General parameters for performance of centrifugal Pump

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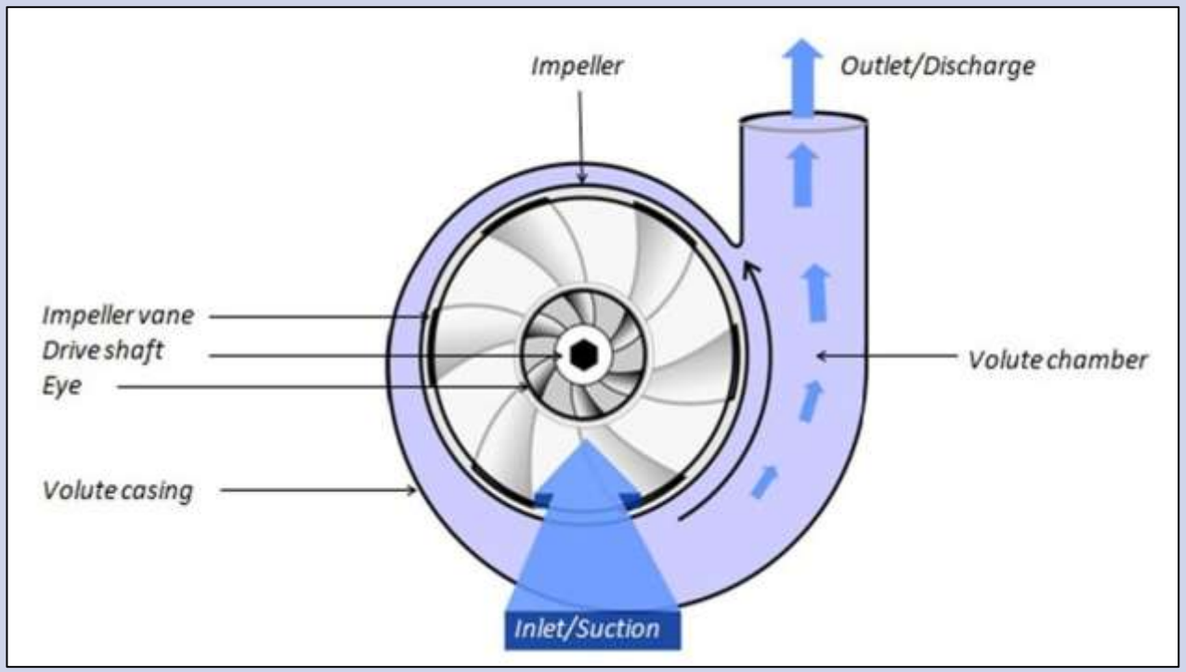
1. What are the centrifugal pumps?

1. Centrifugal pumps are used for transporting liquids by raising a specified volume flow to a specified pressure level.

2. A **centrifugal pump** is a rotating machine in which flow and pressure are generated dynamically. The energy changes occur by virtue of two main parts of the pump, the impeller, and the volute or casing.

3. The function of the casing is to collect the liquid discharged by the impeller and to convert some of the **kinetic (velocity) energy into pressure energy.**



2. Performance parameter of centrifugal pump

1. Main factors affecting the performance of centrifugal pump:

a) Working fluid viscosity
b) Specific density
c) Operating temperature and pressure
d) Vapor pressure of working fluid
e) NPSH and cavitation

2. Pump performance at a given rotor speed is described by :
a) Rate of flow delivered
b) Power absorbed at the coupling (“brake horsepower”)
c) Pressure rise achieved
d) Efficiency η at the pump coupling
e) NPSH or the net positive suction energy NPSE= g × NPSH.

3. Centrifugal pumps are turbomachines used for transporting liquids by raising a specified volume flow to a specified pressure level.

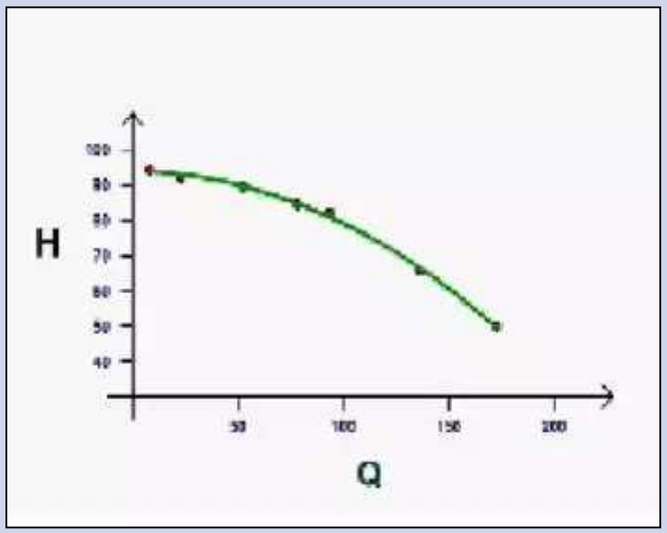
4. The energy transfer in turbomachines is invariably based on hydrodynamic processes for which characteristically all pressure and energy differences are proportional to the square of the circumferential rotor speed.

5. One can easily understand centrifugal pump performance test by the understanding of flow rate, total head, power, and efficiency.

3. Importance of Flowrate and Head in Centrifugal Pump Performance Test

- Volume flow rate (Q), also referred to as capacity, is the volume of liquid that travels through the pump in each time (measured in gallons per minute or GPM).

- It defines the rate at which a pump can push fluid through the system. Flowrate is the first parameter specified by the process designer, who determines the pump requirement on the flow rate that the process needs to function.



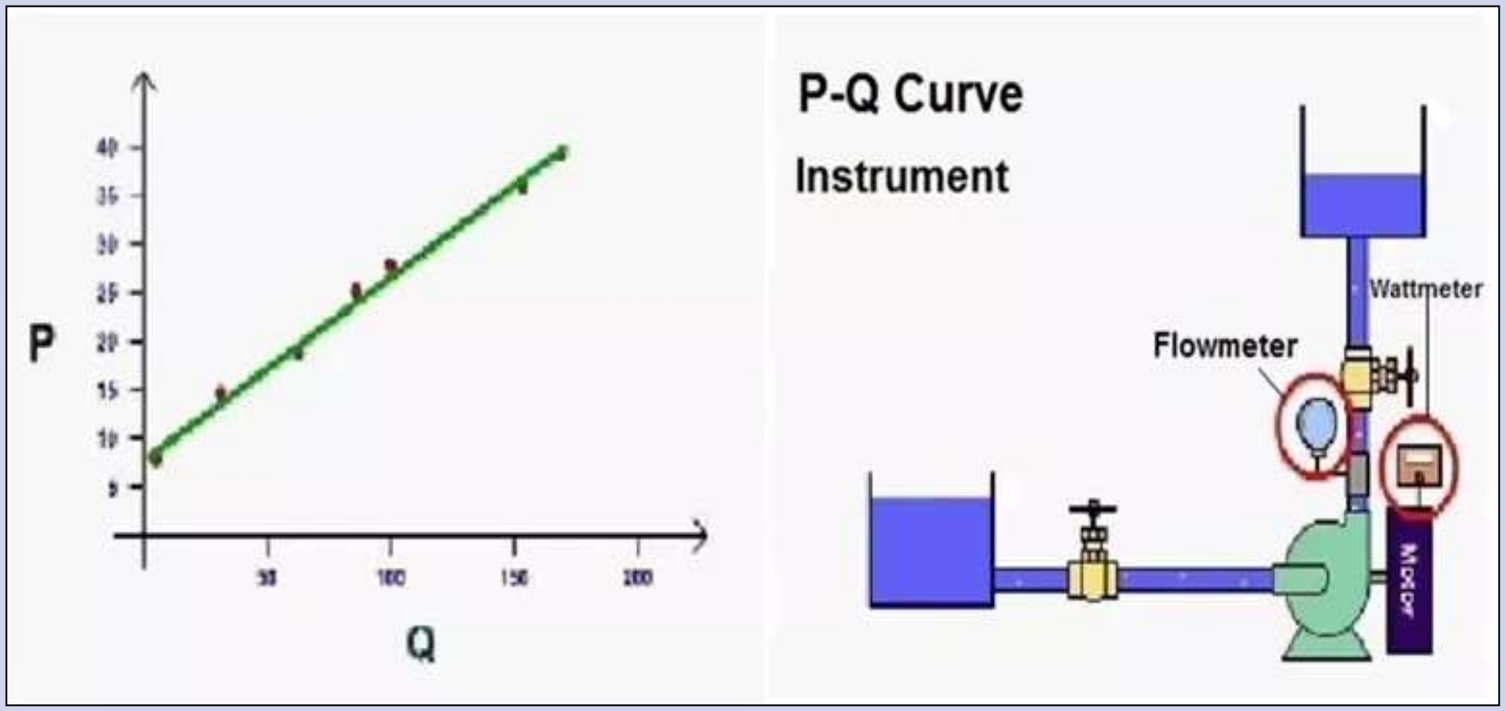
- This 'rated' flow rate is normally expressed in volume terms, and it is represented by the symbol q, with units of cubic meters/ second or GPM.
- The static head of a pump is the maximum height (pressure) it can deliver. The capability of the pump at a certain RPM can be obtained from its Q-H curve.
- The pump manufacturers are interested in providing pump performance curve in a way that does not depend on to the pumped fluid physical properties.

- *Although the theory of centrifugal pumps gives many qualitative results, the most important indicator of a **pump's performance** lies in **extensive hydraulic testing**.*
- *In industry, the characteristics of all pumps are usually read from their **Q-H curve** or **performance curve** (flow rate – height).*

4. Power Consumption in Centrifugal Pump Performance Test

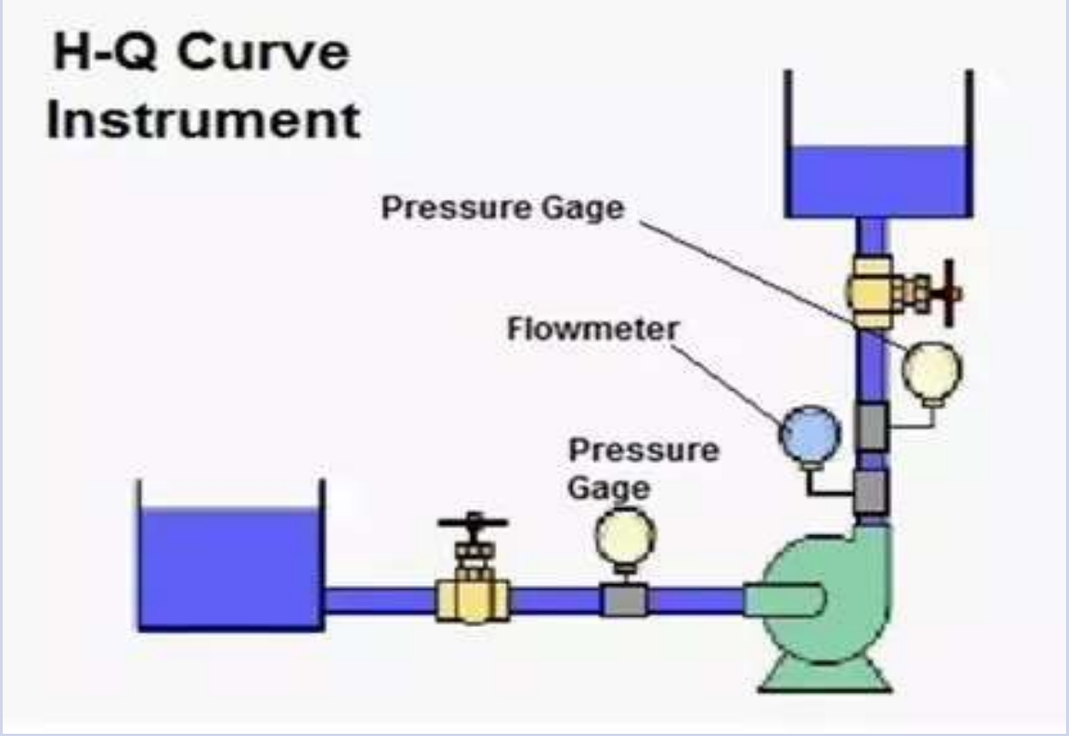
- The power consumption is measured at different flowrates similarly, and the power-flowrate curve is plotted.

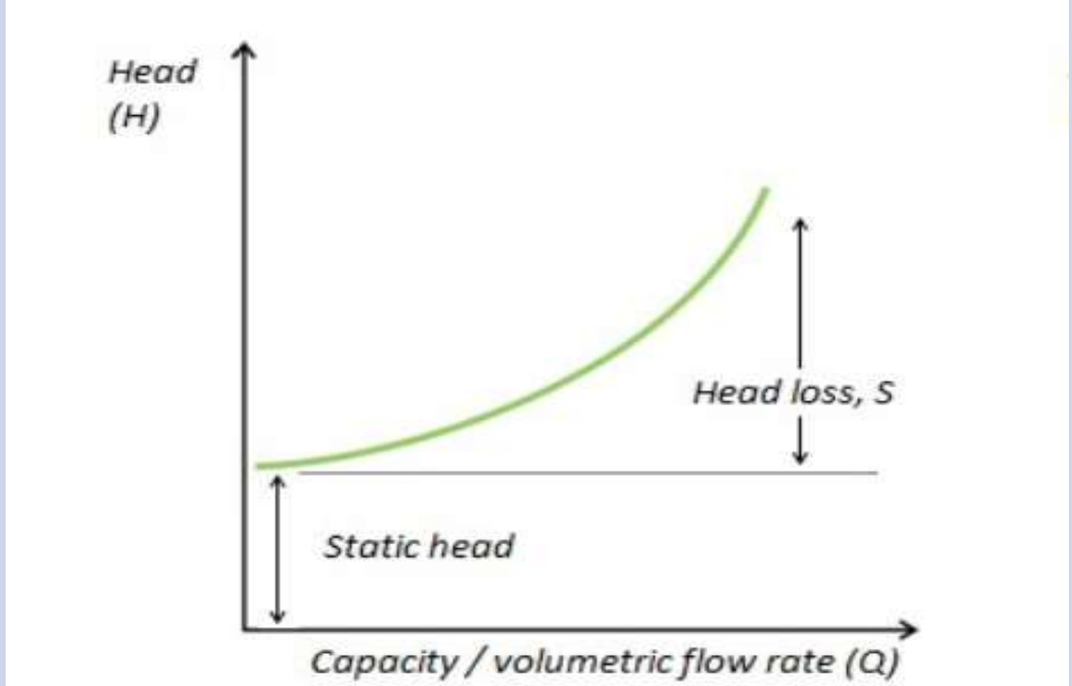
- A wattmeter is connected to motor power input, by multiplying wattmeter amount at motor efficiency the motor output power is calculated at different flowrates. Through these corresponding readings, the power-flow rate curve is plotted.



The q/H Curve Test

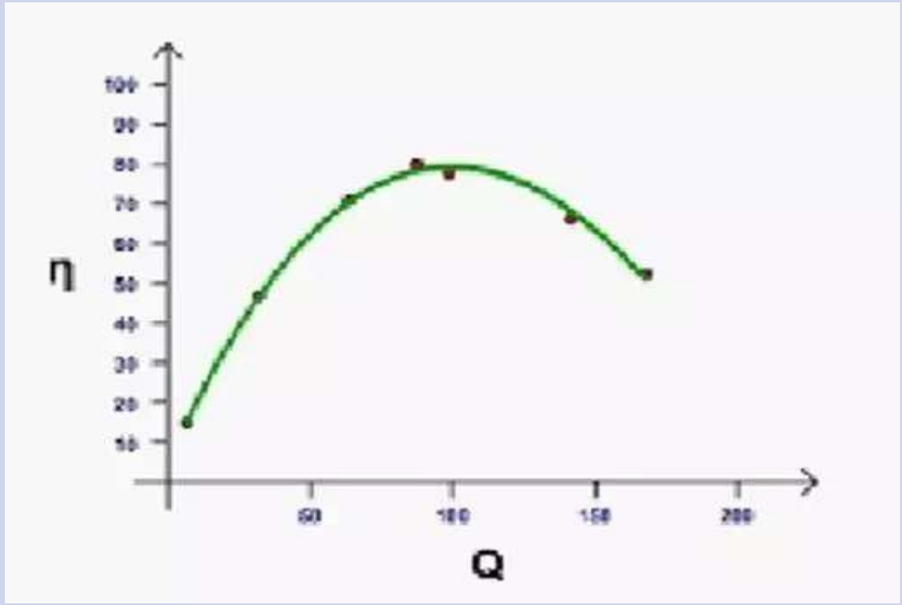
- The test is carried out at a nominally constant shaft speed, and the head (H) decreases as flowrate (q) increases, giving a negative slope to the curve.
- The test engineer changes the flow rate through discharge control valve and takes measurement of different variables and calculates the corresponding head.





5. Efficiency-Flowrate Curve at Centrifugal Pump Performance Test

- The efficiency-flowrate (η-Q) curve can be plotted based on measured values from combination of H-q curve and P-q curve and this formula η=(P out of Pump)/(P input of Pump)=ρgHQ/(P input of pump)



- Pump efficiency (η percent): the efficiency is the ratio of transferred mechanical work of the fluid to consumed power (P) in watts by the pump.

- The efficiency test; the efficiency is checked using the same set of test measurements as the q/H test.

Conclusion

1. To select a pump for any industrial or personal requirement, it is important to determine the required total head for the operation and the required flow rate. All this data is important because each pump which is manufactured by manufacturer has a characteristic value of head and flow at which it leads to maximum efficiency operation.

2. To select the right pump for an application, it is important to understand both system and pump curves. The pump curve describes the relationship between the rate of fluid flow and head for the pump itself.

3. Most pump systems are designed and oversized for worst-case loading conditions. Following the principle of the affinity laws, just by lowering the flow of an oversized centrifugal pump by 20 percent can reduce power consumption by about 50 percent, resulting in dramatic energy savings.

Reference

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