ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 5, Issue 6, June 2016

Design Of Centrifugal Pump Impeller

Vaibhav Bankar[1], SheetalPrakash Manwatkar[2]

[1]H.O.D, Mechanical Engineering, Vidarbha Institute Of Technology, Nagpur, M.S, India

[2]Master Student, Mechanical Engineering, Vidarbha Institute Of Technology, Nagpur, M.S, India

Abstract-Centrifugal pump is most common and widely used kinetic energy pump.The main purpose of this pump is to convert energy into kinetic energy and then into pressure energy of a fluid that is being pumped.The energy changes occur by virtue of two main parts of the pump, the impeller, and the volute or diffuser. The impeller is a rotating part that convert drive energy into kinetic energy. The volute or diffuser is a stationary part that converts kinetic energy into pressure energy.Various types of impeller found in centrifugal pump. But in this paper we will design impeller for lifting water up to 10 meter. Here the water is to be lift by human powered bicycle operated.The design of impeller first done in catiasoftware so that we can see its actual working before manufacturing, hence it saves time also.

Keywords-Centrifugal Pump,Discharge rate, Efficiency, Impeller, Pressure head

I. INTRODUCTION

The centrifugal pump is most common pump. It converts energy into kinetic energy and then into pressure energy. This energy changes by means of impeller and diffuser. Where impeller is rotating parts and the diffuser is stationary parts. And volute or diffuser converts kinetic energy into pressure energy. Centrifugal pump has a two ports i.e. inlet port and outlet port. When start the pump, liquid enters into suction nozzle andthen into eye (center) of revolving part known as impeller. When the impeller rotates, it spins the liquid sitting in the cavities between and vanes outward and provides centrifugal acceleration. As the liquid leaves the eye of the impeller, a low pressure area is created causing more liquid to flow towards the inlet. Because the impeller blades are curved, the fluid is pushed in a tangential and radial direction by centrifugal force. Centrifugal force pushes the liquid from the eye of the impeller where it enters the casing. Differential heads can be increased by turning the impeller faster,using a larger impeller or by increasing the number of impeller. This force acting inside the pump is the same one that keeps water inside a bucket that is rotating at the end of the string. Below figure is a cross section of the centrifugal pump indicating the flow of the liquid.

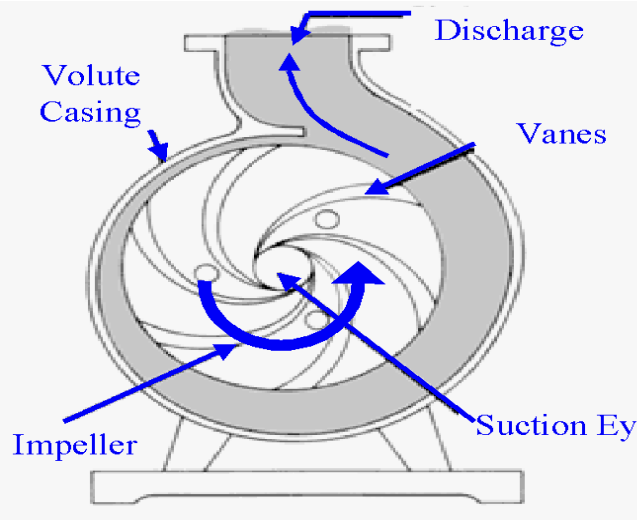


Fig- Liquid flow path inside a centrifugal pump

II. GENERAL PRINCIPLE OF IMPELLER

An impeller is a rotating part in centrifugal pump also called as rotor used to increase ordecrease ofpressure and the flow of fluid. It is made up of steel, iron, bronze, brass, aluminiun or plastic which transfer energy from the motor that drives the pump to the fluid being pumped by accelerating the fluid outwards from the center of rotation. The velocity achieved by the impeller transfers into pressure when the outward movement of the fluid is confined by the pump casing. Impellers are usually short cylinders with an open inlet which is also called eye to accept incoming fluid, vanes to push the fluid radially, and a splined, threaded bore to accept a drive shaft. The impeller made out of the cast material in many cases may be called rotor.Because it is cheaper to cast the radial impeller. The rotor usually names both spindle and the impeller when they are mounted by the bolts.

III. TYPES OF IMPELLER

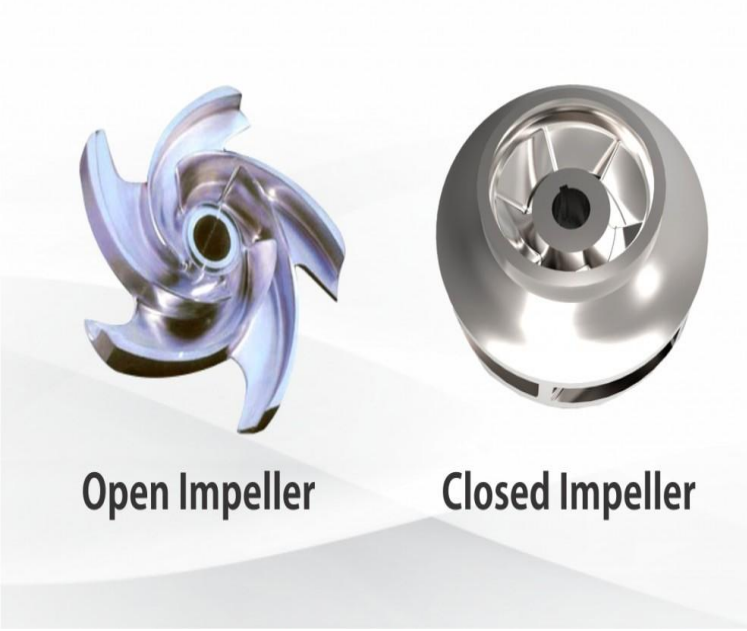
There are basic three types of impeller which is described below. The efficiency of centrifugal pump is determined by impeller. Vanes are designed to meet a given range of flow condition.

OPEN IMPELLER

Vanes are attached to the radial hub, without any form, sidewalls or shroud and are mounted directly onto a shaft. It is structurally weak and require higher NPSHR value. It is used in small diameter, inexpensive pumps, and pumps handling suspended solids. It is more sensitive to wear than closed impeller.

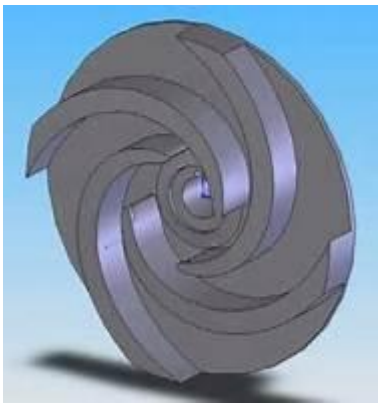
CLOSED IMPELLER

The closed impeller has both a back and front wall for maximum strength.They are used in large pumps with high efficiency and low NPSAR. It has high wear rate. It is most widely used impeller in centrifugal pump handling clear liquid.



PARTIALLY OR SEMICLOSED IMPELLER

It corporates a back wall that serves to stiffen the vanes and adds mechanical strength.They are used in medium diameter pumps and with liquid containing small amount of suspended solid. They are high efficiency and low NPSAR than open impeller.



Impellers are agitated tanks are used to mix fluid or slurry. This can be used to combine material in solid, liquid, or gases form.

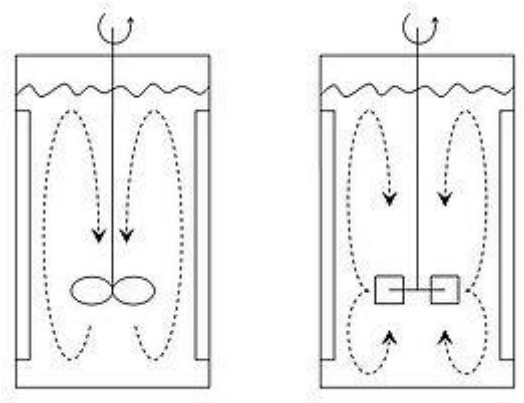
There are two types of impeller, depending on the flow regime created

Radial Flow Impeller

It impose essentially shear stress to the fluid, and are used. Another use of radial flow impeller are the mixing of very viscous fluid.

Axial Flow Impeller

Axial flow impeller impose essentially bulk motion, and are used on homogenization process, in which increased fluid volumetric fluid is important.



Axial flow impeller in left and radial flow impeller in right

In our project we are going to modify the centrifugal pump impeller as per our requirement. As in this project, we will use the bicycle to lift the water upto 10 meters from ground level.The centrifugal pump we use here is without electricity and consume less space, less maintenance and used in rural areas where electricity is not available. In general water is to be lift above 1200 rpm and also it depends upon the person efficiency. So in this project our required RPM is 1500, for this the impeller is to be modified. Below is the basic calculation of the centrifugal pump impeller

IV. PUMP IMPELLER EQUATION

$\frac{u_2^2}{2g} - \frac{u_1^2}{2g}$ = Hm

Where, U = velocity

H= head in meter

A= Acceleration gravity

D2= Diameter outer impeller

D1= Diameter inner impeller

The bicycle N1=300rpm

The required N2 = 1500rpm

The gear ratio is D2=50 D1= 10

Formula N1/N2 = D1/D2

Put D2, D1 in above equation, we get the require N2 i.e. N2=1500rpm

V. CONCLUSION

As per the above information we are going to design the centrifugal pump impeller, which is as per our requirement and as the need of the project. Pumps and impellers are designed in software and then in actual work, hence no any chances of error occurred and our project works as required

VI. REFERENCES

1]"impeller, n.". OED Online. March 2013. Oxford University Press. 20 March 2013 [1]

2]Engineering360 CR4 - Impellers & Propellers

3] Kim S 2007 Design Optimization of a Centrifugal Pump Impeller using DOE and RSM Master Thesis Seoul:Hanyang university

4]Park S H 2001 Modern Design of Experiments, Minyongsa, Seoul 121-140.

5]Imaichi K and Murakami Y , Tsurusaki H and Cho K R 2002 The Basis of Pump Design