SELECTION OF PUMPS

IMPORTANT POINTS TO CONSIDER WHILE SELECTING OF APUMP ARE;

1. Pump Material of construction, 3.NPSH, and 4. Working temperatures and cooling or flushing media plans size, 2. and various other features as governed by liquid to be pumped and pumping conditions;

FOLLOW THE GUIDELINES;

SUITABLE PUMP SIZE

1. Knowing the duty point i.e. head and capacity, find from graph, the near about pump size suitable. In case one or more sizes are suitable, try to offer the economical (normally 2900 RPM) size.

DUTY POINT

2. Refer the exact curve corresponding to the size selected from the family graph and find exact duty point. Note the following;

a). Head / capacity

b). Efficiency.

c). B.H.P.

Apply the corrections corresponding to vapour pressure, viscosity, specific gravity before arriving the at exact duty point and B.H.P. required.

Apply efficiency corrections as mentioned in para 3.

MATERIAL OF CONSTRUCTION

3). Referring to data sheet find out the most suitable material of construction.

If all Iron pumps are suitable in addition to others, it would be always be economical.

However, following are limitations for all C.I. pumps;

A) The impeller peripheral speed should not exceed 135 ft/sc. Or 41.2m/sec. Corresponding to head of 105 m (275 mm dia. Impeller trimmed from 315mm. Normal size) at 2880 rpm. When is C.I.(is 210 GR. 25)

In that case select cast steel or cast alloy steel impeller.

Efficiency correction factor –for Cast Steel, Alloy steel impellers.

Reduce efficiency;

1) By 3.5% upto 12.5 mm width (1/2”)

2) By 2.5% upto 16.0 mm (12.5-16mm) or (½”-5/8”)

3) By 1.5% upto 20.0 mm (3/4”)

4) By 1% above 20 mm impeller width.

B) The overall performance is derated in case of viscous liquids.

C) The limiting temperatures and pressures are as under for C.I. and bronze construction.

C.I. construction / bronze construction.

Temp. 200 deg. C –pressure 12.5 bar.

Temp. 120 deg. C –pressure 16 bar.

Cast Steel & Stainless Steel construction.

Temp. 315 deg. C –pressure 16 bar.

Temp. 150 deg. C-pressure 20 bar.

For higher pressure and temperatures of order of 26 kg /sq. cm and 320 deg. C. use of SG Iron or cast steel IS GRADE 3038 is recommended.

D). Therefore, in case of heating chambers or centerline supports which are recommended above 170°C-175°C liquid temperatures normally cast steel or cast alloy steel pumps are recommended and bronze/C.I. pumps are not recommended.

E). Bearing cooling is offered in case it is expected that the bearing temperatures due to surrounding, condition of heat along shaft and generated heat due to driving friction, would rise above 75°C. The oil temperature in the housing are kept between 75°C to 80°C by carrying away that (liquid temperature above 170°C)

F). External gland cooling is recommended when the temperature at gland is expected to be 100°C and the above. In that case the cooling is adjusted to keep gland temperature between 100°C to 150°C (liquid temperature above 120°C).

G). While selecting a prime mover, check surrounding conditions, if it is necessary to have flame – proof motor to avoid accidents (inflammable, volatile liquids-use mechanical seals to stop dripping of liquids) find the max. H.P. required at 10% lower heads than specified and allow for 15% extra power to take care of process variations considered for viscosity and specific gravity.

SELECTION OF CHEMICAL PROCESS PUMP

Following are the important factors taken in to consideration while selection chemical pumps

1) Capacity and discharge head

This expected in usual terms

2) Suction process pump may be required to lift the liquid from a lower level or liquid coming under pressure at the suction end. It is, therefore, necessary to know the working pressure and the

operating head. For example, if the working pressure of the pump is 25 Kg/cm2 and the inlet pressure is 10 Kg/cm2 the operating head can be only upto 15 Kg/cm2.

One of the most important parameters to be taken into consideration is the Net Positive Head. Generally speaking NPSH is defined as pressure at the suction inlet of the pump, less vapour pressure. It is known that atmospheric pressure can support water column to a height of 34 ft. In practice, this is not true for several reasons. The suction pressure should not go below vapour pressure of the liquid. Otherwise the liquid will get converted into vapuor form and the flow will be discontinued. The pump is not designed to handle vapour. There is some loss of pressure due to friction in the pipe line, foot valve, bend etc. Some head gets converted into velocity head. As a result the head available may be given as 34-ft. vapour pressure –velocity head –friction head +inlet pressure. This can be described as Net Positive Suction Head available. Every pump by its design characteristic requires certain NPSH at the inlet for pumping liquid. This is called, as NPSH available must be more than NPSH required. While selecting chemical pump therefore, both the values must be known. Generally NPSH required by Chemical Process pump is 2.5 metres. However, it differs with different models of pumps and also it differs with speed.

3) Chemical composition of the liquid

In order to ascertain the reaction of the liquid on the wetted parts of the pump, it is necessary to know the chemical composition of the liquid, it is also desirable to know the pH valve which indicates the acidic or basic nature of the liquid. Pure water has a PH valve of 7. Between 0 to 7, the liquid is acidic and between 7 to 14 the liquid is basic.

4) Viscosity

SSU. It can be used viscous liquid from 500 SSU to1500 SSU with due correction. However, in this range the pump has to be heavily departed. It results in selecting a big pump for relatively smaller capacity and head. It is not advisable to use centrifugal High viscosity of liquid can cause high friction loss. As a result the pump develops less head and less capacity. The power consumption increases. In other words the pump required to be derated. Chemical process pump can safely handle viscosity up to 500 pump for viscous higher than 500 SSU.

5) Temperature

Temperature affects the pump in following way;

a) In case of certain chemicals corrosion action depends upon the temperature. Usually hot boiling liquid has more corrosive action.

B) If the temperature raises, heat is transferred from gland packing through the shaft to the bearing. Such a transfer of heat to the bearing reduces bearing life considerably. It may even seize the bearing. In such cases, it is necessary to make sufficient cooling arrangement at the gland, so that heat is carried away. It may be down either by use of direct injection or cooling water in to gland or by providing cooling jacket for the cold water circulation.

c) Temperature affects viscosity. Many times the viscosity is given at certain laboratory temperature. However, If the working temperature is quite different, the viscosity figure given is of no use. In such a case, the knowledge of actual temperature will be quite useful in getting the correct figure for the viscosity.

d) At high temperature, the expansion of metal parts takes part in different proportion. This factor must be taken in to consideration when offered a pump for high temperature

e) Bedside temperature, it is necessary to know whether it is required to preserve heat (or to maintain the low temperature as the case may be). Such a condition may be necessary to maintain the flow condition or to achieve operation economy. In such cases, steam jacketing may have to be used to maintain high *temperature* of the while passing through the pump or proper insulation to be provided to maintain the low temperature.

Chemical process pump can operate in the range of minus 50 deg c to plus 300 deg c. if the temperature is above170°C, it is necessary to provide cooling arrangement at the gland. A stuffing box jacket is provided through which cooling liquid can be passed. Also in such cases, centerline mounting foot support is to be provided. Volute casing is mounted on external feet (not integral with casing) and the support is at the level of shaft centerline. Cold water is circulated through the external feet. This design takes into account uneven expansion of mounted parts.

6). VAPOUR PRESSURE

As soon as the earlier vapour pressure of the liquid influence the working of the pump on the suction side, it is the pressure at which a given liquid vapourises. The vapour pressure again depends upon the temperatures. Higher the vapour pressure, lower the NPSH available. If pressure is more than the available NPSH, cavitation occurs. In case of high vapour pressure, the liquid is supplied to the pump with some suction head created by keeping the pump at a lower level thereby creative positive head at the suction head. The other solution is to reduce the temperature of the liquid before it enters the pump.

7). SPECIFIC GRAVITY

Specific gravity directly influences the power consumption. Hence the liquid with higher specific gravity requires proportionately high H.P. It should be noted that there is no change in the capacity delivered and the head developed, if the specific gravity is higher or lower. Specific gravity also affects the NPSH available. All the while we have taken the figure of 34 ft. of water column while calculating NPSH available. However, if the liquid is heavier than water, the atmospheric pressure again support that liquid to a higher of 34 ft. as is amply clear from the fact that with a heavier specific gravity like mercury in the liquid form, the height is only 32”. If therefore one is required to calculate NPSH available, specific gravity has to be taken into consideration.

8). SOLID CONTENTS

The solid contents of the liquid influences the type of impeller and gland arrangement. The solid may be in two forms. One in the form of fully dissolved state. In this case, it will only affect the specific gravity and the viscosity of the liquid. If the solid remains in undissolved form, it is necessary to know the type of solid, such as hard, soft, abrasive or nonabrasive. A centrifugal pump can normally handle between 10 to 15% by volume.

Hard and abrasive solids wear out the pump parts rapidly. To protect the costlier parts, the manufacture may have to provide suitable renewable liners. The manufacture will also have to take care to prevent the entry of solid in the gland region, so that the life of the gland ring and the shaft protecting sleeve is not shortened. In such cases, double seals may be used. It will also be possible to provide circulation through the seal to carry away abrasive particles. Generally when there are solids in suspension, semi-open impeller, is offered.

TECHNICAL QUESTION AND ANSWERS.

1) Why performance curve should be stable and not drooping?

With an unstable curve, where shut off head is less than the maximum head, for all heads higher than shut-off heads, there will be 2 discharge possible. One does not know, how much is the actual discharge. The pump does not know, the flow keeps hunting, causing an oscillating flow and resultant vibration and damages. When in parallel operation, since the total flow-demand has to be shared by more than one pump, if one pump is hunting, it affects other pumps also, because their contribution also keeps fluctuating. Unstable characteristics is hazardous and more so in parallel operation

2) Why should we add more margins for motors of smaller range and less margin for motors of higher capacity ?

Adding 15 percent margin for say 3 kW, i.e.only 450 watts more would not give you the degree of confidence you need for any ‘margin’. But keeping 15 percent margin for 300 kW need means bargaining for 45 kW higher rating, that much of extra power consumption and energy bill.So the gradation of margins, as recommended have both a mathematical and practical logic.

Also, high discharge would need higher power. High discharges make higher specific speed, which in turn makes for flatter power curve and less need for margin. But this may not be always true. High heads also need high power. But if high head is from a multi-stage pump, multi-staging would again raise the design specific speed and in turn flatter power curve.

Need for margin is also dictated, rather more dictated by system design. If the system is of too many pumps in parallel, say five pumps in parallel; the point of operation would vary from single pump running to all five pumps running. Then the operating range for each pump would be too wide. Then the power rating has to cater to maximum demand from the wide range. But the range is not wide ,one can manage less margin.   .

3) Selection criteria of pumps in API 8 th edition, what rules it should obey ?

The emphasis in API standard is on

a. concern for environment.