© 2017 IJSRST | Volume 3 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Literature Review on Different Factor's That Affecting Jet Pump Performance

S. R. Pandhare, A. K. Pitale
Department of Mechanical Engineering, Prof Ram Maghe Institute of Technology and Research Badnera., Amravti University, Amravti , Maharastra, India

ABSTRACT

The objective of this work is to study experimentally the characteristics of jet pump at various perimeter. Pressure head, Suction head, discharge head, density of fluid, and the ratio of nozzle to throat distance to nozzle diameter etc. are recorded. The effect of each parameter on the jet pump performance is studied, in order to have a better understanding about the behavior of such pump under various conditions & it also helpful to find out the highest efficiency of jet pump at such perimeter. Jet pump is a machine to convert kinetic energy of water into pressure energy. The jet pump is simple in structure and its work without any moving part. That's why it's reliable in performance and provide good sealing to pump. Jet pump has less efficient than any other conventional pump. The efficiency of jet pump has directly affect by the following perimeter. Such as Pressure head, Suction head, discharge head, density of fluid, and the ratio of nozzle to throat distance to nozzle diameter etc. In our study we are designed, developed and tested simple geometry jet pump. The experiments show that we should be careful in increasing the suction head, delivery head and efficiency of jet pump. As well as stability of jet pump must be considered between the suction head and the driving fluid mass flow rate.

Keywords: Jet Pump, Throat Distance, Driving Nozzle, Suction Nozzle, Suction Chamber

I. INTRODUCTION

Jet pump is a device used to pump a fluid (solid, liquid, gases) with the help of kinetic energy of working fluid. A jet-pump is a device that uses the venturi effect of a converging-diverging nozzle to convert the pressure energy of a motive fluid into velocity energy which creates a low-pressure zone that draws in and entrains a suction fluid. Jet pump are used to suck and elevate liquids, gases or granular solids. The efficiency of jet pumps is lower than any of conventional pumps. Jet pumps exhibit the beneficial characteristic of being able to convert a high energy, low volume flow into a low energy, high volume flow ([1] Md. Mizanur Rahman). Jet pump also able to pump fluids containing high levels of abrasive material which would quickly destroy the moving parts of a conventional pump. Jet pump have some advantages over conventional pump low noise level, low maintenance cost, long equipment life reliable operation and it is operating at under different pressure and flow rate.

Most of the experimental study was conducted in this field to get the highest efficiency but very few were done on suction lift. In many cases suction lift is more important than maximum efficiency. From many research paper, we find out different experiment to get higher efficiency as well as increasing the water jet pump performance are as follows. (Md. Mizanur Rahman) carried out to get the effect of nominal diameter and nozzle to throat area ratio on suction lift of water jet pumps. (A.H.Hammoud) carried out Effect of nozzle-to-throat spacing to nozzle diameter ratio. (Santhosh Kumar Gugulothu) carried out the performance of a jet pump depends on turbulent mixing of supply and suction fluids. (Tarek A. Meakhail) carried out a study of the effect of nozzle spacing and driving pressure on the water jet pump performance. (L. Grinis)carried out experiment on influence of the flow rate ratio in a jet pump on the size of air bubbles. (A. A. Saker) carried out experiment different factors that influence jet pump performance. Etc.

The basic structure of jet pump is shown in Fig. Jet pump is composed of nozzle, throat and diffuser. The working principle is that when working fluid comes out through the nozzle at a high velocity, the pressure energy of the working fluid turns into the velocity. Pressure decreases when fluid comes out from the nozzle. Because of that suction was created at the space. The pipe in a vacuum suction the low-pressure fluid. Two kinds of fluids mix up in the throat and exchange their energy. The velocity of the working fluid will decrease, while the suction fluid velocity will rise. After mixing of both fluid reaching at same velocity at the end of throat. When the fluid flows through the diffuser, the velocity of the mixed fluid decreases gradually with the pipe diameter, and the kinetic energy transforms into pressure energy, resulting the pressure increase of the mixed fluid at end of discharge from pump.

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.

Now to explain the working principle of jet pump we have to focus on the components of jet pump. Basically jet-pumps are basically contain of five components. The driving nozzle, suction nozzle, suction chamber, throat and diffuser, as schematically shown in Fig.1. The working fluid comes out through the driving nozzle converting pressure energy into velocity, which creates a low-pressure zone in the suction chamber. Due to these low-pressure suction fluid entrances at the suction chamber, then mixes with driving fluid at the mixing chamber. The velocity of the working fluid will decrease, while the suction fluid velocity will rise. After mixing of both fluid reaching at same velocity at the end of throat. After passing through the mixing chamber, the mixed fluid expands and the velocity is reduced. This results in recompressing the mixed fluids by converting velocity energy back into pressure energy. The motive fluid may be a liquid, steam or any other gases, the entrained suction fluid may be a gas, a liquid, a slurry or granular solids. Schematically diagram of jet pump has shown below with different accessories.

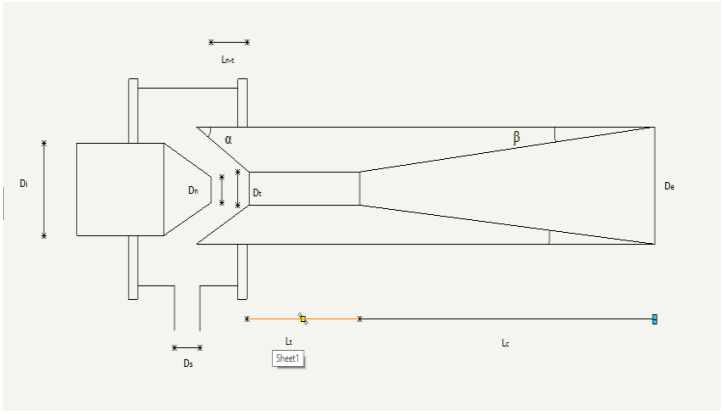

Figure 1. Schematically representation of jet pump

Where,

D_i = Inlet diameter
D_e = 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 = Angle of convergent section
β = angle of divergent section

Jet pump has a less efficiency than any other conventional pump. The performance of jet pump depends upon the different factor such as area ratio, throat diameter, convergent angle, divergent angle, pressure ratio, ratio of distance between nozzle to throat diameter to nozzle diameter. Etc. such factors has directly and indirectly effect on water jet pump performance.

❖ Following parameter have been extensively used to describing the water jet pump characteristics.

- Area ratio (A_R)

It is the ratio of nozzle are to throat area and it is given by

$$A_R = \frac{A_N}{A_T} = \left(\frac{d_N}{d_T}\right)^2$$

Where,

A_N = area of nozzle.

D_N = dimeter of nozzle.

A_T = area of throat.

D_T = dimeter of throat

- Discharge ratio (Q_R)

It is the ratio between suction flow rate and primary flow rate from nozzle.

$$Q_R = \frac{Q_s}{Q_P}$$

Where,

Q_s = suction flow rate.

Q_P = primary flow rate.

- Head ratio (H_R)

It is the ratio between net jet pump head and net driving head of jet pump.

$$N = \frac{H_d - H_s}{H_p - H_d}$$

Where,

H_d = delivery head

H_s =suction head

H_p = pressure head

- pressure ratio

It is the ratio between net pressure of jet pump to driving pressure of jet pump.

$$N = \frac{P_d - P_s}{P_p - P_d}$$

Where,

P_d = Delivery pressure

H_s= Suction pressure

H_p = Supply pressure.

- ratio of nozzle to throat distance to nozzle diameter (X).

$$X = \frac{L_{N-T}}{d_N}$$

Where,

L_{N-T}= Distance between nozzle to throat

D_N = diameter of nozzle.

III. CONCLUSION

Efficiency of jet pump depend upon different factor / perimeter. To find out the highest efficiency of jet pump first we want to find out thus different efficiency at different situation. Hence it proves that efficiency of jet pump is not depend on only one factor It's depend on multiple factor or perimeter.

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