Water Lifting Device without Any External Source

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ABSTRACT: The availability and cost of electric power is a great concern to common man. Convectional energy is also a great concern for environment. More attention of the people is diverted towards use of other form of energy other than conventional energy. Water pump is the most utility item nowadays and are the second most commonly used kind of industrial equipment after electricity motors. The hydraulic ram pump is the mechanical pump which runs on kinetic energy of flowing water. This type of pump is a blessing to rural areas and farmers.

This paper deals with design, fabrication and analysis of water lifting device without using electricity and fuel. Analysis have been done by varying various parameters to analyze flow rate and delivery head.

Key Words: Ram pump, Water lifting, Flow rate

I. INTRODUCTION

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Pumps operate by some mechanism(typically reciprocating or rotary),and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

II. OBJECTIVES

In general hydraulic pump lift water by using electricity, fuel or manpower. There are many technologies are analyzing to lift water without using electricity. As fossil fuel one of the most energy crises in the world. The main aim of the project is to design some of the parameters which determine the flow rate, fabrication and experimental analysis.

A. The following factors to be considered

1. Reservoir: Reservoir or storage tank plays a major role. It determines the flow rate. Placing of reservoir determines the supply head. As the gravity of water is used to lift water at elevated height, supply head plays a major role.

2. Drive pipe: The drive pipe is an important component of a hydram installation. The drive pipe must be able to sustain the high pressure caused by the closing of the waste valve. Selection of proper pipe material is also important factor. Some of the factors such as pipe length and pipe diameter is also carefully analyzed and selected as it determines the flow rate.

3. Air chamber: Water hammer is a plumbing noise created when a quick shutoff closes and the water pressure slams into the valve, creating a banging noise. There are a few approaches to eliminating water hammer noise, such as installing air chambers or mechanical water hammer arresters.

4. Delivery head

Head delivered to destination with efficient flow rate is important parameter. In this type of flow rate on delivery is determined by the supply head and flow rate of drive pipe. Flow rate at different delivery head comparing with supply head has to be analyzed. Delivery pipe also determines the flow rate thereby delivery head.

5. Maintenance

Pump setup is simple in mechanism and has no moving parts which reduce tear and wear.

6. Portable

This pump is very small also very less weight. So we can carry this pump very easily from one place to another.

III. WORKING

A. Operation Principle

The energy required to make a Ram lift water to a higher elevation comes from water falling downhill due to gravity. As in all other water powered devices, but unlike a water wheel or turbine, the ram uses the inertia of moving part rather than water pressure and operates in a cycle based on the following sequences.

B. Working

Sequence I. Water from the source flow through the drive pipe into the ram pump body, fills it and begins to exit through the waste or "impulse" valve. The check valve remains in its normal closed positions by both the attached spring and water pressure in the tank and the delivery pipe (no water in the tank prior to start up). At this starting point there is no pressure in tank and no water is being delivered through exit pipe to the holding tank destination.

Sequence II. Water entering the pump through the drive pipe has its velocity and pressure being directed out of waste valve.

Sequence III. Water has stopped flowing through the drive pipe as a "shock wave" created by the "water hammer" travels back up the drive pipe to the settling tank. The waste valve is closed. Air volume in the pressure tank continues expanding to equalize pressure, pushing a small amount of water out of the delivery pipe.

Sequence IV. The shock wave reaches the holding tank causing a "gasp" for water in the drive pipe. The waste valve opens and the water in the drive pipe flows into the pump and out of the waste valve. The check valve remains closed until the air volume in the pressure tank has stabilized and water has stopped flowing out of the delivery pipe. At this point sequence 1 begins all over again.

Fig. 1. Pump setup.

Fig. 2. Experimental setup.

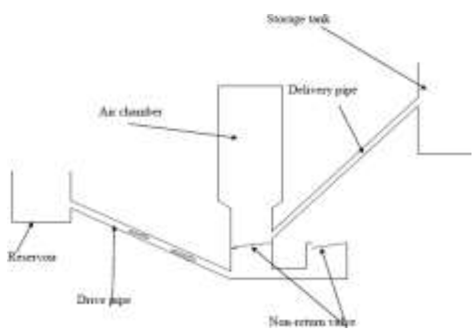

Fig. 3. Setup Sketch.

IV. EXPERIMENTALANALYSIS

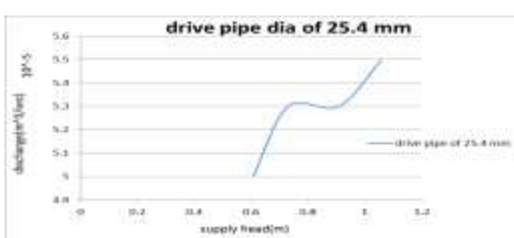

Fig. 4. Supply head v/s discharge for drive pipe dia of 25.4 mm and 10m length.

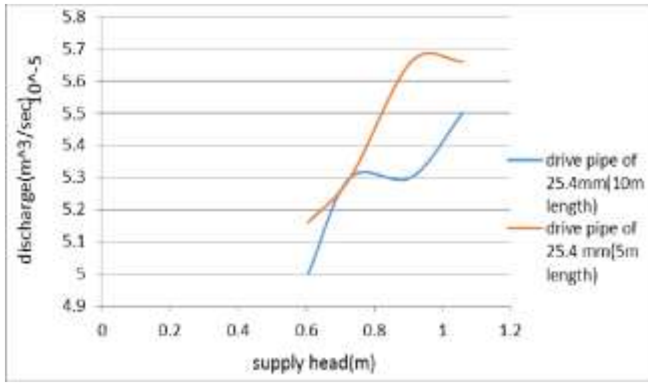

Fig.6. Comparisonofsupplyheadv/sdischargefordifferentlengthdrivepipe.

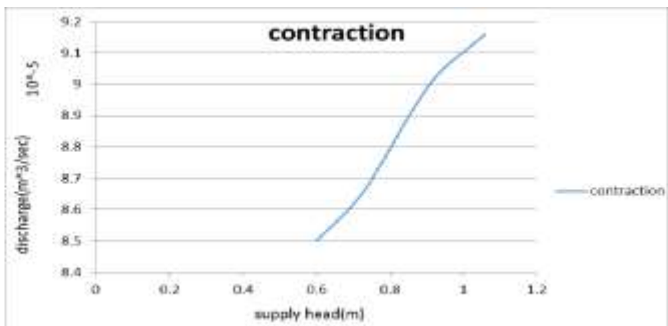

Fig.7. Supplyheadv/sdischargeforcontractionofdrivepipwith18mlength.

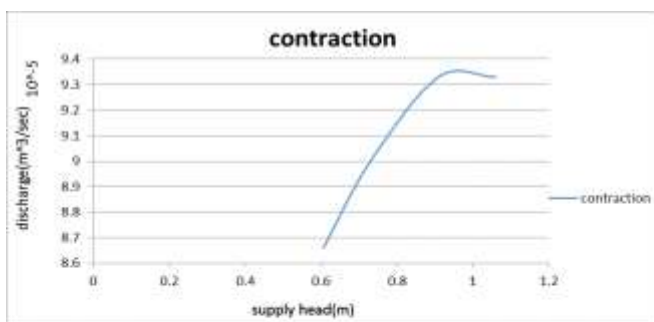

Fig. 8. Supply head v/s discharge for contraction of drive pipe with 13m length.

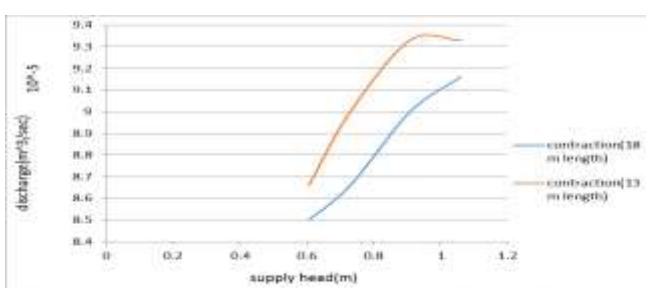

Fig. 9. Comparison of supply head v/s discharge for contraction of drive pipe with different length.

V. RESULTS ANDDISCUSSION

A. Introduction

This chapter deals with the results obtained after carrying out the required experiments. The notable results are represented with the help of tables and graphs by comparing with different parameters to analyze flow rate and delivery head at different supply head.

Table 1: comparison of result for different parameters.

Drive pipe	Supply head (feet)	Q_{in} m^3/sec	Delivery head (feet)	Q_{out} m^3/sec
25.4 mm dia and 10m length	0.606	1.5×10^{-4}	2.97	5×10^{-5}
	0.73	1.7×10^{-4}	3.63	5.3×10^{-5}
	0.909	1.9×10^{-4}	4.3	5.33×10^{-5}
	1.06	2.16×10^{-4}	4.84	5.5×10^{-5}
25.4mm dia and 5m length	0.606	1.66×10^{-4}	2.97	5.16×10^{-5}
	0.73	1.83×10^{-4}	3.63	5.3×10^{-5}
	0.909	2.08×10^{-4}	4.3	5.66×10^{-5}
	1.06	2.33×10^{-4}	4.84	5.66×10^{-5}
Contraction 50.8 to 25.4 mm dia and 18m length	0.606	3.16×10^{-4}	3.09	8.5×10^{-5}
	0.73	4×10^{-4}	3.818	8.66×10^{-5}
	0.909	4.5×10^{-4}	4.66	9×10^{-5}
	1.06	5.5×10^{-4}	5.15	9.16×10^{-5}
Contraction 50.8 to 25.4 mm dia and 13m length	0.606	3.5×10^{-4}	3.09	8.66×10^{-5}
	0.73	4.33×10^{-4}	3.818	9×10^{-5}
	0.909	5×10^{-4}	4.66	9.33×10^{-5}
	1.06	5.83×10^{-4}	5.15	9.33×10^{-5}

VI. ADVANTAGES, LIMITATIONS ANDAPPLICATION

A. Advantages

1) There is no need of power requirements.
2) There are less moving parts.
3) Expensive is less.
4) There is continuous flow over a long period of time.
5) It is a pollution free pump and also known as “green” pump.
6) It is simple in construction and easy to install.
7) Maintenance cost is negligible.
8) Use of a renewable energy source ensuring low running cost.
9) There is good potential for local manufacture in the rural villages.
10) Simplicity and reliability give a low maintenance requirement.
11) Automatic, continuous operation requires no supervision or human input.

B. Limitations

1) Little amount of water is wasted through the impulse valves.
2) It must have continuous source of supply at a minimum height.
3) It cannot pump viscous fluids to a greater height.
4) They are limited in hilly areas with a year-round water sources
5) They pump only a small fraction of the available flow and therefore require source flows larger than actual water delivered.

6) Are limited to small-scale applications, usually up to 1kW, but this requires economical other considerations.

C. Applications

1) In terrain where streams are falling very rapidly, it may be possible to extract water at a point above the village or irrigation site and feed it under gravity.

2) If the water requirement is large and there is a large source of falling water (head and flow rate) nearby, turbine-pump sets can provide the best solution. Many ram pumps could be used in parallel to give the required output but at powers over 2kW, turbine-pump systems are normally cheaper.

3) In small-scale domestic water supply, the choice can often be between using a ram pump on a stream and using cleaner groundwater. Surface water will often need to be filtered or treated for human consumption, increasing the cost of a system and requiring regular filter maintenance. Under these conditions, to select a hydram pump, economical considerations compared to other technologies have to be looked at.

4) Rain harvested water is best source where hydraulic ram can utilizes to supply water

CONCLUSION

An impulse pump is a device which uses the energy of falling water to lift water to desired height. Hydraulic rams are relatively economical to purchase and install. One can be built with detailed plans and if properly installed, they will give many trouble-free years of service with no pumping costs. For these reasons, the hydraulic ram is an attractive solution where a large gravity flow exists.

Flow rate and delivery head can be increased by using contraction in drive pipe. Supply head is important factor which decides delivery head as well as flow rate. Flow rate can be increased by having parallel pumps. To have more delivery head at certain supply it is only possible to have series of pumps, but we need to have reservoir prior to the second pump in order to have continuous flow as well supply head.

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