HEAD OF PUMP – LOSSES AND EFFICIENCIES -SELECTION OF PUMP CAPACITY

Pumping of water requires energy

Energy is required to pump water from one level to another. Energy consumption is usually expressed as power (P), which is energy supplied per unit time. P is measured in joules per second; 1 J/s = 1 watt (W).

The following equation can be used to calculate the energy requirement for pumping:

$P = \rho g h Q$

where:

ρ = density of water (kg/m3)

g =acceleration due to gravity (m/s2) Q =water flow rate (m3/s)

h = height that the water is pumped.

Energy losses occur at several places in the pump. This results in efficiencies below unity (Fig. 2.12). Losses occur in the pump motor (m), trans-mission (t) and in the impeller (p), the sum of which gives the pump efficiency. Low pump efficiency results in the creation of heat, because energy cannot disappear; for example, when using sub-merged pumps this energy will be transferred to the water, which is heated. In water re-use systems this heating can be noticeable. The total efficiency of a pump η A, can be calculated as follows:

$\eta A = \eta p + \eta t + \eta m$

Efficiency may also be defined as hydraulic efficiency ηH (loss when the water flows through a pump), volumetric efficiency ηv (leakage of water between suction and pressure side of the pump, for example in centrifugal pumps) and mechanical efficiency η m (losses in the motor and transmission).

In fish farming the usual efficiency of well-suited pumps is around 0.7. Efficiency normally varies between 0.4 and 0.8.

Selection of Pumps

The following factors influence the choice of pump for a particular operation:

1. The quantity of liquid to be handled: This primarily affects the size of the pump and determines whether it is desirable to use a number of pumps in parallel.
2. The head against which the liquid is to be pumped. This will be determined by the difference in pressure, the vertical height of the downstream and upstream reservoirs and by the frictional losses which occur in the delivery line. The suitability of a centrifugal pump and the number of stages required will largely be determined by this factor.
3. The nature of the liquid to be pumped. For a given throughput, the viscosity largely determines the frictional losses and hence the power required. The corrosive nature will determine the material of construction both for the pump and the packing. With suspensions, the clearance in the pump must be large compared with the size of the particles.
4. The nature of power supply. If the pump is to be driven by an electric motor or internal combustion engine, a high-speed centrifugal or rotary pump will be preferred as it can be coupled directly to the motor.
5. If the pump is used only intermittently, corrosion troubles are more likely than with continuous working.

Applications

The handling of liquids which are particularly corrosive or contain abrasive solids in suspension, compressed air is used as the motive force instead of a mechanical pump.