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Study the Performance of Water Jet Pump by Changing the Angle of Mixing Nozzle

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ABSTRACT

The experiment was about to study of water jet pumps with different angle of mixing nozzle. Most experimental studies on water jet pumps mainly carried out to assess the maximum efficiency. But maximum efficiency occurs when the suction lift is relatively small for a given head loss through the pump, which implies, when the suction flow rate is maximum. However, suction lift is inversely proportional to flow rate. But in the field of application there are many cases (such as drainage, dredging, well-pumping and other systems) where suction lift is more important factor than any other for water jet pumps, which gives importance to the assessment of depending factor of suction lift of water jet pumps. Three different jet pumps of one nominal diameter each of three different angle of mixing nozzle were made to carry out this experiment. The results revealed that the angle of mixing nozzle was an important parameter to characterize the suction lift of the jet pumps or not, but nominal diameter had a negligible play role.

Keywords: Jet Pump, Mixing Nozzle Angle, Nozzle Diameter, Ejector

I. INTRODUCTION

Jet jump is a machine with working medium (liquid or gas) to transport fluid. The characteristic of jet pump is that the jet pump with simple structure and without any moving part has reliable performance and good sealing. It has been applied widely under special working environments of high temperature, high pressure, in vacuum and underwater. The energy of low-speed absorbed liquid can be improved by high-speed flowing liquid in the jet pump. Working with displacement pump or vane pump, the suction lift of the whole system and suction performance can be improved greatly. advantages of the jet pumps the applications through industry are too numerous to mention but some of the most common ones are, in power stations jet pump has been considered as an auxiliary boost pump in Rankine cycle, in ventilation and air conditioning, pneumatic or hydraulic conveyance of products in power form, coal and cinder transport in power plants, pumping of slug from shafts bore holes and pits, solid handling ejector is a special type called a hop- per ejector, pumping sand from filter beds and sparkler nozzle which is the simplest type of ejectors and steam lined ejectors used to remove condensate from vessels under vacuum.

The principle of the jet pump is to convert the pressure energy of the pressure (working) fluid into the velocity energy through driving nozzle. The resultant jet of high velocity creates a low-pressure area in the suction chamber causing the suction fluid to flow into this chamber. Consequently, there is an exchange of momentum between the two streams in the mixing chamber resulting in a uniformly mixed stream traveling at an intermediate velocity between the motive and pumped fluid velocities. The diffuser is shaped to convert the kinetic energy of the mixture to pressure rise at the discharge flange with a minimum energy loss. The absence of moving mechanical parts eliminates the operational problems associated with bearings seals and lubrication. Therefore, such pumps are widely used because of their simplicity and high reliability as a consequence of no moving parts. But, there as some problem associate with the efficiency and performance of jet pump. There is such different factor that's affecting performance of water jet. Jet pump

performance and efficiency is dependent on several factors, such as: loss coefficients, densities, geometrical configurations, depth location, injection rate and pressure. These factors influence on performance have been studied. Mainly, In this research to study performance of water jet pumps with different angle of mixing nozzle. Three different jet pumps of one nominal diameter each of three different angle of mixing nozzle were made to carry out this experiment. The results revealed that the angle of mixing nozzle was an important parameter to characterize the suction lift of the jet pumps or not, but nominal diameter had a negligible play role.

II. WORKING PRINCIPLE

A centrifugal pump delivered water from a storage tank to the jet pump. The pressure energy of water converts into velocity & there is a considerable drop of pressure at the end of nozzle. Due to this pressure drop suction is created. Which causes the suction of another fluid and accomplishes the pumping of another fluid. The suction fluid in general differs from the driving fluid but some time suction fluid is same as driving fluid.

The experimental procedure applied in this study to determine the jet pump performance is detailed below:

1) Water temperature and atmospheric pressure in the laboratory are recorded.
2) The water tank is filled with fresh water and kept at constant water level, using a float switch and an overflow pipe line to maintain a constant suction head for the centrifugal pump.
3) The angle of mixing nozzle is set to 1.
4) The pump was turned on, keeping the angle-valve in the pump delivery side fully opened.
5) The pump pressure was adjusted and then the jet pump discharge valve was gradually closed.
6) When a steady state condition was attained.
7) The readings of the discharge, U-tube manometers, pressure gauges and data about the discharge mixture sample were recorded during a defined period of time.
7) The volume flow rate was then determined.
8) Steps (4) to (7) were repeated with different angle 50^0, 45^0 & 40^0. while the angle of mixing nozzle is kept constant.

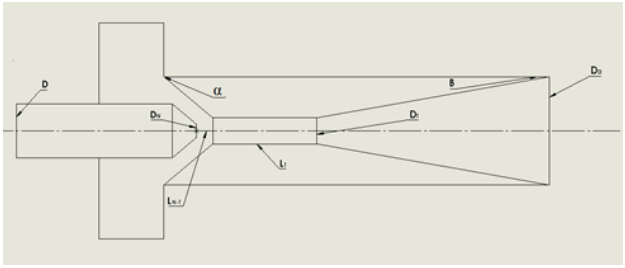

Figure 1. Schematic View of Jet Pump.

Where,

D = Inlet Diameter
D_D= Exit Diameter
D_N = Nozzle Diameter
D_T = Throat Diameter
D_S = Suction Diameter
L_{N-T} = Length Between Nozzle and Throat
L_T = Length of Throat
L_C = Length of Divergent Section
α = Mixing Nozzle Angle
β = Divergent Section Angle

III. OBSERVATION TABLE

Jet pump	D	α	β	L_{N-T}	D_N/D_T	L_T/D_T
JP1	25	50^0	10^0	7.5	0.5	4
JP2	25	45^0		7.5	0.5	4
JP3	25	40^0		7.5	0.5	4

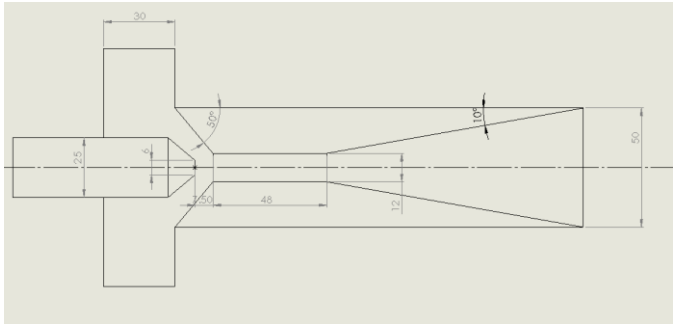

Figure 2. mixing nozzle angle with 50^0

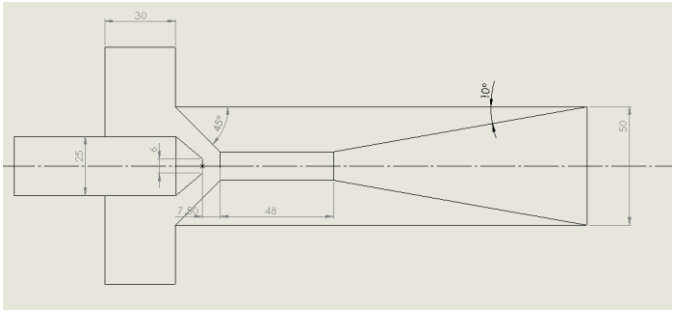

Figure 3. mixing nozzle angle with 45^0

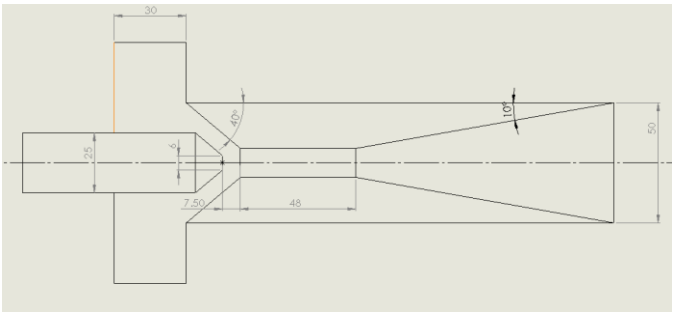

Figure 4. mixing nozzle angle with 40^0

IV. RESULT & DISCUSSION

For different inlet pressure, value of discharge for different jet pumps were enlisted, which graphical representation is given below.

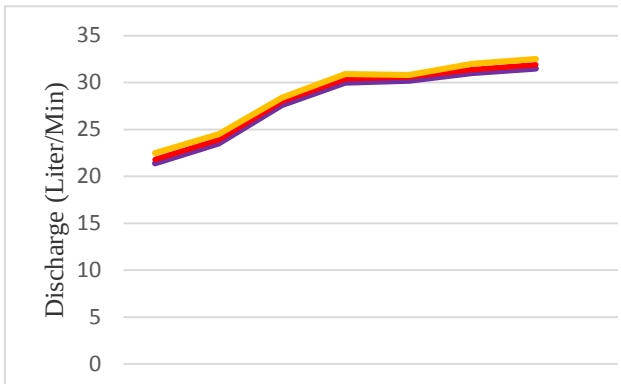

Figure 5. Inlet Pressure Vs Discharge

For different inlet pressure, value of suction pressure for different jet pumps were enlisted, which graphical representation is given below.

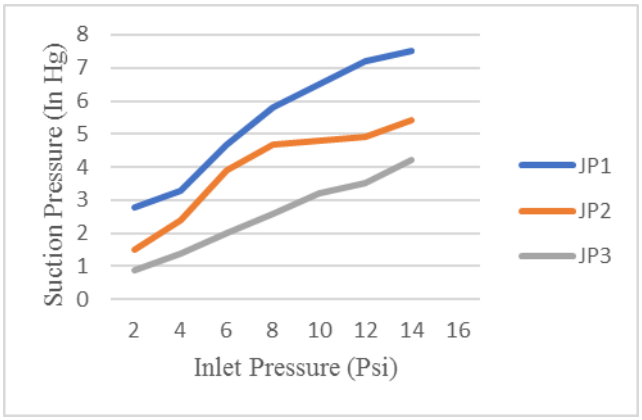

Figure 6. Suction Pressure Vs Discharge

V. CONCLUSION

An experimental study was performed on water jet pumps with different angle of mixing nozzle. The results showed that the Suction Pressure is directly dependent on angle of mixing nozzle of jet pumps. So, angle of mixing nozzle was found to be an important geometrical parameter to characterize the suction lift of the jet pumps, while their nominal diameter had a negligible impact.

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