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Natural Energy Water Pump: Revisit the Water Sling Pump

M.I. Ramli, M.F. Basar, N.H.A. Razik

Abstract*— Most people who live in rural areas come from the low income families. One reason for this is that the revenue generation is limited to certain domestic economic activities due to poor access to electricity. As a result, it limits the productivity of the people in these particular areas. By using this new pump where sling pump concept is adopted, it is believe that the people in rural areas could have more access to electricity and simultaneously grow the income related activities. This new pump is capable of providing water supply to the domestic agriculture areas. Sling pump is the enhancement of the coil pump where it powered by the water flow. This pump is driven by a propeller which finally resulting the entire pump to rotate the water and turns it into stream. Water and air enter the rear side of the pump and are forced to flow through a coil of plastic tubes while the pump is rotating. Water will be channeled through a hose and into stock tank or reservoir. The pump is applicable for low head and low flow river. From the experiment, this pump is capable to deliver up to 0.5m^3 in a minute for stream water with flow rate 5L/s.

***Index Terms*— Low head, low flow, natural energy, pico hydro, water sling pump.**

I. INTRODUCTION

People in rural areas have disadvantages in their revenue generation activities owing to limited access to power supply especially the electricity. This limitation leads to low productivity in their economic development processes. It also has become the prominent factor to the economic geography issues to these types of areas. It requires huge investments in terms of infrastructure, and man powers in order to establish and develop a reliable system of power supply such as grid cables in transmitting electricity to the village [1]-[2]. Most remotes areas especially the east coast of peninsular Malaysia as well as the east Malaysia are separated and surrounded by hills and valleys along with mountains. Therefore, connecting the grid cables to these areas is a challenging task [3].

This paper, describes the natural energy water pump where no electricity is required to operate the pump to overcome the challenge in power supply to rural areas in Malaysia specifically. An enterprise such as Rife Hydraulic Engine Mfg Co. has developed and commercialized these types of pumps. However, it is considered to be so expensive for the intended users in Malaysia to procure the water pump. As such, this research work is focusing in the development efforts on product localization, and more affordable water pump [5]-[6]

Basically, the scope of this project is to develop a pump that can be operated without regard to non renewable energy power sources; under natural condition using stream flows.

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II. EXISTING WATER PUMP

A. Coil Pump

Coil pump is a low lift pump which composes a tube that is shaped into a coil and mounted on rotating axle powered by an engine. This engine is capable of turning the axle around rapidly. Due to the rotation, intake tube will pick up the water and pump upward by the coiled tube (hose). Coil pumps usually use for irrigation purposes and drainage of lands and are capable to deliver water up to 10m [7]. Fig. 1 shows the simple manometric pump which is also known as coil pump.

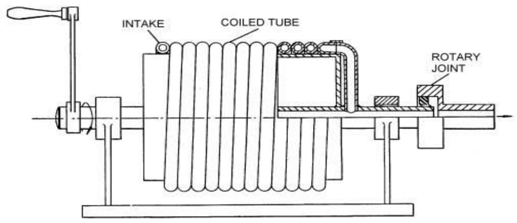

Fig. 1. Simple Manometric Pump

B. Sling Pump

Sling pump is powered by the low head low stream flows. This innovative pump works when water flow hit the propeller and simultaneously making the entire pump to rotate. Water and air will enter at the back of pump and are forced through a coil of plastic tubes while the pump is rotating. Water will be pushed through a hose and into a reservoir (stock tank). Since the pump is operating continuously the stock tank has an outlet when overflow. Fig. 2 shows the sling pump manufactured by the Rife Hydraulic Engine Mfg Co.

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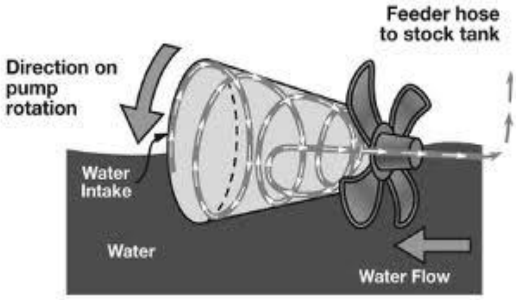

Fig. 2. Sling Pump

III. DESIGN SLING PUMP VIA SOLID WORKS

The components of the sling pump were designed using SolidWorks software. The sling pump is scaled down by 100 times (1:100) from its actual size or dimension, resulting the final size of the sling pump down to 86cm. The propeller becomes 47cm in size. The scale down approach is used to illustrate the actual size of sling pump. Figure 3 shows the drawing of propeller for the sling pump.

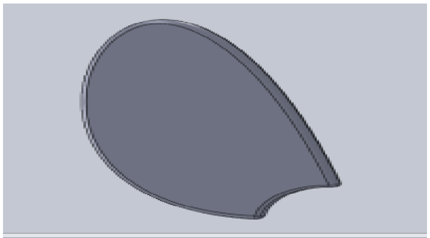

Fig. 3. Propeller

The most challenging design procedures in the design efforts was developing the propeller for the sling pump as it consumed a lot times to determine the best angle for the propeller. The first step in designing the propeller is to draw the ellipse shape. Fig. 4 shows the body of sling pump prior to extruding. The cylinder was extruded to 200cm in length.

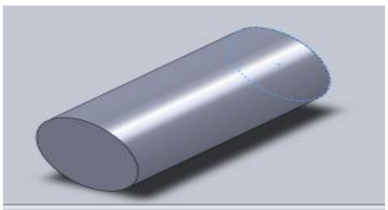

Fig. 4. Extruding Process

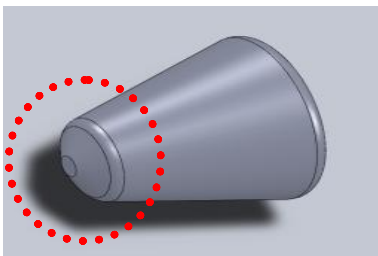

Fig. 5. Draft Process

Next, the cylinder was assigned with a draft angle of 15^{o} as shown in Fig. 5. Meanwhile, Fig. 6 shows the chamfered edges at 45^{o} and 20mm in length, indicating with blue color. All angles were crucial as it determined the stability of the pump afterward.

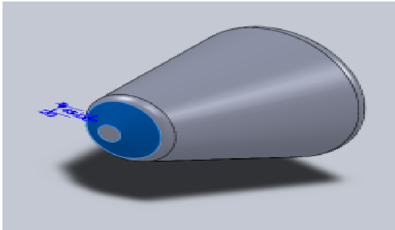

Fig. 6. Chamfer Process

The small cylinder as shown in Fig. 7 is the outlet pump, and it was extruded to 75mm. Similarly, after the extruding process the outlet pump was chamfered at an angle of 30^{o} and a length of 20mm. The hole at the centre of the outlet pump is made by using the extrude cut process. Besides that, Fig. 8 shows the complete sling pump with propeller attached to it.

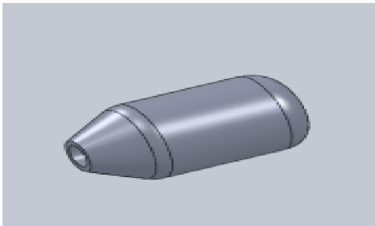

Fig. 7 Outlet Pump

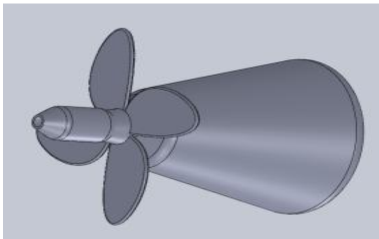

Fig. 8 Complete Sling Pump

IV. PUMP BODY : PROTOTYPE FABRICATION

The material used for the sling pump as well as the turbine was zinc. Zinc was selected due to low cost and its durability. The pump size is 86cm in length. The prototype fabrication can be divided into three phases which are the development of the body pump, the development of the propeller socket and the development of the socket outlet.

For the body of sling pump, the zinc was formed into a cone shape. Rivets were used to shape the zinc into cone. Besides that, the body pump as shown in Fig. 9 was tested at natural stream. It was found that the structure of pump was strong, stable, and capable to perform well in water during the testing.

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Fig. 9 Body of Sling Pump.

Next developments were fabricating the propeller socket and followed by the outlet socket. The propeller socket was installed between the propellers and the pump body. The socket outlet was mounted at the middle of the blades in order to channel the incoming water. Fig. 10 displays the propeller together with the propeller socket and outlet socket.

Fig. 10 Propeller Component and Outlet Socket.

Meanwhile, Fig. 11 illustrates the transparent water tube with various diameters starting from 1cm to 9cm and 3 meter in length. This tube collected water from the stream and channel it to the socket outlet for storage purposes. This tube was in coil formation and was installed inside the body pump.

Fig. 11 Fixing Tube

Wire was used to form the tube into coil, and joined to the pump body. By using the coiled tubing, the water flow and the volume of water can be easily controlled.

V. EXPERIMENTAL RESULT

Fig. 14 portrays the pump behavior during the experiment. The pump worked properly, as it managed to transfer the incoming water to the storage tank up to 5m in height. All data from the experiment were shown in Table 1. The experiment was conducted at the natural small stream in Sungai Udang, Melaka, Malaysia

Fig. 14 Water flow out from the water pump developed

TABLE I
VARYING THE DIAMETER PIPE WHILE MAINTAIN THE WATER FLOW AT 5L/S

Water Flow Rate	Diameter Pipe (cm)	Diameter Pipe^2 (cm)^2	Length of tube in the pump (m)	Water Stored in 1 minute (m^3)
5 Liters/second	1.0	1.00	3	0.47
	1.5	2.25		0.69
	2.0	4.00		0.98
	2.5	6.25		1.02
	3.0	9.00		1.36
4 Liters/second	1.0	1.00	3	0.37
	1.5	2.25		0.55
	2.0	4.00		0.83
	2.5	6.25		0.90
	3.0	9.00		1.15
3 Liters/second	1.0	1.00	3	0.24
	1.5	2.25		0.41
	2.0	4.00		0.69
	2.5	6.25		0.75
	3.0	9.00		1.02

According to the data in Table 1, it indicated that when the diameter of the pipe increased, the volume of the outgoing water flow from the pump also increased. It proves that, the volume of water is directly proportional to the diameter of the tube and the incoming water flow rate as expected. With reference to the table, the results obtained gave a positive indication that the sling water pump has successfully performed its function, and considered to be reliable.

VI. CONCLUSION

In this project, some parts that have been used may be have some lack of effectiveness, but nevertheless, it prove to us that in simple manner, the pump shows good result and has bright future for innovation and commercialization.

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