the diameter of the ½ inch waste valve. 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 17.27% on the length of the 2 meter input pipe with the di- ameter of the ½ inch waste valve [1].

Research on hydraulic ram pumps that have an ILK (input – waste – compressor) arrangement has the best efficiency at the inlet elevation above the pump 2.5 meters with an input discharge of 2,458 lt/s while the output discharge that can be lifted by the pump is 0.087 lt/s while the lift height or height vertical of the pump is 30 meters and the efficiency of the hydraulic ram pump is 13.6%. Meanwhile, the IKL arrangement has the best efficiency at the inlet elevation above the pump 2 meters with an input discharge of 2.302 lt/s while the output discharge that can be lifted by the pump is 0.068 lt/s while the lift

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 682-685 www.ijaem.net ISSN: 2395-5252

height or vertical height of the pump is 25 meters and the pump efficiency hydram that is equal to 14.2% [2].

The effect of the diameter of the air tube and the distance of the pressure pipe hole with the delivery valve on the efficiency of the hydraulic ram pump. The air tube used is a tube with a height of 1.2 m with various diameters of 2, 2.5, 3 and 4 inches and the distance between the delivery valve and the delivery pipe hole is 0.15, 0.175, 0.20, 0.225 and 0.25 m. The results showed that the use of air tubes and the distance of the pressure pipe bore each had the highest and lowest efficiency values in each condition, but overall the highest efficiency occurred at a 2 inch diameter air tube with a pressure pipe hole distance of 22.5 cm by 35.3% while the efficiency was 35.3%. the lowest was 19.57% in the use of a 2.5-inch air tube at a pipe hole distance of 25 cm [3].

Research on hydraulic ram pumps shows that for every 1 m increase in the inlet elevation above the pump, the output discharge will increase on average by 36.6% and the maximum head will increase by 5-6 m. Variations in the d/h ratio of the compressor tube affect the delivery flow rate but do not affect the maximum head of the hydraulic ram pump. While the highest efficiency is obtained at the inlet elevation above the pump 2 m and the compressor tube d/h ratio is 0.198 which is 33.98% [4].

The greater the plunge angle, the smaller the suction and thrust of the hydraulic ram pump. From the research results of the hydraulic ram pump at the inlet elevation above the pump 2 m, the largest suction force value is 194.1 N at a plunge angle of 35° and the smallest is 164.6 N at an angle of 55°. While the largest thrust is 19.9 N at a 35° plunge angle and the smallest thrust is 17.2 N at a 55° angle [5].

The pump with a size of 1.5 inches had the best efficiency at a plunge height of 2 meters which was 18.4% with an input discharge of 1.44 liters/second while the output discharge produced was 0.11 liters/second while the lift height of pump which is 26.1 meters [6].

II. RESEARCH METHOD

The hydraulic ram pump used in this study has the following specifications: 1.5 inch input diameter, 0.5 inch output diameter and 5 mm piston stroke on the waste valve, and the compressor tube size is 3 inches in diameter and 24 cm high. The inlet elevation above the pump is 1.25, 1.5, 1.75, 2, 2.25 and 2.5 meters.

The variables to be studied in this study are divided into independent variables and dependent variables

a. Independent Variable

The independent variables in this study were the The inlet elevation above the pump (H1) in meters (m), the input water discharge (Q1) in LPM and the pump dimensions in mm.

b. Dependent variable

The dependent variable in this study is the yield hydraulic height (H2) in meters (m), and the yield discharge (Q2) in LPM.

To determine the input and output parameters, measurements were made with the following criteria:

- The input pressure height (H1; the inlet elevation above the pump) is measured as the vertical distance from the water elevation in the reservoir to the hydraulic ram pump. In this study used variations of the inlet elevation above pump 1, 1.25, 1.5, 1.75, 2, 2.25 and 2.5 meters.
- High output pressure (H2) is measured using a pressure gauge, which is the vertical distance from the pump to the reservoir.
- Drive flow rate (Q1) and delivery flow rate (Q2) are measured using a flowmeter.

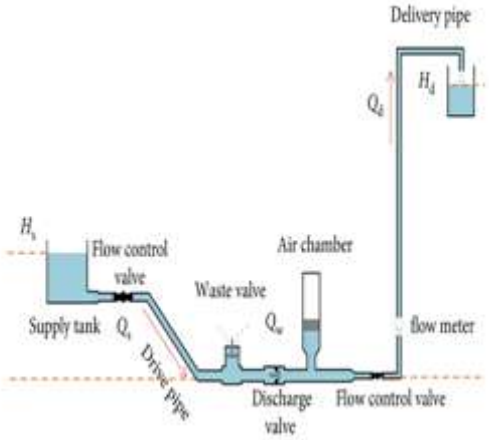

Figure 1. Series of test equipment

Table 1. Tools and materials

Name	Specification
Hydram	Pump body 1.5”,
Presure	Max 2.5 kg/cm^2
Drive pipe	1.5 “
Delivery pipe	0.5 “
Flowmeter	1-15 LPM

III. RESULTS AND DISCUSSION

The results of laboratory research obtained input and output pressure. Figure 2 shows that the more the inlet elevation above the pump the water that enters the pump, the higher the water that can be pumped, as well as the more the inlet elevation above the pump, the greater the input water discharge, so the greater the water that can be pumped up. This is because the more the inlet elevation above the water

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 682-685 www.ijaem.net ISSN: 2395-5252

pump, the greater the pressure in the input pipe. If the input pressure is greater, it will be followed by an even greater output pressure, thus the resulting water discharge will be even greater. For every 0.25 meter increase in the inlet elevation above the pump, the delivery flow rate will increase by an average of 12.7%. The highest delivery flow rate is generated at the inlet elevation above the pump 2.5 meters at 1.78 LPM.

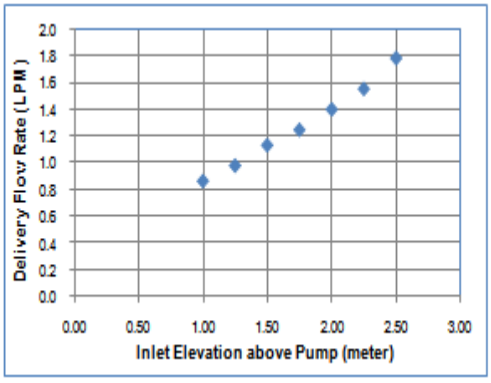

Figure 2.Graph of the relationship between the variation of the the inlet elevation above pump and the delivery flow rate

The greater the inlet elevation above the pump, the greater the input pressure. If the input pressure is greater, it will be followed by an increasing output pressure, thus the waste flow rate will be smaller, as shown in Figure 3. For every 0.25 meter increase in the inlet elevation above the pump, the waste flow rate will decrease by an average of 1.3 %. The largest waste flow rate is generated at the inlet elevation above the pump 1 meter of 12.38 LPM.

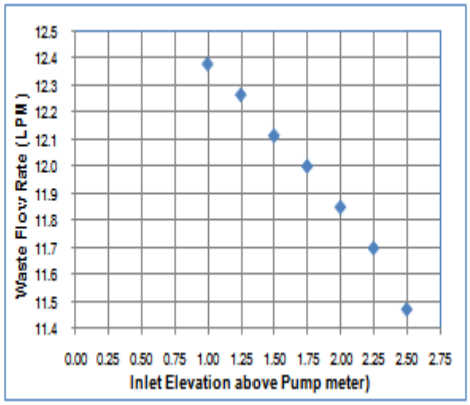

Figure 3.Graph of the relationship between the variation of the the inlet elevation above pump and the waste flow rate

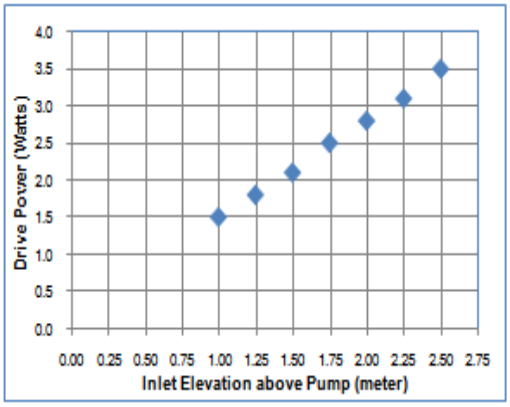

Figure 4.Graph of the relationship between the variation of the the inlet elevation above pump and drive power

On the hydram pump with a size of 1.5 inches on the pump input pipe and 0.5 inches for the pump output pipe, the data obtained as shown in Figure 4 shows that the more the inlet elevation above the pump water, the greater the drive power contained in the input water or water flowing into the pump. For every 0.25 meter increase in the inlet elevation above the pump, the drive power will increase by an average of 15.2%. This will also be followed by an increase in pumping power which will have an impact on the delivery flow rate which will be even greater, as shown in Figure 5. For every 0.25 meter increase in the inlet elevation above the pump, the pumping power will increase by an average of 13.6 %.

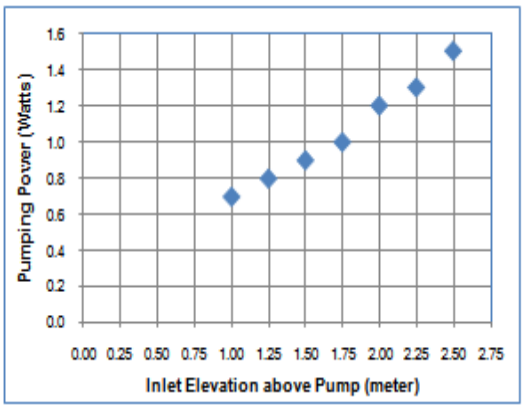

Figure 5.Graph of the relationship between the variation of the the inlet elevation above pump and pumping power

IV. CONCLUSION

For every 0.25 meter increase in the inlet elevation above the pump, the delivery flow rate will increase by an average of 12.7%, the waste flow rate will decrease by an average of 1.3%, drive power will increase by an average of 15.2% and pumping power

will experience an average increase of 13.6%. The largest delivery flow rate is generated at the inlet elevation above the pump 2.5 meters at 1.78 LPM. The highest pumping power is obtained at the inlet elevation above the pump 2.5 meters at 1.5 watts, while with the inlet elevation above the pump, the drive power is 3.5 watts.

REFERENCES

[1]. Rudy Sutanto and Sujita, 2022, Analysis of Hydraulic Ram Pump Performance on The Effect of Variations in The Diameter of The Waste Valve Hole, Global Scientific Journal, 10 (3), 2361-2365.

[2]. Sutanto R., dan Wirawan M., 2011, Analisa Pengaruh Variasi Susunan Terhadap Kemampuan Unjuk Kerja Pompa Hidram Ditinjau Dari Aspek The inlet elevation above pump , Jurnal Dinamika Teknik Mesin Vol 1 / No 1, Januari – Juni 2011, ISSN no. 2088-088X, hal 21-25.

[3]. Silla C., Jafri M., Limbong I.S., 2014, Pengaruh diameter tabung udara dan jarak lubang pipa tekan dengan katup penghantar terhadap efisiensi pompa hidram, Jurnal LONTAR Undana, 1(2), 1-7.

[4]. Nurchayati, Mulyanto A., Sutanto R., Wardani K., 2017, Pengaruh variasi the inlet elevation above pump dan dimensi tabung kompresor terhadap unjuk kerja pompa hydram, Jurnal Mesin ITB, 26(2), 91–101.

[5]. Sutanto R., Wardani K., Wirawan M., Salman, 2019, Variasi sudut pipa masukan terhadap unjuk kerja pompa hydram, Jurnal Dinamika Teknik Mesin, 9(1), 7-14.

[6]. Rudy Sutanto and Sujita, 2022, Performance Characteristics of Hydram Pumps Against Variations of Waterfall Height, International Journal of Advances in Engineering and Management (IJAEM) Volume 4, Issue 2, pp: 1428-1432.