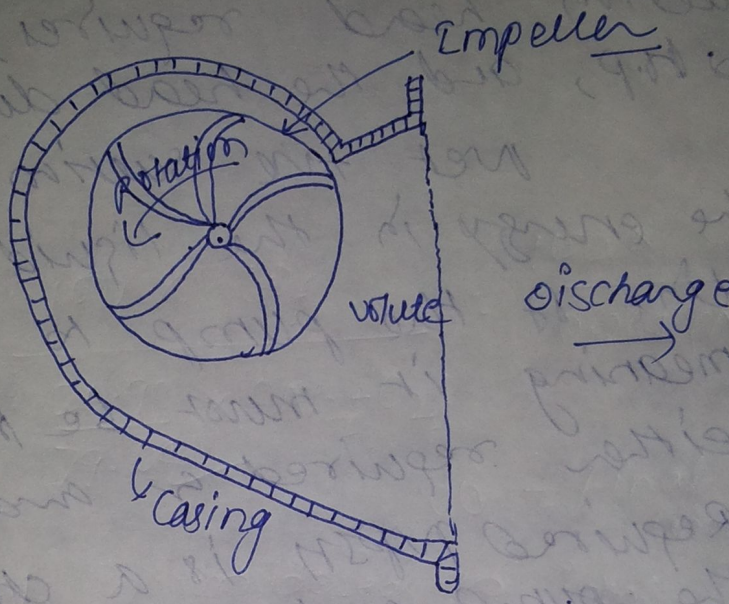
20/08/15

Pumps

(1) Centrifugal pumps:



The purpose of any pump is to transform mechanical or electrical energy into press. energy. The C.F pumps accomplishes that in two steps. The 1st transform the mech or elect energy in K.E with a spinning element or impeller. The K.E is then converted to pressure energy by diffusor vanes or a gradually diverging discharge tube called a volute.

Water enters at the centre or eye of the impeller and is forced outwards towards the casing by centrifugal force

The discharge head of C.Pump is a fn. of the impeller dia. and speed of rotation.

Design factors requiring considerations in the selection of a C.P are net +ve suction head required, efficiency, & B.P, and the head discharge relationship.

Net +ve suction head NPSH is the energy in the liquid at the central line of the pump to have a practical meaning it must be related to as either required or available NPSH.

Required NPSH is a characteristics of the pump and is given by the manufacturer.

Available NPSH is a characteristic of the system and is determined by engineers. It is the press in the liq. over and above its vapour pressure at the suction flange of pump and is given in "feet" by following formula

$$\text{Available NPSH} = \frac{Pa - Pv}{w} - hf + Z$$

Pa : press. on a free water surface at central line of a closed in psi'a

P_v :- vapour press. of water at its pumping temp. psia

h_f :- friction loss in suction line (feet of water)

Z :- elevation diff. in feet of water b/w pump central line & water surface

W - unit wt of liquid in pound/ft³.

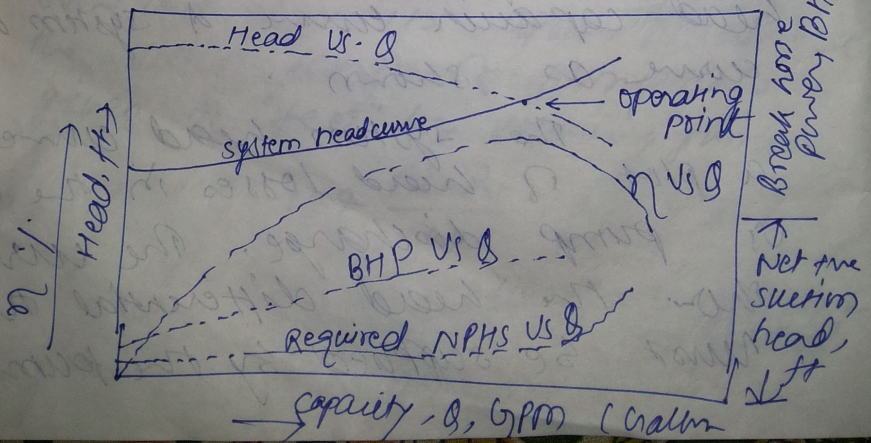
If the suction water surface is below pump central line Z is -ve and to prevent cavitation it is necessary to have the available NPSH always greater than required NPSH. For that reason it is customary to analyse a required NPSH vs discharge curve with break hp head an η curve when selecting a pump.

The operating pt of a C.pump is determined by the intersection of pump head capacity curve & system head curve as shown.

The system head curve is a plot of head losses in the system vs pump discharge. The curves show the head differential that must be supplied by the pump.

In a typical water system there may be 3-4 system head curves at various consumption rate. The intersection of these curve with the head vs Q curve define a range of operation rather than a single point

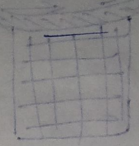
selection of a C.Pump is largely a matter of matching one of the many pump available to the system chara. In doing so the point of max. η should be at or near operating pt. C.Pumps are available in any capacity desired which is with 7000 ft / min η as high as 93%. for large pumps.



Date 25/8/2015

Well pumps

These are classified as centrifugal, propeller, jet, Helical, Rotary, Reciprocating and air lift. Although C.F are the commost, for though shallow wells and deep wells. Circumstances may be ____ for other types.



propeller pumps:

They are axial. They are used in high cap. low head appl.

Jet pumps:-

These operates by discharging water through a nozzel and diverging conical tubes which are located at the well bottom. The diverging conical tube creates lift by converting the high velocity head to press. head. The suction connection is made btw the nozzel and entrances to the diverging tube. Jet pumps have low efficiency they are used in small cap. low lift application specially when water contains sand or other impurity.

fig. jet pump.

Hellical pumps: They are +ve displacem. type with a metal hellical rotor rotating inside a rubber hellical stator. The screw section of the rotal forces water through the pump and up to the discharge pipe. Hellical pumps are small cap. High lift pumps. These may be used in wells over 4" inside ø.

Rotary pumps: They are also of displacement type. They have a fixed chamber in which gears, vanes, cones or pistons rotate

with close tolerances. These pumps have relatively constant partial load efficiency full range η range from 50-85%. because of the close tolerances they can be used only for sediment free water.

Reciprocating pumps: Either hand or motor driven utilise piston action to motive water. Their present use is primarily is for small cap. low lift private locations.

Air lift pumps: Generates lift by using air bubbles to decrease the sp. wt. of column of water in the discharge pipe below that of the surrounding water in the well. This creates a pres. differential that forces the water out of the well. These are simplest and most well pumps beca. they have no submerged part. They can be used in any well but disadv η < 50%.

A widely used criterion for pump selection is the specific speed (N_s). It is the impeller speed corresponding to a discharge of 1 USgpm (gallon) at 1' of head for most efficient design

$$N_s = N\sqrt{\frac{Q}{h^{3/4}}}$$

N = impeller speed

Q = discharge (in USgpm)

h = head in feet

The favourable design range of N_s for radial flow (centrifugal pump) is from 1500 to 4100. For N_s between 4100 and 7500 fixed flow pumps having more axial & radial nature should be used. For N_s above 7500 axial flow (propeller) pump should be used.

Shallow well pumps have the motors and impeller at ground level so the entire lift is suction.

since excessive suction lift cause cavitation. The lift is limited by atm. pres and velocity head at the impeller which is a fn of specific speed. At sea level the max. suction lift for shallow well pump is about 25 ft.

Deep well pumps have their impellers closed enough to the water surface to eliminate cavitation. The motor may be at ground level with a long shaft connecting to the impeller or it may be at the bottom of the well below and directly adjacent to the impellers. The former type is called Deep well turbine pumps and the latter submergible pumps. Deep well turbine pumps can only be used in straight well. The pump shaft is supported at interval of about 10 ft by rubber or metal bearing which are water or oil lubricated.

if sand is carried out by water and enclosed shaft or submersible pumps must be used to avoiding damage.

Submersible pumps are used in cooked well (dam). Other adv include to an increasing well depth or lift and silent operation. One disadv is that the motors are difficult to reach for repairs.

(. pumps are used in wells over 6in ϕ. They have cap. of upto 4000 - 5000 GPM and heads upto 1250 ft. depending on no. of stages. η may be as high as 90%. For larger capacities however below 200 GPM the η max is 75-80%.