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Efficiency of a Working Hydraulic Ram Pump System

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***Abstract*—** Hydraulic Ram Pump like any other kind of pump delivers water. It is durable and runs without electricity. It can deliver water from one point to another point at a high head. The main advantage of Hydraulic Ram Pump is that it is cheaper & can run at a stretch of 5-10years continuously without stopping or without maintenance. This interesting pump is thus considered for experiments & further explored in this paper. All the findings mentioned are found out from a working model of the hydraulic ram pump which was made within a very reasonable price and cheaper than existing pumps. This paper also focuses on the head & efficiency of the Hydraulic Ram Pump.

***Keywords*—**Hydraulic Ram Pump, Energy Conservation, Fluid Mechanics

I. INTRODUCTION

In many countries, villages are located nearby springs. Taking for instance, East Nusa Tenggars (NTT) province, Indonesia, almost 70% of the total population lives in upstream which is the closest source of water.

These countries face the following challenges:

I. These are no electricity
II. Engines are difficult to maintain & fuelling is also unavailable.
III. Draught animals are unavailable & it is difficult to apply to water lifting

The Hydraulic Ram Pump (HRP) overcomes these constraints:

I. It does not require a source of energy.
II. It has zero to negligible maintenance cost.
III. It is long lasting and works when water is available
IV. It contains very few moving parts which means less friction / wear & tear.

Ram pump has a potential to quench needs of people in various parts of the world & has a worldwide applications in irrigations, industries which are situated nearby rivers etc. Thus this paper gives an idea how to make Hydraulic Ram Pump & its detailed study regarding performance & cost effectiveness.

II. RELATED WORK

N S M Hussin et al [1] conducted an analysis in which it was simulated with a given model of certain chosen values & attaining an efficiency of 15% with the chosen values. Khedre et al [2] wrote a paper in which the working and the application of the hydraulic ram pump was mentioned. Asvapoositkul et al [3] conducted experiments with several hydraulic ram pump configurations and plotted graphs for head ratios, delivery head, and supply flow rate. Mohammad [4] designed and constructed a hydraulic ram pump & showed an overall efficiency of 57.3%. Mishra et al [5] in a paper explored the effects of water hammering effect which gives a wonderful insight about the phenomenon along with the role it is playing in the efficiency of Hydraulic Ram Pump.

III. METHODOLOGY

Literature survey

A pump lifts water by consuming electricity at a high head. The hydraulic Ram Pump device however does not consume any power but it delivers at low head. It works on the principle of water hammer effect.

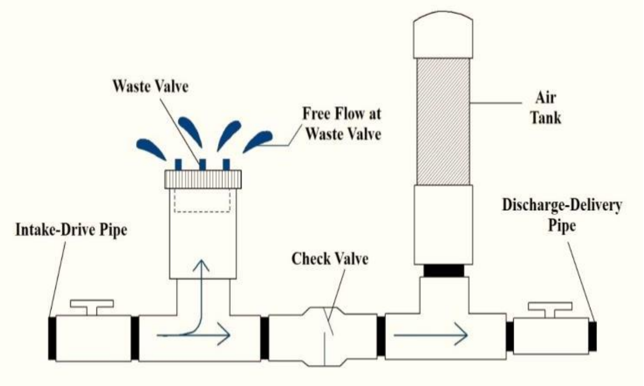

Fig 1: Hydraulic Ram Pump

Water Hammer Effect

The phenomenon that increases water pressure in a pipe over a short period of time which is known as the water hammer effect plays a very crucial role for the Hydraulic Ram Pump system. The water which is flowing inside a pipe has a certain kinetic energy. But when the valve inside such a pipe is closed, all the water molecules are under a compressed action and this kinetic energy is converted into pressure.

Principle of Operation

The waste valve is initially opened & water starts flowing through the deliver pipe & out of the valve. The flow of water becomes fast & it suddenly grabs the 1st swing check valves flapper & shuts it off. Now this fast moving water generates a pressure when it hits the closed flapper of the first swing check valve. This generated pressure is sufficiently high to push the flapper of the second swing check valve & enter into the pressure chamber, while this process happens, the fast flowing water again repeats this shutting down of the first swing check valves flapper. And again water enters into the pressure chamber building a potential energy. This process is allowed for a span of 3 to 5 minutes to ensure that there is a sufficient pressure built inside the pressure chamber. After 3 to 5 minutes ball valve beside the mounted pressure gauge is very slowly opened keeping in mind that the water hammer effect continues to go on. A word of caution, if the water hammer stops, then the process is to be re-started from the beginning. So, when the ball valve opens at 100%, water rushes from the pressure tank to the low pressure areas. It shuts the second swing check valves & rushes through the delivery pipe of a lesser diameter to a high head. This cycle now continues which is when water goes to the waste valve when delivery is occurring. But when the pressure drops in the pressure tank, the waste valve shuts & the pressure tank is filled with water, thus building the pressure & making it ready for delivery. All these processes occur within a fraction of a second. This is how the Hydraulic Ram Pump works.

Experimental Setup

a. Components

Table 1

SL. NO.	ITEM	NO.	TYPE
1.	1-1/4" Ball valve (with threads)	1	PVC
2.	1-1/4"Tee(with threads)	3	PVC
3.	1-1/4" Union (with threads)	1	Metal
4.	1-1/4" Threaded brass swing check valves	2	Brass
5.	3/4" Ball valve(with threads)	1	PVC
6.	3/4" Tee (with threads)	1	PVC
7.	Pressure gauge 100 psi(1-1/4")	1	-
8.	Pressure gauge 100 psi (3/4")	1	-
9.	3/4" Union(with threads)	1	PVC
10.	1-1/4" x3/4" Bushing (threaded)	2	Metal
11.	3/4" x 2" Nipple	5	PVC
12.	1-1/4" x 3" Nipple	8	PVC
13.	3" x 36"PVC Pipe	1	PVC
14.	3" PVC glue cap	1	PVC
15.	2" Flexible pipe 20 ft.	1	PVC
16.	3/4" Flexible pipe 20 ft.	1	PVC
17.	Reducer 2"- 1"	1	Metal
18.	Reducer 2" – 1-1/4"	1	Metal
19.	Clamp 2"	2	-
20.	Clip	1	-
21.	PVC Cement & Primer	1	-
22.	Teflon Tape Rolls	5	-

Fig 2

b. Assembly

- Rubber pipe connector (2" to 1½") is taken and placed on the end of PVC Ball valve. This component is tight and using screwdriver.
- Now the 1½" and ¾" inch pipe nipple are owned by Teflon tips by tape to make a leak proof and tight connection.
- A 1½" pipe nipple is taken, teflon tape wound on it and screwed into 1¼" Ball valve. The pipe's other end is connected to the end of the 1¼" union. The union helps to separate other parts and prevent them from misalignment.
- 1¼" pipe nipple is fitted into the free end of the union. Now on the free end of this pipe nipple the 1½" threaded is attached. It is made sure that that tee remains in the upright position approx. 90 degrees by adjusting the union. The two remaining ends are fitted with 1½" pipe nipples.
- A 1½" check valve is screwed from the top of the tee. The direction of flow of water must be facing down on the check valve. The arrow present on the check valve will help to indicate the flow of water.
- The second check valve is to be placed on the other end of the tee. The direction of the valve needs to be going out of the system. A pipe nipple is to be attached and then another 1½" threaded tee. it is to be ensured that this tee is facing upward at 90 degree angle.
- 1¼" pipe nipple is to be attached from the 90 degree end of the tee facing upward. And in the other free end of the tee the 1½" to ¾" bushing is screwed. The ¾" pipe nipple, the ¾" ball valve is connected. The ball valve cut-off handle is to be kept in an upright position.
- Another pipe nipple of ¾" is fitted so that the ¾" union is connected with the ¾" to 1½" bushing from which the ¾" flexible delivery tube is to be fitted.
- Now the credit p which is left is to be connected with 1¼" to 1½" bushing. The major part is now left to build that is the pressure tank.

- The 1¼" to 1½" metal bushing is connected to a PVC 1½" threaded to 1½" PVC glue end. Now a 1½" to 3" bushing or reducer is used to make connection from 3" tank with the system the pipe primer is used to coat all connections of PVC pipe. Both the ends of 3" pipe are glued. One end has the end cap while the other end has the reducer (bushing).
- Hence the 3" pressure tank is thus prepared. At the supply line the 2" flexible tube pump is fitted so that all the parts of the pump are connected.

c. Installation

- We have selected a surface that is flat so that the pump can rest on.
- The supply tank is at six feet above the RAM pump.
- The supply pipe and delivery pipe is connected.
- The supply pipe for delivery pipe is connected by means of a nipple and connector.
- The delivery pipe is placed 30 feet above the RAM pump.
- The check valve needs to be upright so that gravity opens it.
- A support would be required as the hammering effect will tend to move the setup.

d. Initialising the Pump

First, we will have to make sure that there is no liquid (water) inside the hydraulic Ram pump. Now the drive pipe (supply pipe) Ball valve is to be opened. The first check valve is to be pressed and held open to let the water along with the air bubbles out of the drive pipe. After a few minutes the first check bulb is to be released. Once the pump starts, the pressure tank will start building the required pressure. After the pump is working for a few minutes the delivery pipe Ball valve is to be opened very slowly and allows the system to adjust to the change. When the Ball valve is fully opened, we will get the delivery of water.

IV. RESULTS AND DISCUSSION

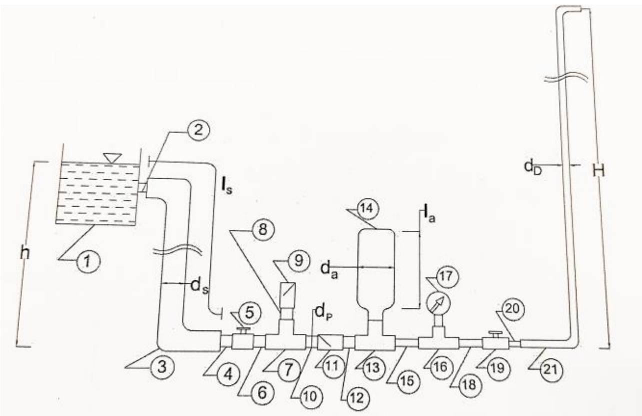

Fig 3: Schematic Diagram of Hydraulic Ram Pump Setup

Let, m_F = Mass of the flapper

m_F = 29 gm = 29 x 10^{-3} kg

So, Weight of the flapper,

$W_F = m_F$ x g

W_F = 29 x 10^{-3} kg x 3.81 m/s^2

W_F = 0.28449 N

Let, F = Maximum force needed to close the flapper of the waste valve

Therefore, F = W_F = 0.28449 N

Again from Newton's 2nd law o Motion,

$F = \dot{m} (V_2 – V_1)$

Where, $\dot{m}$ = mass flow rate of the water in the source pipe

V_1 and V_2 = Initial and final velocity of water in the source pipe respectively

Again, $\dot{m} = \rho * \dot{Q}$

Where ρ = density of the water

$\dot{Q}$ = Volume flow rate of water

So, $F = \rho$ x $\dot{Q}$ x $(v_2 – v_1)$

[$\dot{Q} = \frac{0.3*0.3*0.05}{6}$ m^3/s = 750 x 10^{-6} m^3/s]

- 0.28449 N = 1000 kg/m^3 x 750 x 10^{-6} m^3/s x (V_2 – 0)
- v_2 = 0.38 m/s

So, $v_2 = V_{max}$ = Maximum velocity of water flowing through the supply pipe.

=0.38 m/s

Design of supply pipe

$\dot{Q} = A_S$ x V_{max}

$= \frac{\pi}{4}$ x d_S^2 x V_{max}

Where, A_S = area of the supply pipe

d_S = diameter of the supply pipe

Or, 750 x 1010^{-6} m^3/s = $\frac{\pi}{4}$ x d_S^2 x 0.38 m/s

- d_S = 0.0501m
- d_S =1.96 in

$d_S \cong 2"$

So, d_S = 2"

From the data sheet (Technical note no RWS 4DS) there is an empirical relationship that ,the diameter of the supply pipe (d_S),diameter of the pump fittings (d_P) and the diameter of the delivery pipe(d_P) should be in the ratio 3:2:1 respectively.

Therefore, $d_S : d_P : d_D$ = 3:2:1

In the delivery side we have chosen the diameter of the pipe, d_P = ¾ in = 0.019m

So, The diameter of the supply pipe = 3 x ¾ =2.25 in

But from the above calculation it is sufficient to take the diameter of the supply pipe (d_S) = 2 in to perform the experiment efficiently.

So, d_S = 2 in

From the experimental data sheet (Design Methodology for hydraulic ram pump by section Sheikh CC Honda,A.P. Ninawe) to get better performance of pump,

L_S/h =2.5 and H/h = 5

Where, L_S = Length of the supply pipe

h = Height of the water level in the supply tank from the base of the pump.

H = Height of the water level in the delivery side from the base of the pump.

From the experimental data(Technical note no. RWS 4D.S),to run the pump properly,h should be within 6 ft – 12 ft.

Considering h = 6 ft = 1.83m
Therefore, L_S =2.5 x 6ft =15 ft = 4.5m
So, L_S = 4.5m

Design of pump fittings
From the empirical relationship , $d_S : d_P : d_D = 3:2:1$
So, The diameter of the pump fittings, d_S = 2 x ¾ = 0.038m = 1.5 in
d_S = 1.5 in

Design of Waste Valve
The waste valve is made of the brass.
The stress value of the brass → σ_{brass} = 275 Pa
$F = \sigma_{brass} \times A_{WV}$
Where, A_{WV} = c/s area of the waste valve
d_{WV} = diameter of the waste valve
so, 0.28449 N = 275 N/m² x $\frac{\pi}{4}$ x d_{WV}^2
Or, d_{WV} = 0.036 m
= 1.42 in
≅ 1.5 in
So, d_{WV} = 1.5 in
Dynamic Pressure head , $h_{WV} = \frac{P_{WV}}{\rho g} = \frac{V_{WV}^2}{2g}$
Where , P_{WV} = Pressure at the waste valve
V_{WV} = Velocity of the water passing through the waste valve.
Again, $W = \frac{\pi}{4} \times d_{WV}^2 \times P_{WV}$
Or, $h_{WV} = \frac{4W_F}{\pi d_{WV}^2 \rho g}$
Or, $h_{WV} = \frac{4 \times 29 \times 10^{-3}}{\pi \times (0.036)^2 \times 1000 \text{ kg/m}^2 \times 9.81 \text{ m/s}^2}$
Or, $h_{WV} = 9.21 \times 10^{-3}$ m of H_2O
Again from the conservation of mass,
$(\Pi \times d_{WV} \times b_{WV}) \times V_{WV} = \frac{\pi}{4} \times d_S^2 \times V_{max}$
where , b_{WV} = lift of the waste valve
or, $(\pi \times 0.036\text{m} \times b_{WV}) \times \sqrt{(2 \times 9.81 \text{ m/s}^2 \times 9.12 \times 10^{-3} \text{ m})}$
$= \frac{\pi}{4} \times 0.051^2 \times 0.38$ m/s
or, b_{WV} = 16.34 mm

Design of the Delivery Pipe
From the empirical relationhip, $d_S : d_P : d_D = 3:2:1$
Or, d_D = ¾ in
Again from the empirical relationship
$\frac{h}{H} = \frac{1}{5}$ or, H = 5 x 6 ft = 30 ft

Deign of the Air Vessel
From the base level of the pump to lift the water at H= 30 ft , the pressure required at the delivery side,
H = 30 ft , the pressure required at the delivery side ,
$P_d = \rho g H$
= 1000 kg/m³ x 9.81 x $\frac{30*12*25.54}{1000}$
= 90153.9 N/ m²
= 13.07 Psi
Or, P_d = 13.07 Psi
As ,there is a reciprocating motion within the air vessel , from the experimental data sheet ,to lift the water at 30 ft , pressure required in the air vessel is 25Psi to run the pump at 13Psi.
The air vessel is made of PVC
Or, The Stress Valve (σ_{PVC}) = 1000 Psi
Or, Hoop stress , $\sigma_H = \frac{P_i \times d_a}{2t}$
Where , P_i = internal pressure developed
d_a = diameter of the air vessel
= 3 in = 0.076 m
Or, $P_i = \frac{(2 \times 1000\text{Psi} \times 2 \times 10\text{-}3)}{0.076\, m}$
Or, P_i = 52.63 Psi
Again longitudinal stress ,
$\sigma_L = \frac{Pi \times da}{4t}$
Or, $P_i = \frac{(2 \times 1000\text{Psi} \times 2 \times 10\text{-}3)}{0.076\, m}$
Or, P_i = 105.26 Psi

As the ultimate pressure required in the air vessel , i.e. , 25 Psi is less than the limiting calculated internal pressure using strength criteria of the air vessel.
So, diameter of the air vessel d_a = 3 in within safe limit
Or , d_a = 3 in
Again , $\frac{\pi}{4} \times d_a^2 \times \sigma_{PVC} = P_i * d_a * L_a$
Where , L_a = Length of the air vessel
Or, $L_a = \frac{\pi \times 0.076\text{m} \times 1000\text{Psi}}{4 \times 52.63 \text{ Psi}}$
Or, L_a = 3.70 ft
To sustain internal developed pressure 52.63 Psi , the length of air vessel should be,
L_a = 3.70 ft

Loss in the supply side
From Fig
At position 1-2:
$Q_1 = A_1 \times V_1$
From continuity equation $Q = Q_1$
V_1 = Velocity of the water at position 2
750 x 10^{-3} m³/s = $\frac{\pi}{4}$ x$(\frac{1 \times 25.54m}{1000})^2 \times V_1$
Or, V_1 = 1.46 m/s

There are two losses present in that position:-

- *Head loss due to entrance &*
- *Head loss due to fittings*

Head loss due to entrance, $h_{EN1} = k\frac{V_1^2}{2g}$
Or, $h_{EN1} = 0.5 \times \frac{(1.46\text{m/s})^2}{2 \times 9.81}$ [k = 0.5 assumed]
Or, h_{EN1} = 0.054 m of H_2O
Head loss due to fittings, $h_{f1} = k\frac{V_1^2}{2g}$
Or, $h_{f1} = 0.5 \times \frac{(1.46\text{m/s})^2}{2 \times 9.81}$ [k = 0.5 assumed]
Or, h_{f1} = 0.054 m of H_2O

In the supply pipe:
There are two losses that are present in that position

- *Head loss due to friction*
- *Head loss due to bending of the pipe*

As we know ,
Reynolds No. $R_e = \frac{\rho_H V_2 d_S}{\mu_W}$

So, Re = $\frac{1000 \times 0.366 \times 0.051}{0.798 \times 10^{-3}}$

Re = 23.39 x 10^3

From Moody's diagram,

For PVC Pipe , surface roughness = 1.0 mm

= 1 x 10^{-3} m

Relative pipe roughness = $\frac{t}{d_s} = \frac{1 \times 10^{-3}}{0.051}$ = 0.02

Friction factor , f = 0.05

For Re = 23.39 x 10^3 and $\frac{t}{d_s}$ = 0.02

Heat loss due to friction , $h_{Fr1} = \frac{4fL_sV_2^2}{2gd_s}$

Or, $h_{Fr1} = \frac{4 \times 0.05 \times 4.5m \times (0.366m/s)^2}{2 \times 9.81\ m/s^2 \times 0.051m}$

Or, h_{Fr1} = 0.120485 m of H_2O

Head los due to pipe bending,

$h_{B1} = k \frac{V^2}{2g} \times \eta$

or, $h_{B1} = 0.5 \times \frac{(0.366m/s)^2}{2 \times 9.81} \times 2$ [k = 0.5(assumed) & η = 2]

At position 3-4:

From continuity equation,

$Q_S = Q = A_3 \times V_3$

Where, V_S =velocity of water at position 4

Or, 750 x 10^{-6} $m^3/s = \frac{\pi}{4} \times (0.038m)^2 \times V_3$

Or, V_3 = 0.65 m/s

There are two losses present at position 3-4,

- *Head loss due to sudden contraction*
- *Head loss due to fittings*

Head loss due to sudden contraction,

$h_{C1} = k \frac{V32}{2g}$

where, $k = (\frac{1}{CC} - 1)^2$

$C_C = 0.06 + 0.38 [\frac{dP}{dS}]^6$

$= 0.06 + 0.38 [\frac{0.038m}{0.051m}]^6$

Or, C_C = 0.68

Or, $k = (\frac{1}{0.68} - 1)^2 = 0.21$

Or, k = 0.21

Or, $h_{C1} = 0.21 \times \frac{(0.65\ m/s)2}{(2 \times 9.81\ m/s2)}$

Or, h_{C1} = 0.0045 m of H_2O

Head loss due to fitting,

Or, $h_{F3} = k \frac{V32}{2g}$

Or, $h_{F3} = 0.5 \times \frac{(0.65\ m/s)2}{(2 \times 9.81\ m/s2)}$

Or, h_{F3} = 0.00341 m of H_2O

At position 5 – 13

Head loss due to fitting,

Or, $h_{F4} = k \frac{V32}{2g}$

Or, $h_{F3} = 0.5 \times \frac{(0.65\ m/s)2}{(2 \times 9.81\ m/s2)}$ X 10 [K = 0.5 & η = 10]

Or, h_{F3} = 0.1076 m of H_2O

Therefore , in the supply sided, actual potential head,

$h_S = h - [h_{EN1} + h_{F1} + h_{E1} + h_{F2} + h_{FR1} + h_{B1} + h_{C1} + h_{F3} + h_{F4}]$

or, h_S = *1.83 – [0.054 + 0.054 + 0.061 + 0.054 + 0.120485 + 0.0034 + 0.0045 + 0.00341 + 0.1076]* m of H_2O

or, h_S = 1.36m of H_2O

Loss in delivery side

At position 13-15:

$$q = A_4 v_4$$

where v_4=velocity of water at the pump fittings

$$38.46 \times 10^{-6} = (0.019)^2 \times v_4$$

$$\boldsymbol{v_4 = 0.1335\ m/s}$$

There are two losses present at position 13-15

- *Head loss due to sudden contraction*
- *Head loss due to pipe fitting*

Head loss due to sudden contraction

$$h_{c2} = \frac{kv_4^2}{2g}$$

Where $h_{c2} = (\frac{1}{C_c} - 1)$

$$C_c = 0.62 + 0.38 \times (\frac{d_D}{d_P})^6$$

$$C_c = 0.6259$$

$$k = (\frac{1}{0.6259} - 1)^2$$

$$k = 0.3571$$

$$h_{c2} = (\frac{0.3571 \times 0.1335^2}{2 \times 9.81})$$

$h_{c2} = 0.000324379m$ of H_2O

Head Loss due to fitting,

$h_{F5} = \frac{kv_4^2}{2g}$ [k=0.5 assumed]

$$h_{F5} = (\frac{0.5 \times 0.1335^2}{2 \times 9.81})$$

$h_{F5} = 0.0004541m$of H_2O

At position 15-21:

Head loss due to fittings

$h_{F6} = \frac{kv_4^2 \times n}{2g}$; [k=0.5 assumed; n=6]

$$h_{F6} = (\frac{0.5 \times 0.1335^2}{2 \times 9.81})$$

$h_{F6} = 0.002725m$of H_2O

In the delivery pipe:

There are three losses present at that position

- *Head loss due to friction*
- *Head loss due to bending of the delivery pipe*
- *Head loss due to exit*

$$Re = \frac{\rho_w \times v_4 \times d_D}{\mu_w}$$

$$Re = \frac{1000 \times 0.1335 \times 0.019}{0.798 \times 10^{-3}}$$

$$Re = 3178.57$$

From Moody's diagram,

For the delivery pipe surface roughness

ϵ= 1mm = 1×10^{-3}m

Relative pipe roughness,

$$\frac{\epsilon}{d_D} = \frac{1 \times 10^{-3}}{0.019} = 0.05$$

Friction factor, f=0.081

For Re=3178.57 & $\frac{\epsilon}{d_D} = 0.05$

Head loss due to friction,

$$h_{FR2} = \frac{4 f l_D {v_4}^2}{2 g d_D}$$

$$h_{FR2} = (\frac{4 \times 0.081 \times 12.26 \times 0.1335^2}{2 \times 9.81 \times 0.019})$$

$h_{FR2} = 0.19m$ of H_2O

Head loss due to bending,

$h_{B2} = \frac{k {v_4}^2 \times n}{2g}$; [k=0.5 assumed; n=6]

$$h_{B2} = (\frac{0.5 \times 0.1335^2 \times 4}{2 \times 9.81})$$

$h_{B2} = 0.00182m$ of H_2O

Head Loss due exit,

$$h_{Ex} = \frac{{v_4}^2}{2g}$$

$$h_{Ex} = (\frac{0.1335^2}{2 \times 9.81})$$

$h_{Ex} = 0.00091m$ of H_2O

Therefore, in the delivery side actual potential head,

$h_D = H + [h_{C2} + h_{F5} + h_{F6} + h_{FR2} + h_{B2} + h_{Ex}]$

$h_D = 9.38\ m$ of H_2O

Efficiency of the hydraulic ram pump

- D' Aubuission Efficiency

  $\eta_D = (q \times H \times 100) \div (Q \times h)$

  $$\eta_D = \frac{38.46 \times 10^{-6} \times 9.91 \times 100}{750 \times 10^{-6} \times 1.83}$$

  $\boldsymbol{\eta_D = 25.752}\%$

- Rankine Efficiency

  $$\eta_R = \frac{q(H - h) \times 100}{(Q - q)h}$$

  $$\eta_R = \frac{38.46 \times 10^{-6}(9.19 - 1.83) \times 100}{(750 \times 10^{-6} - 38.46 \times 10^{-6}) \times 1.83}$$

  $\boldsymbol{\eta_R = 21.74}\%$

- Volumetric Efficiency

  $$\eta_V = \frac{q}{Q} \times 100\%$$

  $$\eta_V = \frac{38.46 \times 10^{-6}}{750 \times 10^{-6}} \times 100\%$$

  $\boldsymbol{\eta_V = 5.128}\%$

Fig 4

V. CONCLUSION AND FUTURE SCOPE

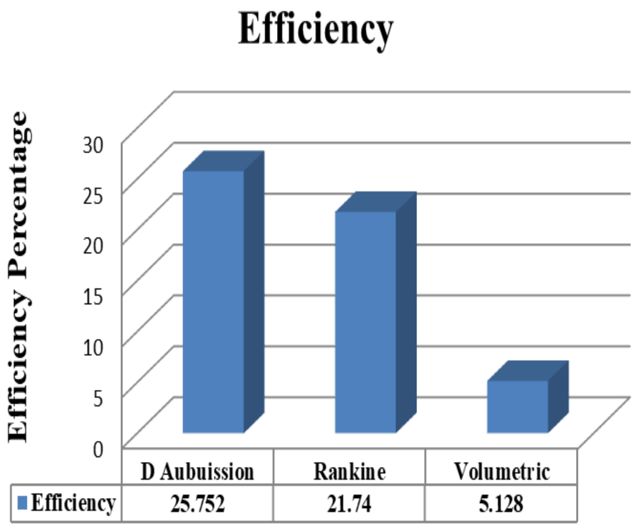

Fig 5: Efficiency of Hydraulic Ram Pump

This Hydraulic Ram Pump that was constructed will cost around INR 6000 ($75) which is extremely affordable and can serve a life of 5years without any maintenance or any electricity, if kept under shade. Thus it seems a very viable option for a variety range of application. Even though hydraulic ram pump is out-dated but, there are certain areas where its usability can still be explored.

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