

The Figure 6.24 is that of a typical radial flow impeller of a pump used to handle coarse solids or fibrous matters. These pumps use volutes because diffuser is prone to clogging. The design of sewage pumps is largely determined by the size of foreign matter that must pass through the pump without clogging.

6.10 Agricultural Pumping System

The pumps used in agriculture sector are normally installed by individual farmers based on the guidelines provided by agriculture department/state utilities and feedback from other users. Most of the pumps used are locally manufactured keeping initial investment as the selection criteria rather than efficiency and energy conservation.

The pump sets used are generally inefficient with operating efficiency ranging from 30 - 55%. The wide variation is due to changing water levels in the intake thus forcing the pump to operate away from the best efficiency point. The pump sets are more often oversized so as to draw water from increasingly declining depths and also to withstand large voltage fluctuations.

Mostly centrifugal pumps are used and the capacity of the pumps vary from 1 Hp to 25 HP. The rating of the pumps is decided based on water table levels. High rating pumps above 25 HP are also used in several areas. Large capacity centrifugal pumps of 75 HP to 500 HP ratings are also used by Irrigation departments to provide water to agricultural consumers. Diesel engine driven pumps are also common in areas where there is erratic or no power supply.

The following energy conservation opportunities have been demonstrated for energy savings in agricultural pumping.

- Installation of low friction foot valves
- Installation of low friction HDPE suction and delivery pipes
- Installation of long bends
- Installation of high efficiency pumps and motors

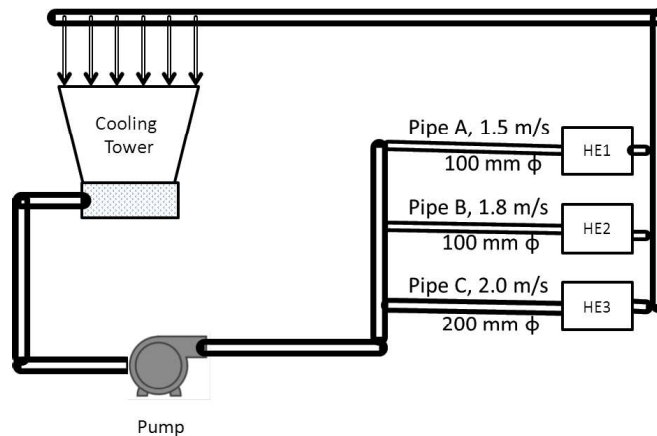
6.11 Energy Conservation Opportunities in Pumping Systems

- Ensure adequate NPSH at site of installation.
- Ensure availability of basic instruments at pumps like pressure gauges, flow meters.
- Operate pumps near Best Efficiency Point.
- Modify pumping system and pumps losses to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of multiple units.
- Stop running multiple pumps - add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase liquid temperature differentials to reduce pumping rates in case of heat exchangers.
- Decrease outlet cold water temperature of cooling tower in order to reduce the pumping flow rates in case of mixing.

- Separate High Pressure and Low Pressure systems
- Repair seals and packing to minimize water loss by dripping.
- Balance the system to minimize flows and reduce pump power requirements.
- Avoid pumping head with a free-fall return (gravity); Use siphon effect to advantage:
- Conduct water balance to minimize water consumption.
- Avoid cooling water re-circulation in DG sets, air compressors, refrigeration systems, cooling towers feed water pumps, condenser pumps and process pumps.
- In multiple pump operations, carefully combine the operation of pumps to avoid throttling.
- Provide booster pump for few areas of higher head.
- Replace old pumps by energy efficient pumps.
- In the case of over designed pump, provide variable speed drive, or downsize / replace impeller or replace with correct sized pump for efficient operation.
- Optimize number of stages in multi-stage pump in case of head margins.
- Reduce system resistance by pressure drop assessment and pipe size optimization.

Solved Example:

The cooling water circuit of a process industry is depicted in the figure below. Cooling water is pumped to three heat exchangers via pipes A, B and C where flow is throttled depending upon the requirement. The diameter of pipes and measured velocities with non-contact ultrasonic flow meter in each pipe are indicated in the figure.



The following are the other data:

Measured motor power	:	50.7 kW
Motor efficiency at operating load	:	90%
Pump discharge pressure	:	3.4 kg/cm ²
Suction head	:	2 meters

Determine the efficiency of the pump.