Generally, the head produced decreases as the amount of water pumped increases. The shape of the curve varies with the pump's specific speed and impeller design. Usually, the highest head is produced at zero discharge and is called the shut-off head.

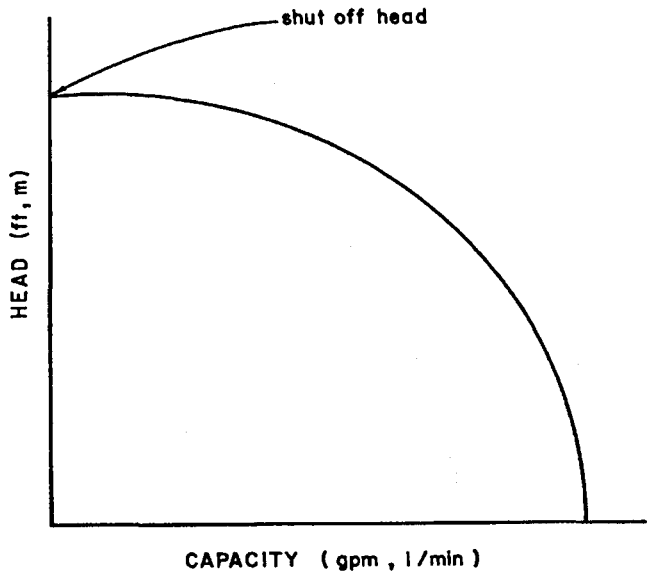

Figure 4. A typical head versus capacity characteristic curve of a centrifugal pump.

Efficiency versus pump capacity

Figure 5 shows the curve relating efficiency (E) to discharge (Q). The E-Q relationship can also be drawn as a series of envelope curves upon the H-Q curve (Figure 6). The efficiency of a pump steadily increases to a peak, and then declines as Q increases further. Efficiencies vary between types of pumps, manufacturers and models.

Efficiency is defined as the output work divided by the input work. The input work is usually expressed as the size of the engine required to drive the pump. It is commonly expressed in English units as the brake horsepower.

Brake power versus pump capacity

The shape of the brake power versus discharge curve is a function of the head versus discharge and efficiency versus discharge curves. The most common form of the BP-Q curve for centrifugal pumps is presented in Figure 7. In some cases the highest power demand is at the lowest discharge rate and continues to decline as the discharge increases. It is important to notice that even at zero discharge, when the pump is operating against the shut-off head, an energy input is needed.

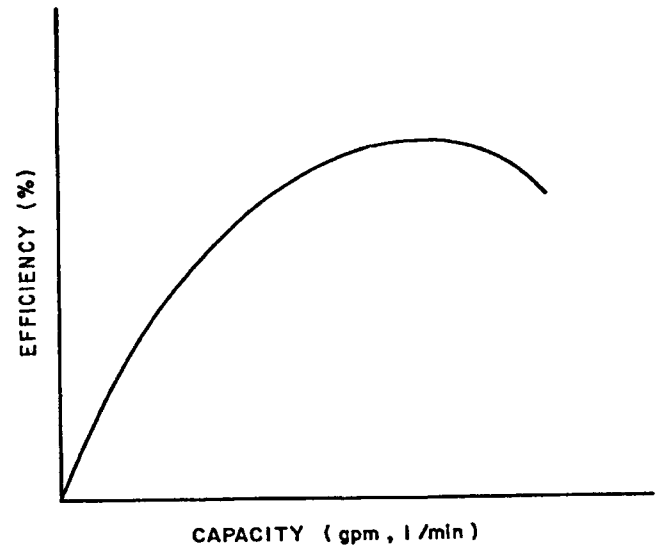

Figure 5. A typical efficiency versus capacity characteristic curve of a centrifugal pump.

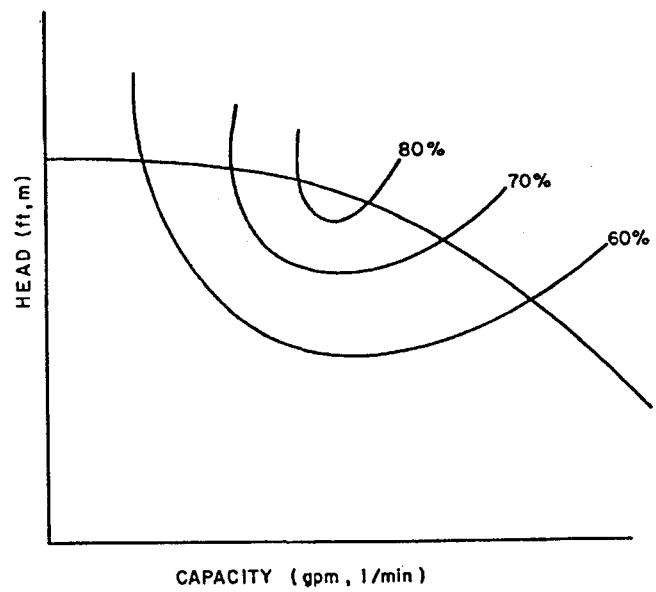

Figure 6. Efficiency expressed as a series of envelope curves upon the head versus discharge characteristic curve of a centrifugal pump.

It is recommended that the power requirement (brake power) be calculated using equation (1) because the vertical scale for most BP-Q curves cannot be read accurately.

Net positive suction head required versus pump capacity

One of the curves typically published by manufacturers is the net positive suction head required,