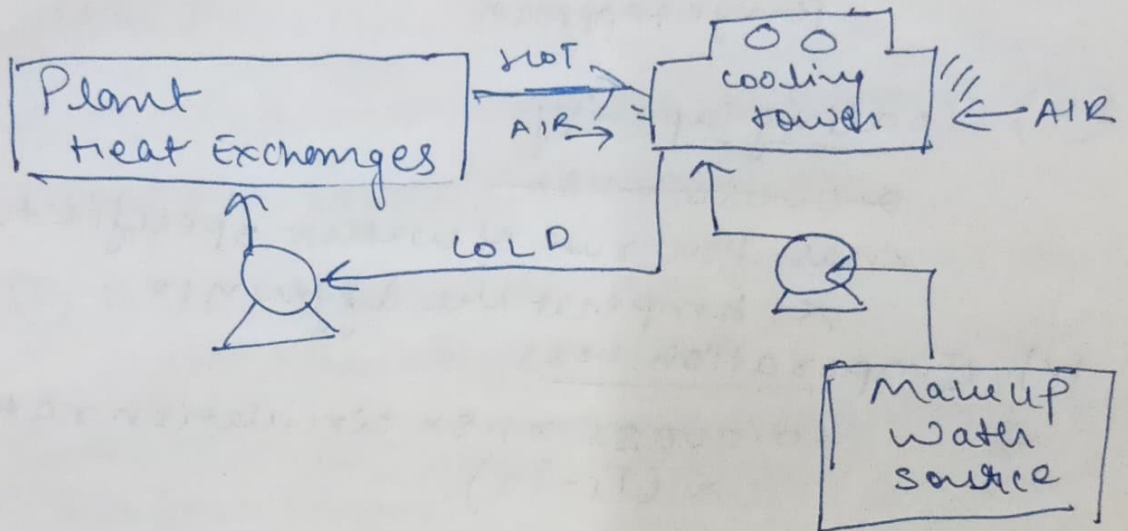


FEAR THE PLAYERS

Cooling Tower



- => Primary Task of a CT is to reject heat into the atmosphere.
- => Represents a relatively inexpensive and dependable means of removing low-grade heat from cooling water.
- => make-up water source is used to replenish water lost to evaporation

Performance Parameters

Range: Difference b/w cooling water inlet and outlet temperature

Approach: Difference b/w the cooling tower outlet cold water temperature and ambient wet bulb temperature

(iii) cooling Tower Effectiveness

$$= \frac{\text{Range}}{\text{Range} + \text{Approach}} \times 100$$

(v) Cooling Capacity

~~$0.00085 \times 1.8 \times$~~

mass flow rate of water \times specific heat
 \times temperature difference

(v) Evaporation Loss

$$= 0.00085 \times 1.8 \times \text{circulation rate} \times (T_1 - T_2)$$

(vi) Cycles of concentration

$$= \text{ratio of } \frac{\text{dissolved solids in circulating water}}{\text{dissolved solids in make up water}}$$

~~(vii)~~ Blow Down = $\frac{\text{Evaporation Loss}}{\text{COC} - 1}$

(viii) Liquid - gas ratio $\frac{\text{enthalpy at exhaust}}{\text{enthalpy at inlet}}$

$$L (T_1 - T_2) = G (h_2 - h_1)$$

$\downarrow \qquad \downarrow \qquad \qquad \downarrow$
hot water cold water enthalpy at inlet

Energy Saving Opportunities (~~10~~⁵ subse chati)

- ① Replace splash bars with self-extinguishing PVC cellular film fill.
- ② Install new nozzles to obtain a more uniform water pattern.
- ③ Balance flow to cooling tower hot water basins
- ④ Restrict flows through large loads to design values
- ⑤ Optimize cooling tower fan blade angle on a seasonal and/or load basis.

Pumps

working

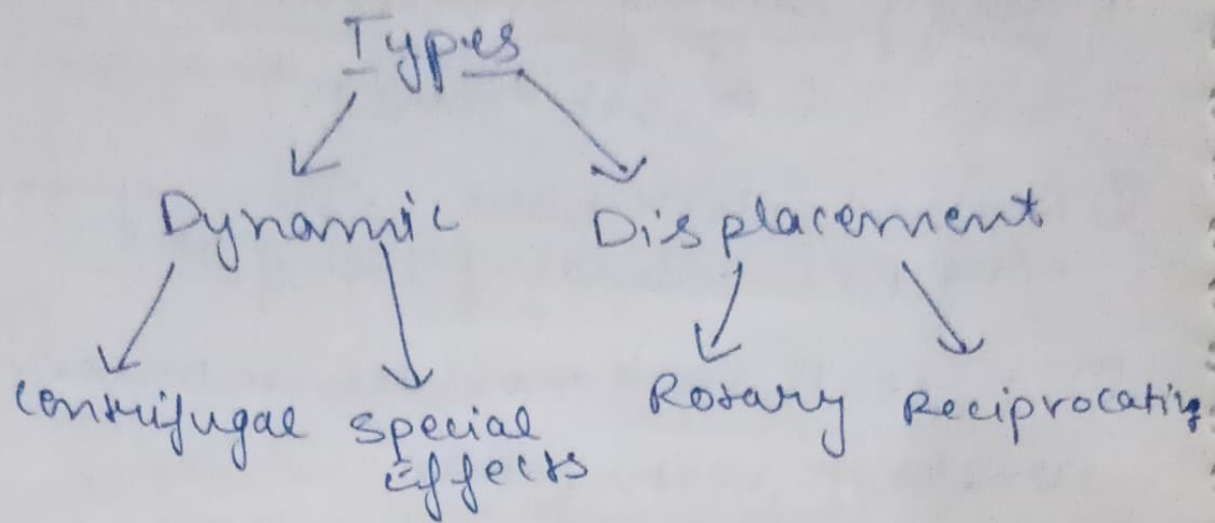
=> Mechanical device used to pick water from low pressure level to high pressure level. Basically the pump changes the energy flow from mechanical to the fluid.

(centrifugal)

=> most used

=> Has impeller and Propeller

=> Diffuser/volute houses the impeller and directs the water off the ~~pro~~ impeller



Flow Control Strategies

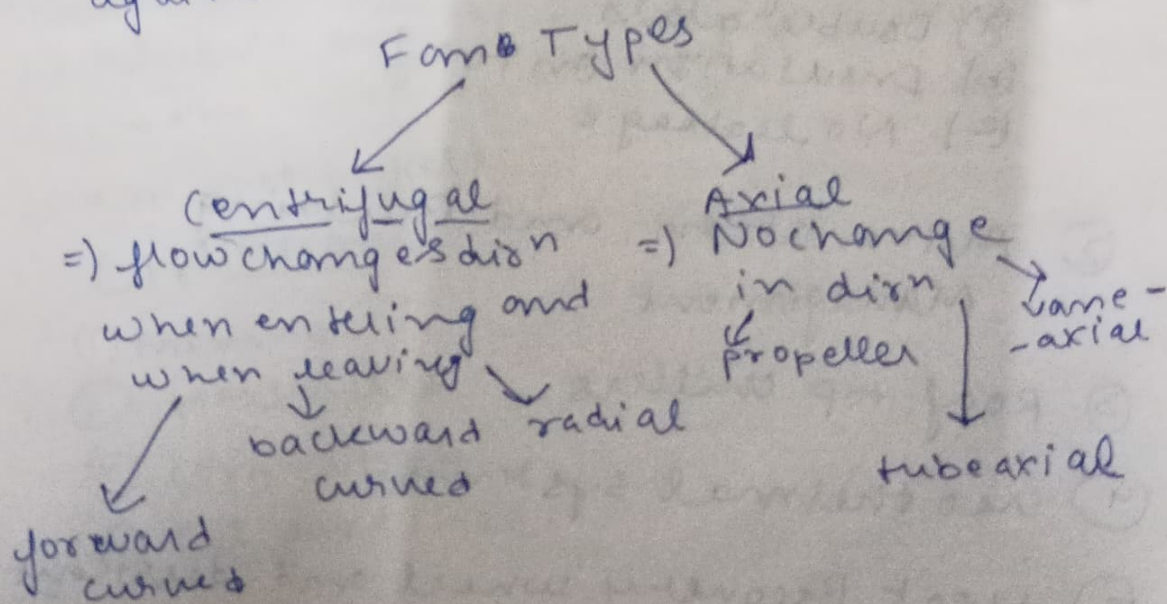
- ① Pump control by varying speeds
⇒ speed variation changes the duty point
- ② Pumps in parallel switched to meet demands
⇒ for systems where static head is a high proportion of the total
- ③ Stop/start control
⇒ causes additional load on the power transmission components and increased heating
- ④ Flow control valve
⇒ Pump runs continuously and a valve in the discharge line is opened or closed to adjust the flow.
- ⑤ By-Pass control
⇒ when a lower flow is required, the surplus liquid is by passed and returned to the source.

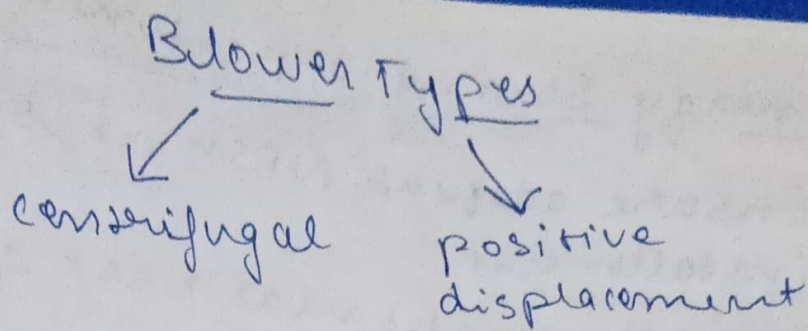
Energy Saving Opportunities

- ① Ensure adequate NPSH at site of installation.
- ② Operate pumps near best efficiency point
- ③ Modify pumping system to minimize throttling.
- ④ Use booster pumps for small loads requiring higher pressures.
- ⑤ Repair seals and packing to minimize water loss by dripping

Fans and Blowers

- =) Provide air for ventilation and industrial process requirement.
- =) Generate a pressure to move air against a resistance.





Energy Saving Opportunities

- ① Change of impeller by a high efficiency impeller along with lone
- ② Impeller de-rating
- ③ Change of fan assembly
- ④ Fan speed reduction by pulley
- ⑤ Adopting inlet guide vanes in place of discharge damper control

HVAC

Heating, Ventilation and Air Conditioning
Energy Saving Opportunities

- ① Building Orientation
 - (a) Double glass
 - (b) Insulation on roof
 - (c) No leakage
- ② Automation and Building Management
- ③ Roof top chillers
- ④ Geothermal systems
- ⑤ Heat Recovery wheel and desiccant cooling systems for fresh air.

Energy Efficiency in Building

- ① Use of energy efficient and Eco-friendly Equipment
- ② Use of renewable energy
- ③ Use of Non-Toxic and Recycled materials
- ④ Effective use of landscapes
- ⑤ ~~Ad~~ Efficient use of water.

Diesel Generator

- => Convert some of the chemical energy to mechanical energy through combustion.
- => This mechanical energy then rotates a crank to produce electricity.
- => Electric ~~energy~~ charges are induced in the wire by moving it through a magnetic field.

Applications

- ① Mining
- ② Healthcare
- ③ Commercial
- ④ Oil and Gas.

Advantages

- ① Low installation cost
- ② High efficiency
- ③ Minimum cooling water required
- ④ Short startup time.

Energy Saving Opportunities

- ① Ensure steady load conditions
- ② Provide cold, dust free air to intake
- ③ Consider fuel additives
- ④ Calibrate fuel injection pump frequently
- ⑤ Consider parallel operation among Dh sets.

Air conditioner and Refrigeration

A/c: Process of removing heat and ~~most~~ moisture from the interior of an occupied space to improve comfort of occupants

Refrigeration

Process of maintaining lower temp. compared to surroundings / process of removing heat from a low temp reservoir.

Refrigeration

Vapour compression system

- =) Refrigerant vapor is compressed
- =) works on mechanical energy

Vapour Absorption system

- =) Refrigerant vapor is absorbed and heated
- =) works on heat energy

Energy saving opportunities (in refrigeration)

① Use water-cooled condensers rather than air-cooled.

② Avoid oversizing

③ ~~to~~ consider gas powered refrigeration

④ Use refrigerated water load in series if possible

⑤ Inspect moisture / liquid indications.