Pump cavitation is caused by the reduction in pressure behind the impellers to the point that the water vaporizes. It can be very damaging to the pump. Cavitation is described in IFAS Extension Circular 832 "Pumps for Florida Irrigation and Drainage Systems."

In every irrigation system there are some additional friction or minor losses due to various fittings and other components such as flow meters and intake strainers. Minor losses can be estimated using tables that relate each type of fitting to the certain equivalent length of the same diameter pipe.

Velocity head

Velocity head is the amount of energy required to provide kinetic energy to the water. For systems with a high total head this component is very small compared with other components of the total system head. Velocity head is calculated using the following equation:

$$H_v = V^2/2g \quad (5)$$

where:

H_v = velocity head ft (m)
V = water velocity in the system ft/sec (m/sec)
g = acceleration of gravity 32.2 ft/sec^2 (9.81 m/sec^2).

In most installations velocity head is less than one foot (.3m). An increase of water velocity in the system will not usually result in large increases in velocity head. However, velocities that are too high will increase friction losses as discussed above and also may result in water hammer which should be avoided. Water hammer is a sudden shock wave propagated through the system. To avoid it, the velocity is generally maintained below 5 ft/s.

System-head variations

The total system head can vary with time due to variations in well drawdown, friction, operating conditions, and static water level changes throughout the seasons. The friction losses increase with system age due to corrosion or deposits in the pipe and other components. The static lift component of the total dynamic head may vary due to fluctuating water levels throughout the season, or from year to year.

In some systems there is a periodic change in the operating head. It may not be possible to select a pump that is efficient under a wide range of system heads. In some cases an additional (booster) pump, in series with a main pump, may provide the additional head when necessary (see the section on pumps in series). This arrangement is frequently used in center pivot systems, where a small booster pump provides the additional operating head required for end gun operation at the corners of the field.

Characteristic curves for centrifugal pumps

A set of four curves known as the pump's characteristic curves is used to describe the operating properties of a centrifugal pump. These four curves relate head, efficiency, power, and net positive suction head required to pump capacity (Figure 3). Pump manufacturers normally publish a set of characteristic curves for each pump model they make. Data for these curves are developed by testing several pumps of a specific model. The operating properties of a pump depend on the geometry and dimensions of the pump's impeller and casing.

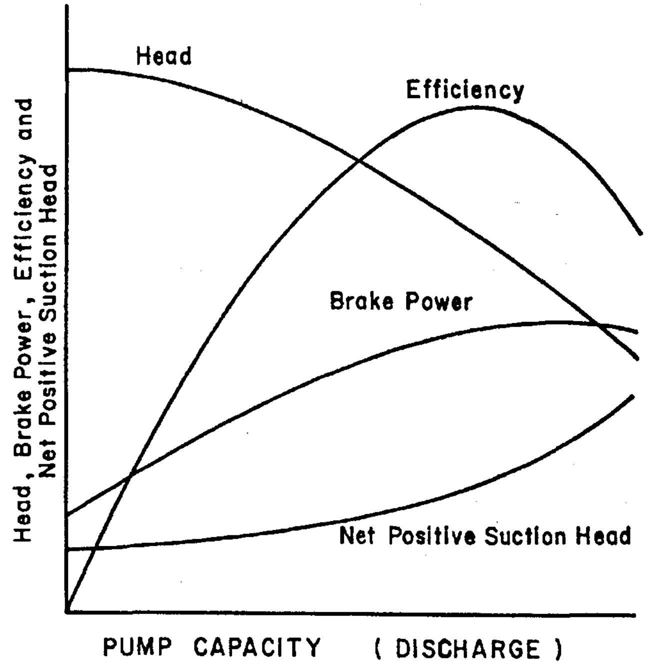

Figure 3. Characteristic curves for a single-stage centrifugal pump.

Head versus pump capacity

Figure 4 shows a typical head, H (ft), versus capacity (discharge), Q (gpm), curve for a single-stage pump. This curve relates head produced by a pump to the volume of water pumped per unit time.