
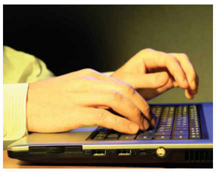

SPECIALISTS IN FLOW MEASUREMENT AND HYDRAULIC SURVEYS

Flowcheck Ltd. Tel: 0151 336 8328 Email: info@flowcheck.co.uk **www.flowcheck.co.uk**

Guide to specifying pumps

Introduction

Pumps are a major source of energy usage. A pump that is incorrectly sized or excessively worn will waste large amounts of energy.

To ensure that an individual pump, or a combination of pumps, deliver the required flow rates and operate at their best efficiency points, they must be closely matched to the pressure and flow characteristics of the pipeline they pump into.

A pump that does not operate at its best efficiency point will use excessive energy; this is both expensive and damaging to the environment.

When specifying a pump or pumps the two essential pieces of information required are:

1. The volumetric flow rate the pumps must deliver.
2. The total heads (pressures) they must generate to deliver the desired flow rates

Definitions

Total head
The addition of static head plus friction head.

Static head
The head difference between the surface of the liquid in the suction well and the surface of the liquid at its point of discharge.

Friction head
The head lost in overcoming friction through piping, fittings and valves.

The friction head is determined by a number of factors:

- Flow rate
- Dimensions of the pipeline
- Effective roughness (Ks value) of the internal surface of the pipe
- The number and types of bends, valves etc within the pipeline
- The viscous characteristics of the liquid being pumped

Considerations

As flow in a pipeline increases the friction head generated also increases. Therefore on duty assist pump configurations the head (pressure) each pump must be able to generate should equate to the static head plus the friction head produced at the maximum flow rate. The maximum flow rate is the combined flow rate of all the pumps that can possibly run together.

Similarly this principle must be applied when using variable speed pumps where the flow rate and head generated will change with the speed of the pump.

Two identical pumps running in a duty assist configuration will not deliver twice the flow of a single pump; this is due to a greater friction head being generated at the higher flow rate.

To view the theoretical effects of different flow rates, pipe dimensions, roughness values, and the influence of settled solids in the pipe, use the 'Friction head calculator' on our website **www.flowcheck.co.uk**

Efficiency points

The efficiency of each component in a pumping unit, pump, motor, transmission (shaft, coupling, gears, etc), can be calculated by dividing the output power by the input power. To the user who wishes to pump the maximum liquid for the minimum cost the most important parameter is the overall efficiency of the pumping unit:

Overall efficiency = Liquid power delivered by the pump
÷ Input power to the motor

The flow delivered by centrifugal and axial pumps, as commonly used in Water and Wastewater applications, will vary depending on the head they are pumping against. There is a maximum head they are capable of delivering and also a best efficiency point at which they are running at their optimum efficiency.

For greatest economy a pump needs to be matched to its pipe system so that under normal running conditions it operates at its best efficiency point.

Installing a pump that is designed to deliver greater heads than actually required is likely to have a higher operational cost than one closely matched to the needs of the system.

Pump Curves Explained

To aid pump selection manufacturers produce graphs showing numerous performance characteristics of a pump over its operational range. To determine the most suitable pump for an application the pump curves must be compared to the pressure and flow characteristics of the pipe system that the pump will deliver into.

Figures 1 to 4 below show curves for different versions of a centrifugal pump that is typically used on Wastewater pumping installations. All versions of the pump used in the examples below have 150mm diameter suction and discharge pipe connections.

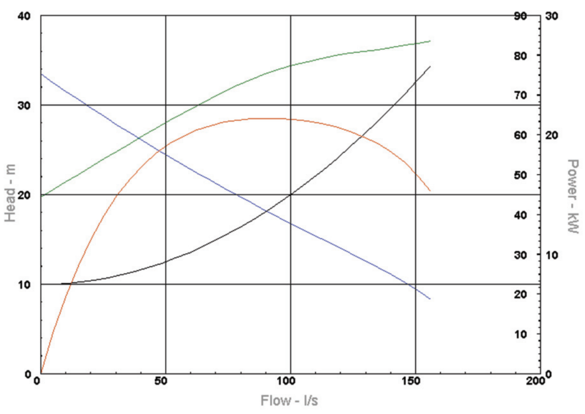

Figure 1

System curve
The black curve rising from the lower left hand side to the upper right hand side.

This shows the head generated within a pipe system at different flow rates. This information is essential to enable a pump to be accurately specified.

Pump curve
The blue curve sloping from the top left hand side to the lower right hand side.

This shows the flow the pump is capable of delivering when pumping against different heads. The lower the head the greater the flow delivered by the pump.

Power curve
The green curve rising from halfway up the left hand axis to the top right corner.

This shows the input power to the motor and should be read against the scale on the right hand axis, Power - kW.

Overall efficiency
The red curve rising from the bottom left hand corner to the centre of the graph and then falling to the lower right hand side.

This shows the percentage efficiency of the pump unit. The peak of the curve is the pumps best efficiency point. The efficiency should be read against the 0 – 90 scale on the right hand axis.

The graphs show the pump and system curves cross when the pump is delivering 90l/s against a head of 18m. This coincides with this pumps best efficiency point.

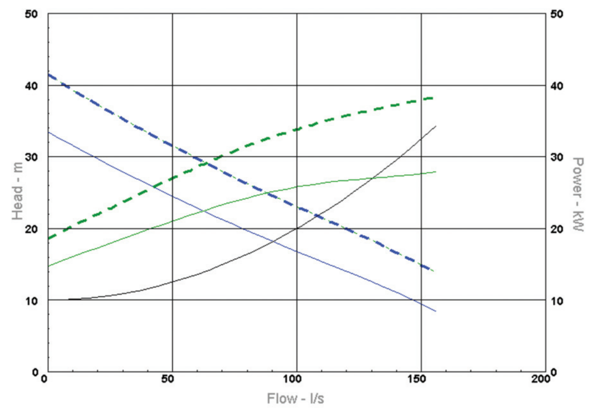

Figure 2

Figure 2 shows the same blue pump curve, green power curve, and black system curve, as Figure 1.

The broken (dashed) traces show the pump and power curves generated when a larger impeller is fitted to the pump. Using the larger impeller, the pump and system curves cross when the pump is delivering a flow of 110 l/s against a head of 22m.

This is an increase in flow and head of 22%; power consumption however, is increased by approximately 40%.

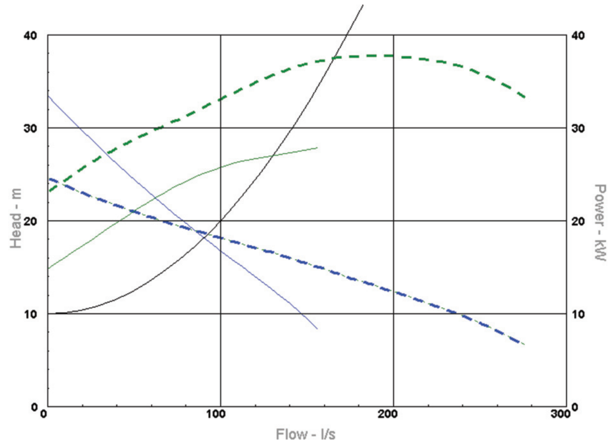

Figure 3

The solid blue and green traces in Figure 3 again show the same pump and power curves as Figure 1 and the same system curve in black. The broken (dashed) lines show the effects to the pump and power curves when a larger impeller and slower motor configuration are used.

Both pump curves cross the system curve when they are delivering approximately 90 l/s at 18m head. At this point however, the pump fitted with the larger impeller and slower motor is using approximately 30% more power than the original pump. Although both pumps are equally capable of pumping 90 l/s at 18m head, in this instance the one with the larger impeller and slower motor will cost 30% more to run at this duty point.

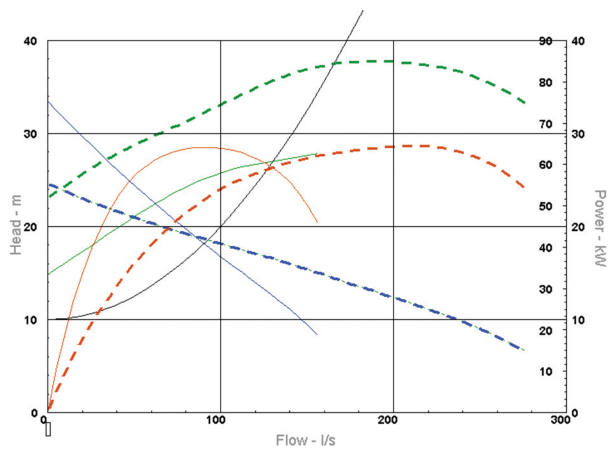

Figure 4

In Figure 4 the solid curves demonstrate a pump running at its optimum efficiency of 65% at the duty point of 90 l/s at 18m head.

The broken (dashed) curves demonstrate the pump with the larger impeller and slower motor is also capable of delivering 65% efficiency. This pump however, is at its optimum efficiency when delivering a flow of approximately 210 l/s against a head of 12m.

Summary

The previous comparisons of pump performance are not intended to show a preference for any particular type of pump, they are designed to demonstrate the large differences in performance achievable between different versions of the same pump. There are endless comparisons that can be made between the many pump manufacturers, their range of products and the combinations of pump types, motors and impellers. There are also other factors to take into consideration such as maintenance costs, quality and the ability to cope with the media being pumped.

Before these factors can be considered however, it is important to establish the two fundamental pieces of information.

1. The flow rate the pumps need to deliver
2. The heads (pressures) they must generate to achieve the desired flow rates

Flowcheck can supply you with this information.

For pumps to deliver the required flow rates, and operate at their best efficiency points, they have to be carefully matched to the hydraulic characteristics of the pipeline they deliver into.

Flowcheck specialise in performing surveys of pumping systems. We take on-site measurements to determine the pressures generated at varying flow rates.

Our surveys can establish the performance of individual pumps and combinations of pumps. We supply true pump curves and system curves which are produced from actual on site measurements.

The data we supply enables our clients to accurately specify the duty requirements of replacement pumps, identify any problems e.g. blockages, and ascertain if a rising main is capable of accommodating an increase in flow rate.

Contact us

To discuss your specific requirements contact Flowcheck Ltd

Tel: 0151 336 8328
Email: info@flowcheck.co.uk
Web: www.flowcheck.co.uk