ENERGY CONSERVATION IN CHLOR-ALKALI & CHEMICALS INDUSTRY THROUGH INSTRUMENTATION

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P.N.Parikh-Introduction

- Certified Energy Auditor -2006
- UPL- Consultant, Technical Services-Instrumentation +EC
- Instrumentation Chief at GACL- 24 Years

  Gujarat Alkalies and Chemicals Limited
- Chief Engineer : Chlor-Alkali plant at Saudi-Arabia
- Asst. Professor Instrumentation) at LDCE, A' bad
- Engineering Qualifications: BE (electrical)

  DME (mechanical)

  DERE (electronics)

Total experience:33 yrs.industrial+ 5 yrs.Acadamic

Types of Energy in Chlor-Alkali & Chemical Industry

- **Electrical :** Grid Power or
  Co-gen. Captive Power

- **Thermal:** Steam Generators
  Heat Recovery Units

- **Renewable:** Wind/Solar/Hydro

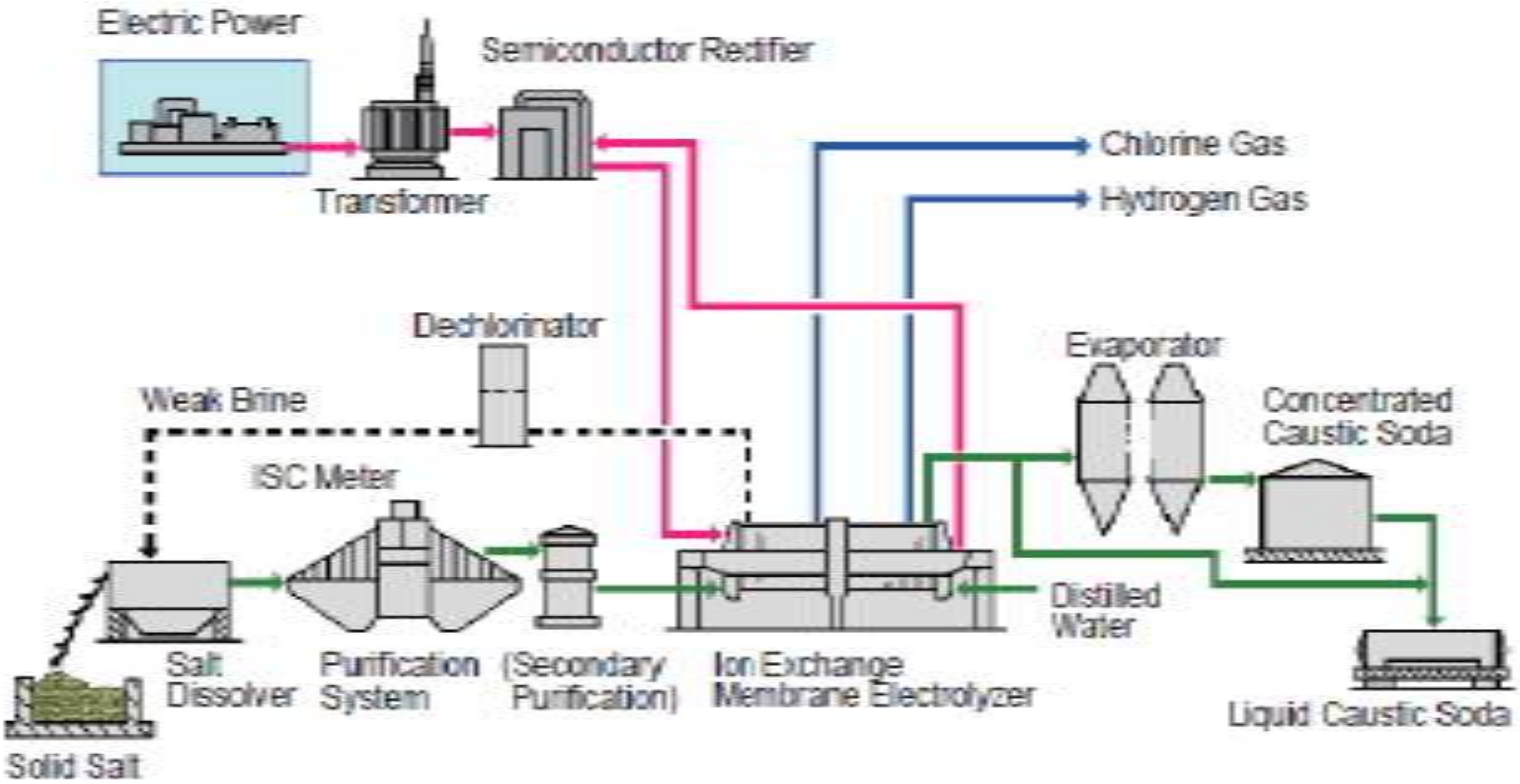
Five areas of High Saving Potential in Chlor-Alkali plant and Chemical plants

- Electrolysers :Membrane or Mercury Cells
- Compressors: Chlorine, Air, Refrigeration
- Pumps: Cooling water; Brine to cells,
  Anolyte, Catholyte
- Rectiformers /Boilers : New EE Equipments
- Motors :EE & VFD deployment

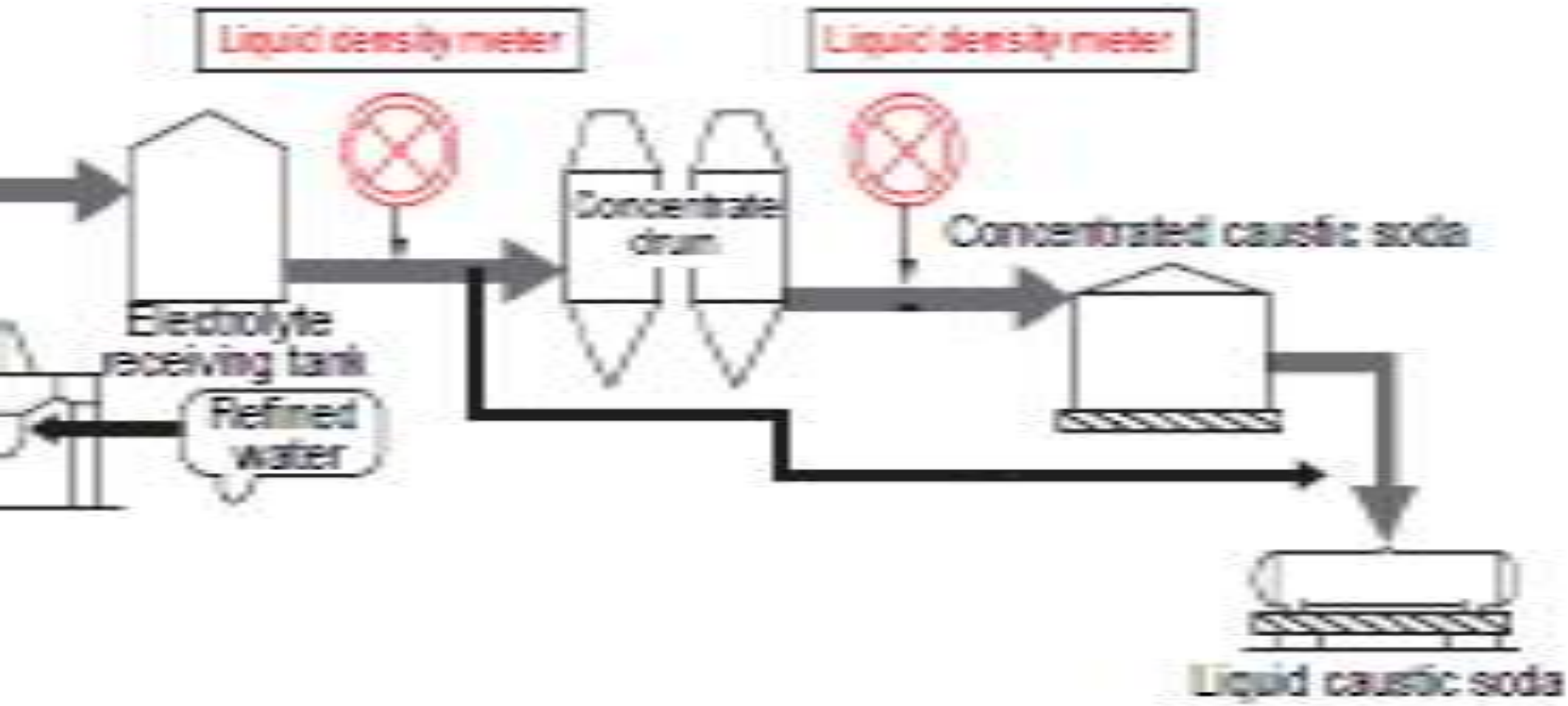
Thermal:

- Caustic Evaporation / Concentration units.
- Heat Exchangers, Cooling Towers

Schematic of Chlor-Alkali plant



Accurate Density Measurement of Caustic-lye : Essential for True SEC



* EE SCOPE : Energy is Money Save it (*Energy Efficiency)

- How ? (Through Instrumentation)

  Energy Measurement is applied science
  of Instrumentation-especially for Pressure,
  Temperature ,Flow and Electrical Power.

- Assess : Measure what you want to Manage
- Measure the losses:

Pressure: Flow

Pumping System, Compressor Systems, &
Steam Transmission, Distribution and Radiation losses)

Temperature: (Heat Exchangers, Cooling Towers)

Electrical :Transmission, Distribution, Transformers, Motors

Mechanical: Frictional, Drives-Belt / Chain, Valves /Control Valves pressure drops , Over size designs

Energy Efficient Operation

Introduction and Application of

DCS – Distributed Control System for a large Chemical complex(Ch-Alk.,CCP,Chem.)

PLC- Programmable Logic Control for a small or medium scale industry.

On line power /current monitoring of large motors- Daily/Weekly/Monthly Reports

- Specific Power Consumption-online for each Product ,large pumps/compressors/Utility systems.

Measure(Accurately) to Manage

- Density of Reactor Chemicals/ Finished Chemicals (Nucleonic/ Vibrating fork/Conductivity)
- Quantity of Chemicals to Reactors (Mass flow meter / Vortex meter)
- Quantity of water (Magnetic flow meter)
- Quantity of Steam (Vortex flow meter)
- Quantity of Air(Vortex flow meter)
- Quantity of Hydrogen (Mass flow meters)
- Quantity of AC Power in major Motors/Reactors
- Quantity Liquid Chemicals (Magnetic flow meters)
- **Temperature Measurements by Infra-red non-contact Temp.Gun**
- **Electric Power by Power -Analyzer**

General Instrumentation Philosophy/ Tips for Chlor-Chemical Industry:

- No relay based panels in the new plants/package suppliers.

  GACL has followed this since 1991. Use PLC –only for better reliability and less maintenance cost
- Opt for 24 Volts operating voltage for PLC/DCS – all suppliers offer this option

  It reduces need of UPS /Size of UPS.
- Specify Control Valve Operating pressure as 4 bar (not 5 bar) air pressure as maximum. This will help to keep Instrument air pressure low to save energy.

Suggested Measures

- DCS deployment for substation / MCC power /status monitoring
- DCS to be configured for Energy –Overview page with dynamic data & alarms functions
- Deploy magnetic flow meters, vortex flow meters, mass flow meters for accurate & reliable quantity measurements
- Be ready to deploy RFID technology for monitoring with active /passive devices with in complex may save transportation cost for hazardous chemicals.

No –more orifice meters, Turbine meters. Use current transmitters, kWh transmitters

- Use Magnetic flow meters, Vortex flow meters, Mass flow meters instead of orifice flow meters / Turbine meters for better accuracy , no /low maintenance .
- Monitor current of large motors, 90 kW & all agitator motors on DCS using alarm & trend features
- Digital signal transmission through power cable is a well proven option used in energy metering systems by utility companies.
- Gas supply company also uses wire less data transmission for supply of Natural Gas with PV Solar panel at remote locations

Cooling Towers

- **VFD application potential may be checked for throttled operation of manual valves/ control valves in brine pumps.**
- **Determine which of the pumps Operating or Stand by is better energy efficient by measuring /monitoring current**
- **This applies for cooling water pumps on cooling towers also.**
- **Vortex meter okay on DM water with tantalizer in DCS.**
- **Cooling Towers- most neglected important utility system which has great potential to save energy by regular maintenance & daily/weekly monitoring for effectiveness %, power consumption, flow, pump-efficiency, uniform water distribution,TDS etc**

Energy Efficiency in Reactors

- **Agitator motor current monitoring:**
  VFD deployment –feasibility.
- **Accurate mass transfer for reaction by mass flow meters or vortex/magnetic flow meters.**
- **Recovery of heat in case of Exothermic Reaction**
- **Batch –Automation to control the reaction within a narrow range ,saving energy consumed.**

DCS/PLC/ Field-Instrumentation Selection : Key to success for energy conservation also.

- GACL has seven different DCS selected to suite the application of the best available foe the field. Power Plant , H_2O_2 plant, Phosphoric Acid Plant, Caustic plant- each has different needs.
- SS diaphragm transmitters with FEP pad saves 60 % of cost compared to tantalum / titanium diaphragm transmitters.
- PLC based interlock panels in stead of relay based interlock panels.
- Low pressure operating control valves.
- Magnetic ,Vortex meters with tantalizer in PLC/DCS
- Mass-flow meters-Corialis effect

DCS to compute for mass for cases density is maintained

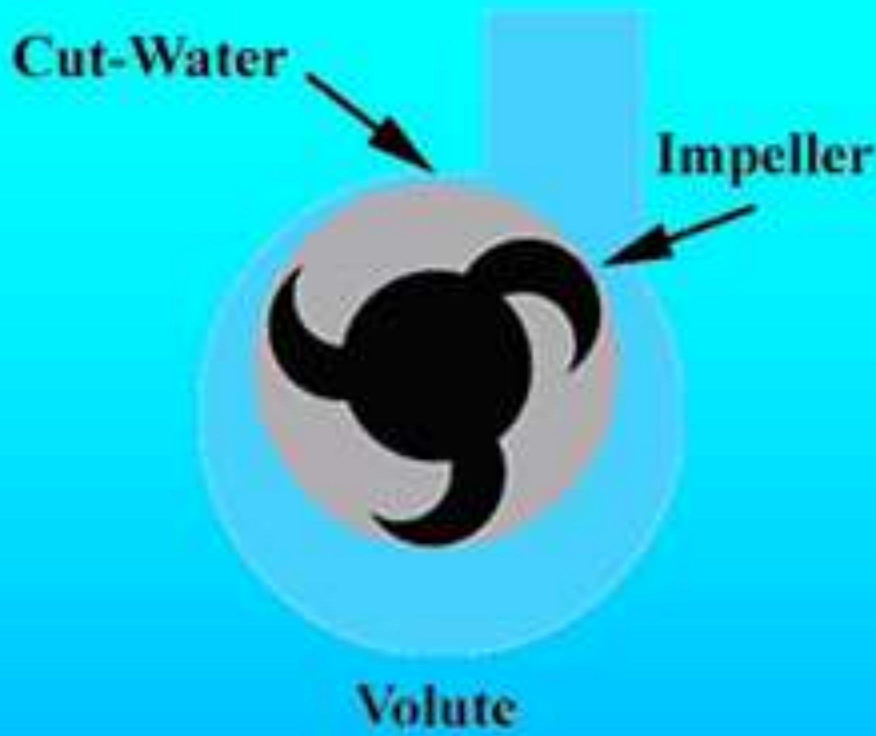
- Caustic Dispatches measured by magnetic flow meters at low but reliable way can compute in MT as known density (QCD- certified) is being dispatched.
- Flow reading can be totalized by a programme in DCS
- DCS data can be hooked up to commercial computer on LAN through RS 232 port/ Printer port

EE in Steam Generation, Distribution

- **Meter and record the Natural Gas /Oil/Fuel to Boilers.**
- **Leakage prevention by better maintenance practice.**
- **Steam Trap : Yearly Audit, Daily monitoring, Bi-Weekly Checking**
- **Insulation Checks-Yearly audit, Monthly checking**
- **Calculate Boiler Efficiency on weekly basis.**

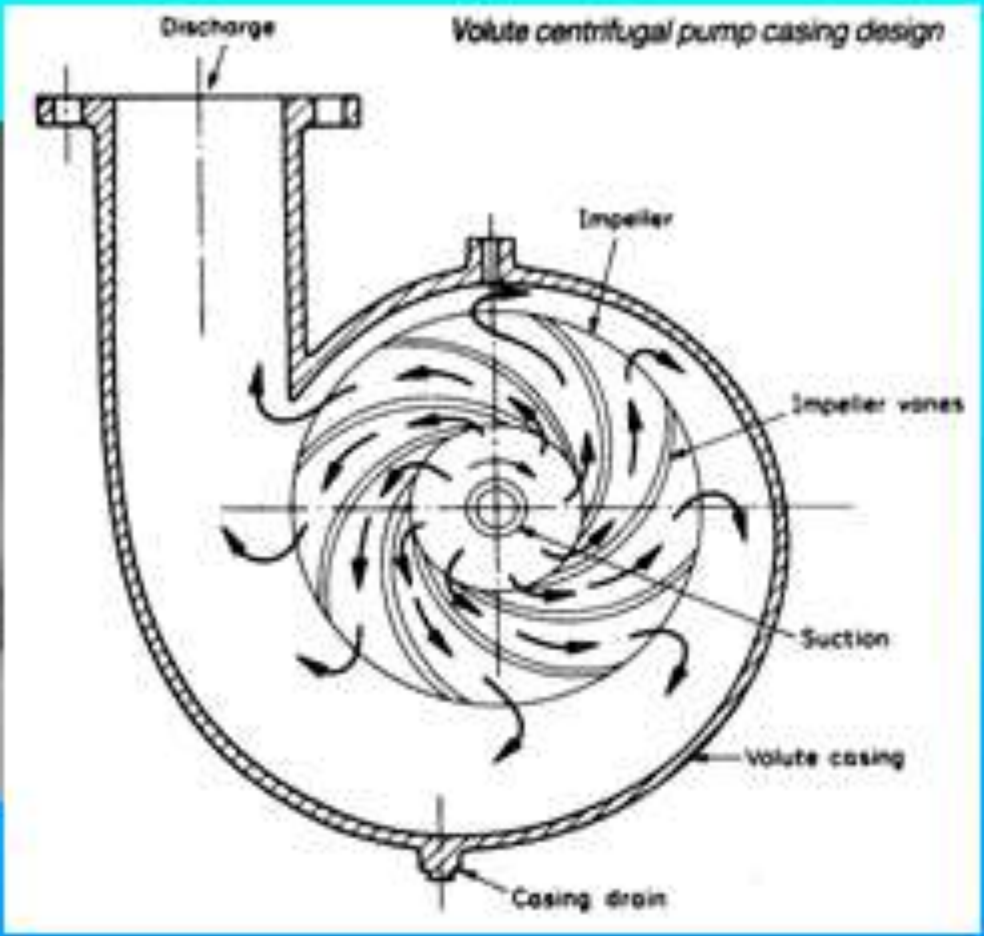
Use Vortex Flow meters with temperature compensation for calculating evaporation ratio and other key efficiency indicators.

- **Steam Distribution : Online Monitoring on PC system**



Pumping system

Centrifugal Pumps



Centrifugal pump parameters

* Pressure (Head)
-Direct relationship with impeller diameter
No. of impellers
size of impeller eye
shaft speed

* Capacity (flow)
- Determined by exit width of the impeller

* Power
- Depends on head and flow

Power Requirement & Efficiency

Hydraulic Power (P_h) : $$\frac{\text{Flow } (m^3/s) \times \text{total head } (m) \times \rho\,(kg/m^3) \times g\,(m^2/s)}{1000}$$

where, total head: hd – hs

(hd - discharge head)

(hs – suction head)

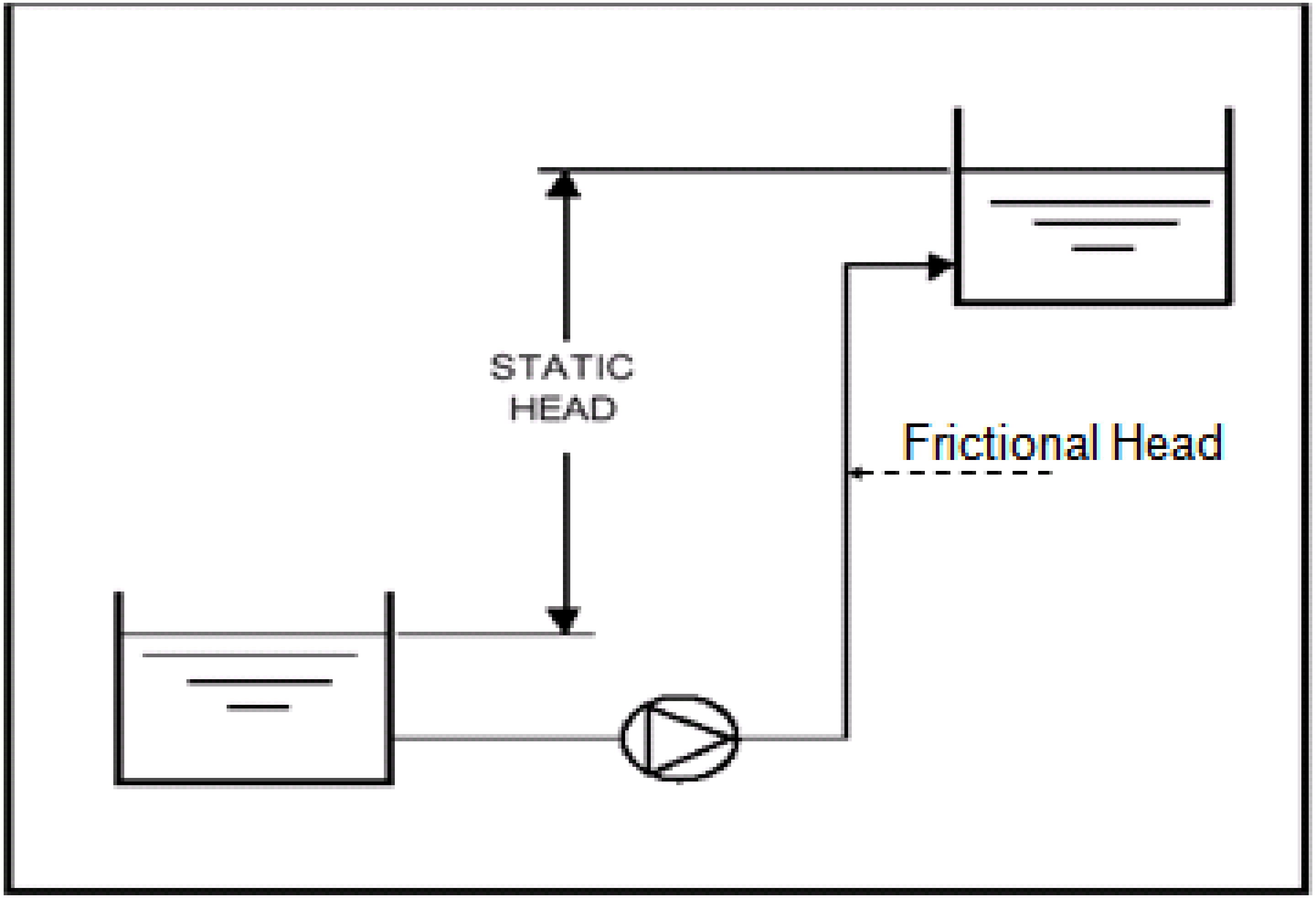
ρ - density of the fluid

g – acceleration due to gravity

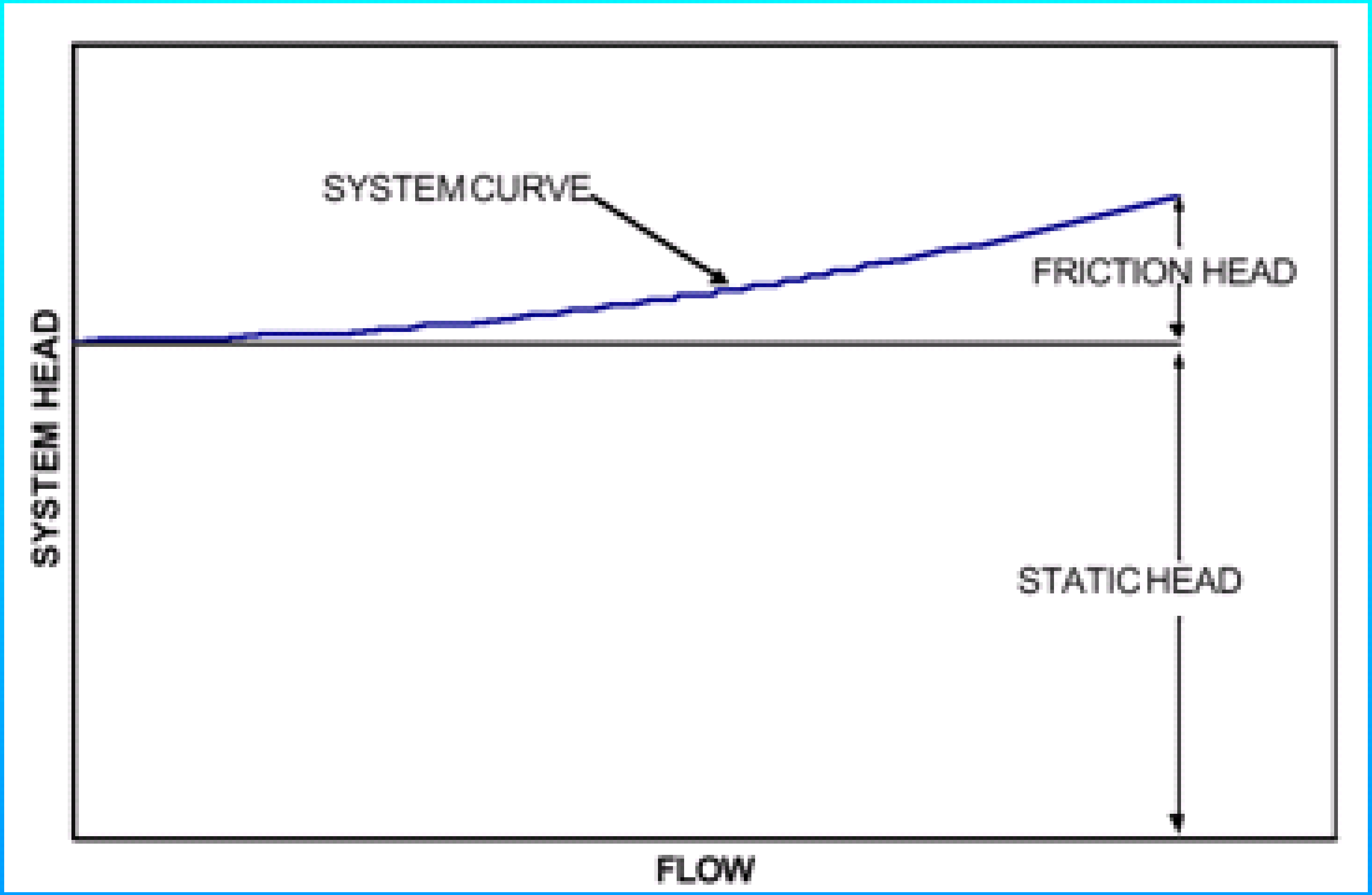
Pump shaft power (P_s): $$\frac{\text{Hydraulic power}, P_h}{\text{Pump efficiency}, \eta_{pump}}$$

Electrical input power (P_e): $$\frac{\text{Pump shaft power}, P_s}{\text{Motor efficiency}, \eta_{motor}}$$

Operation of Pump



System Characteristics



System with high static head

Calculation of Pump Efficiency

Flow (Q)	:	110 m^3/h
Head (H)	:	50 m
Power (P)	:	15 kW (shaft power)
Application	:	Thermic fluid circulation
Operating temp	:	250°C
Density	:	730 kg/m^3 @ 250°C

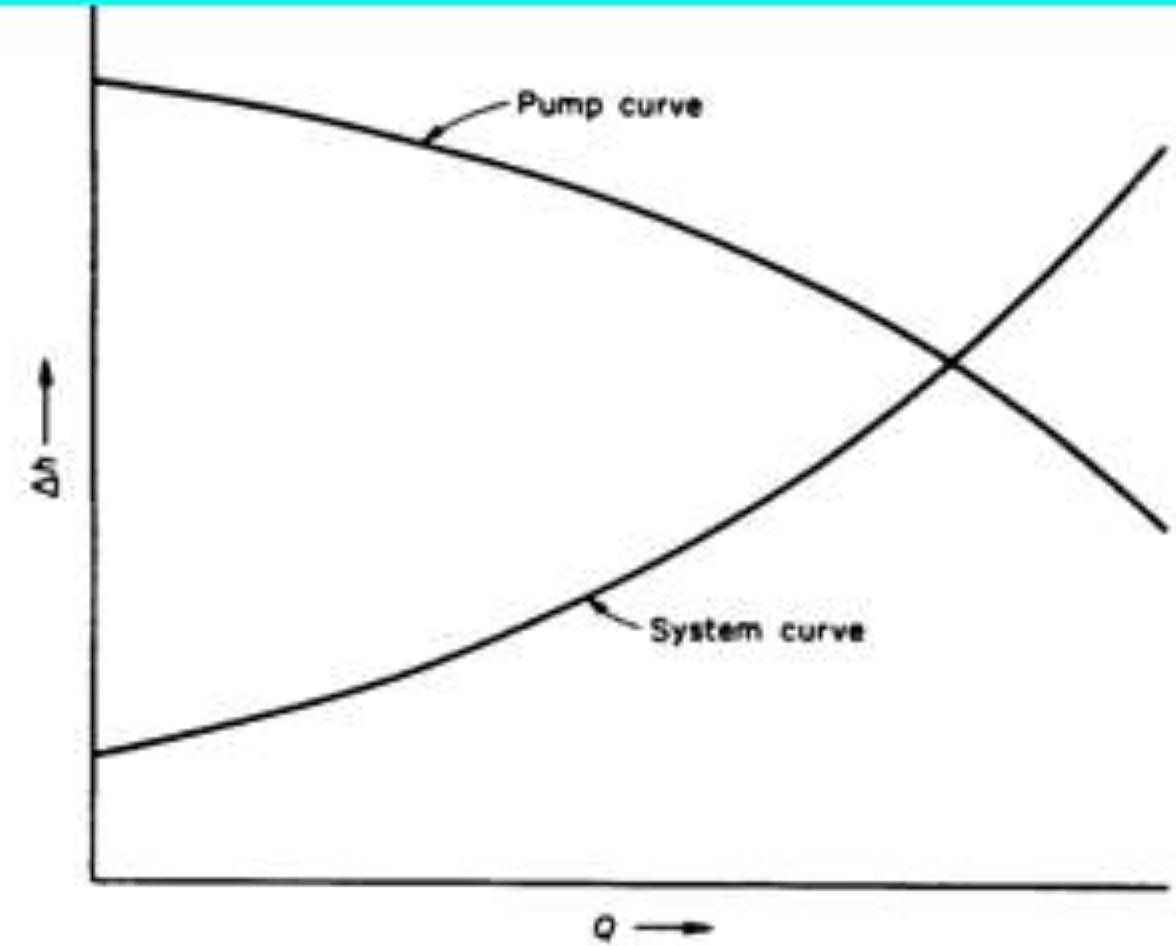
$$P_h = \frac{Q \times H \times \rho \times g}{1000}$$

$$P_h = \frac{(110/3600) \times 50 \times 730 \times 9.81}{1000} = 10.94\ KW$$

$$\eta_{Pump} = \frac{\text{Pump hydraulic power}}{\text{Pump shaft power}}$$

$$= \frac{10.94}{15} \times 100 \quad = \ 72.9\%$$

Operating point defined

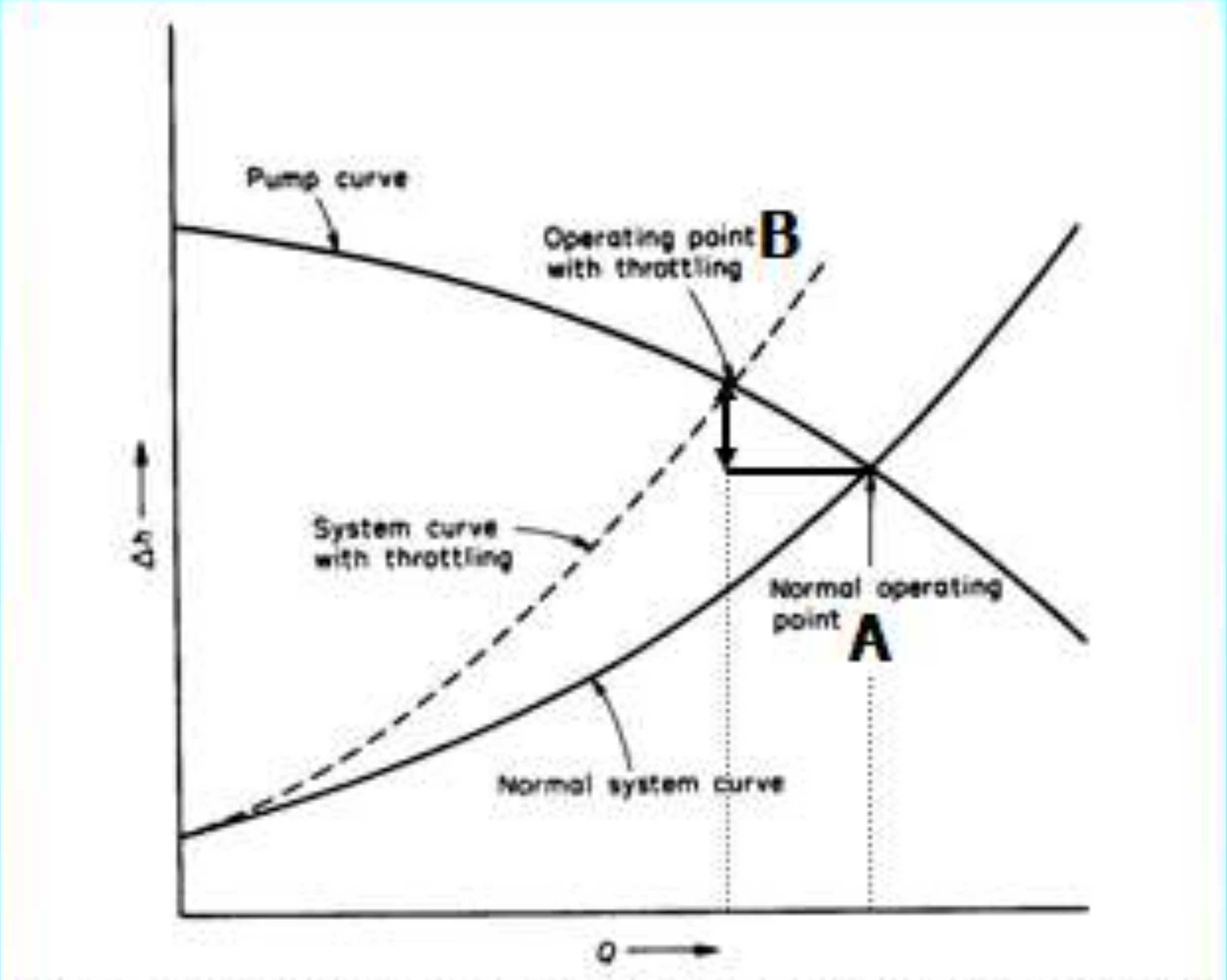


System and pump total head against capacity curves. The intersection of the two curves defines the operating point

Unsafe safety allowance

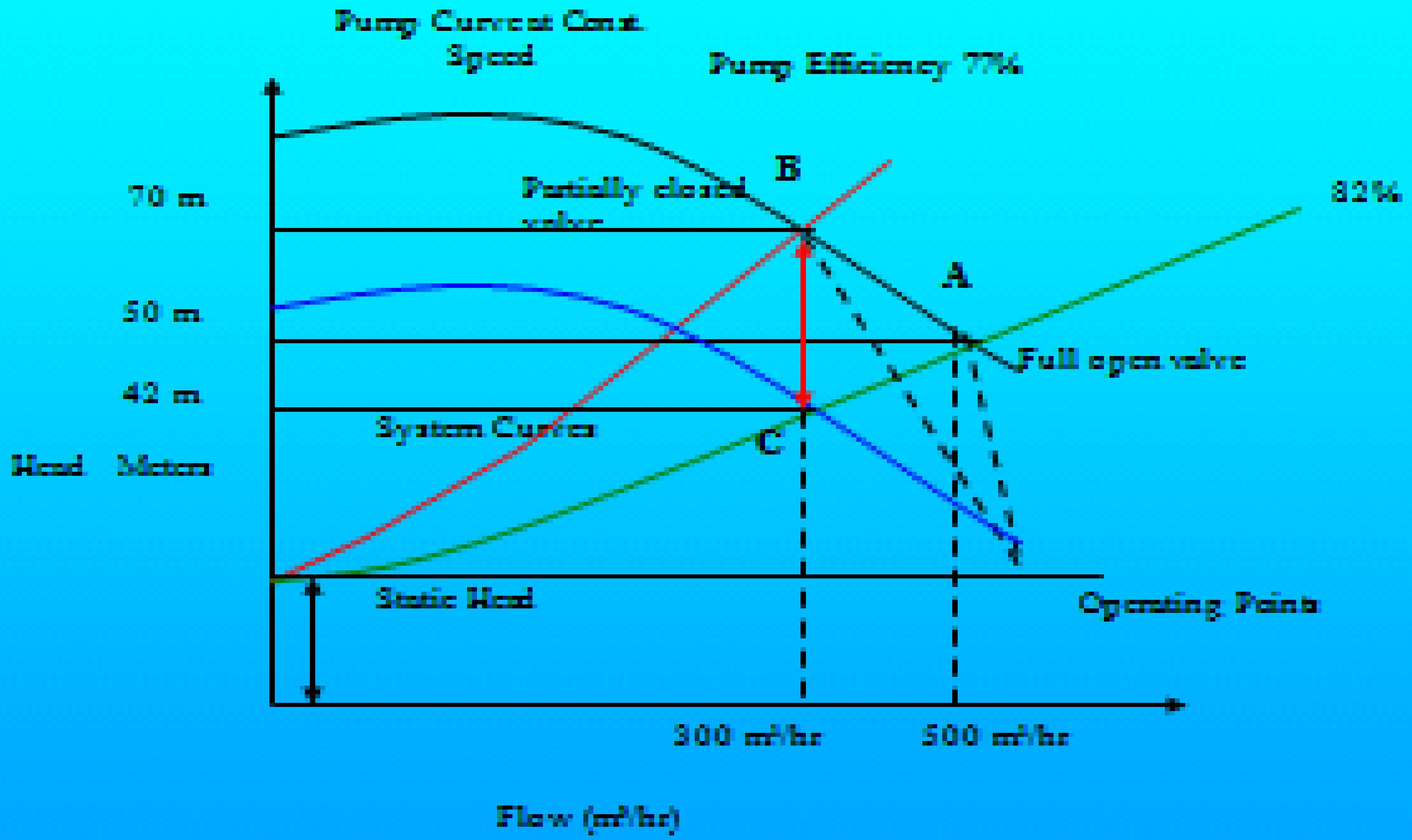
- System heads should be estimated as accurately as possible
- Do not add a "margin for safety" to the system head
- In trying to match the *over specified* head, a larger pump will be recommended by the supplier
- The larger pump will operate at a higher capacity point (as required by the *actual* system head)
- This can overload the pump motor and require greater throttling

Operation with throttling



Effect of throttling the discharge valve on the operating point of a centrifugal pump

Effect on system curve with throttl



Example for throttling operation

Parameters	Unit	Part A	Part B	Part C
Flow	m^3/hr	500	300	300
Head	M	50	70	42
Power	kW	83	74	45
Efficiency	%	82	77	77
Remarks		Existing pump	Throttling operation	New small pump trimmed impeller VSD in use

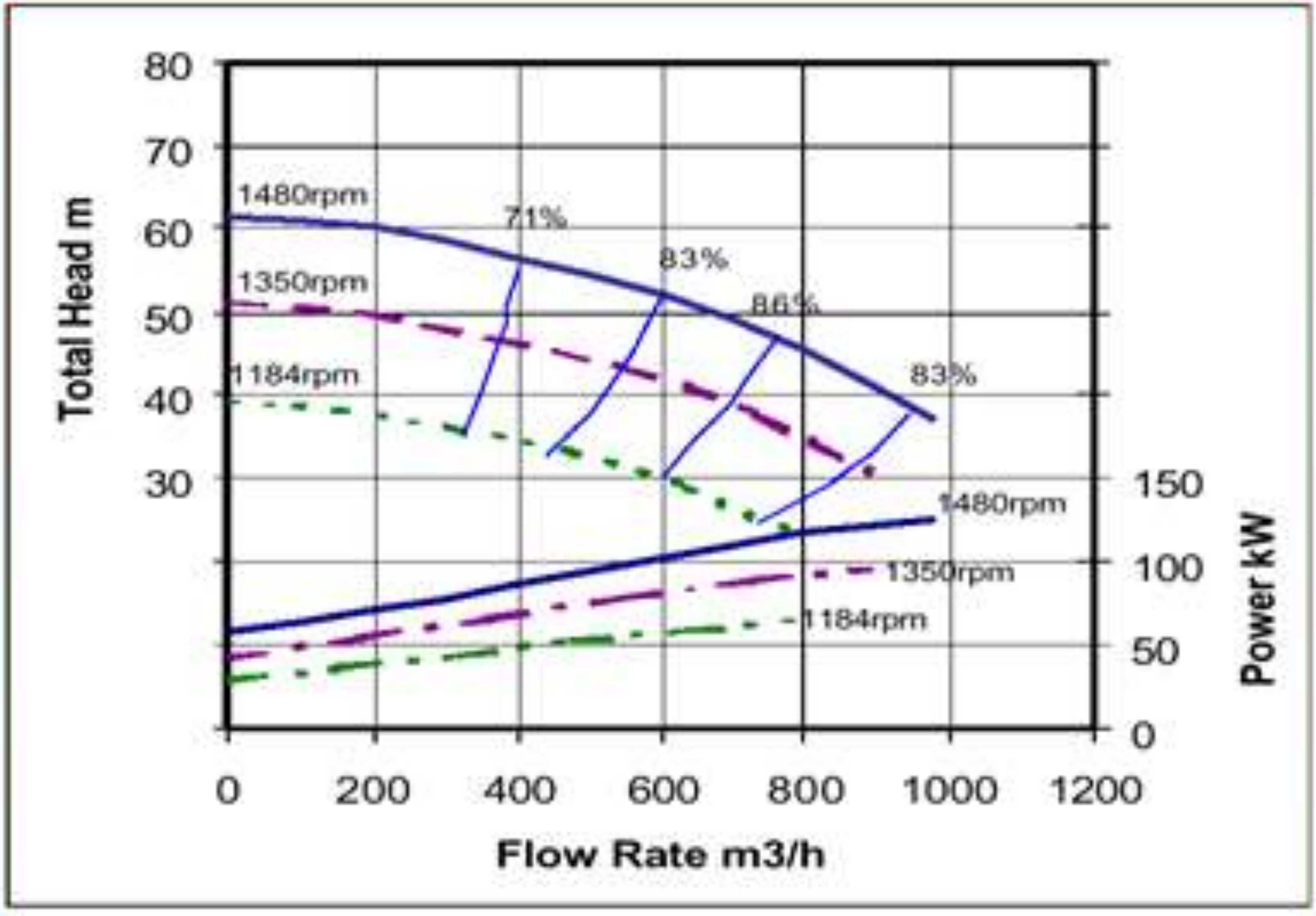
AFFINITY LAWS

A. EFFECT OF CHANGE IN SPEED :

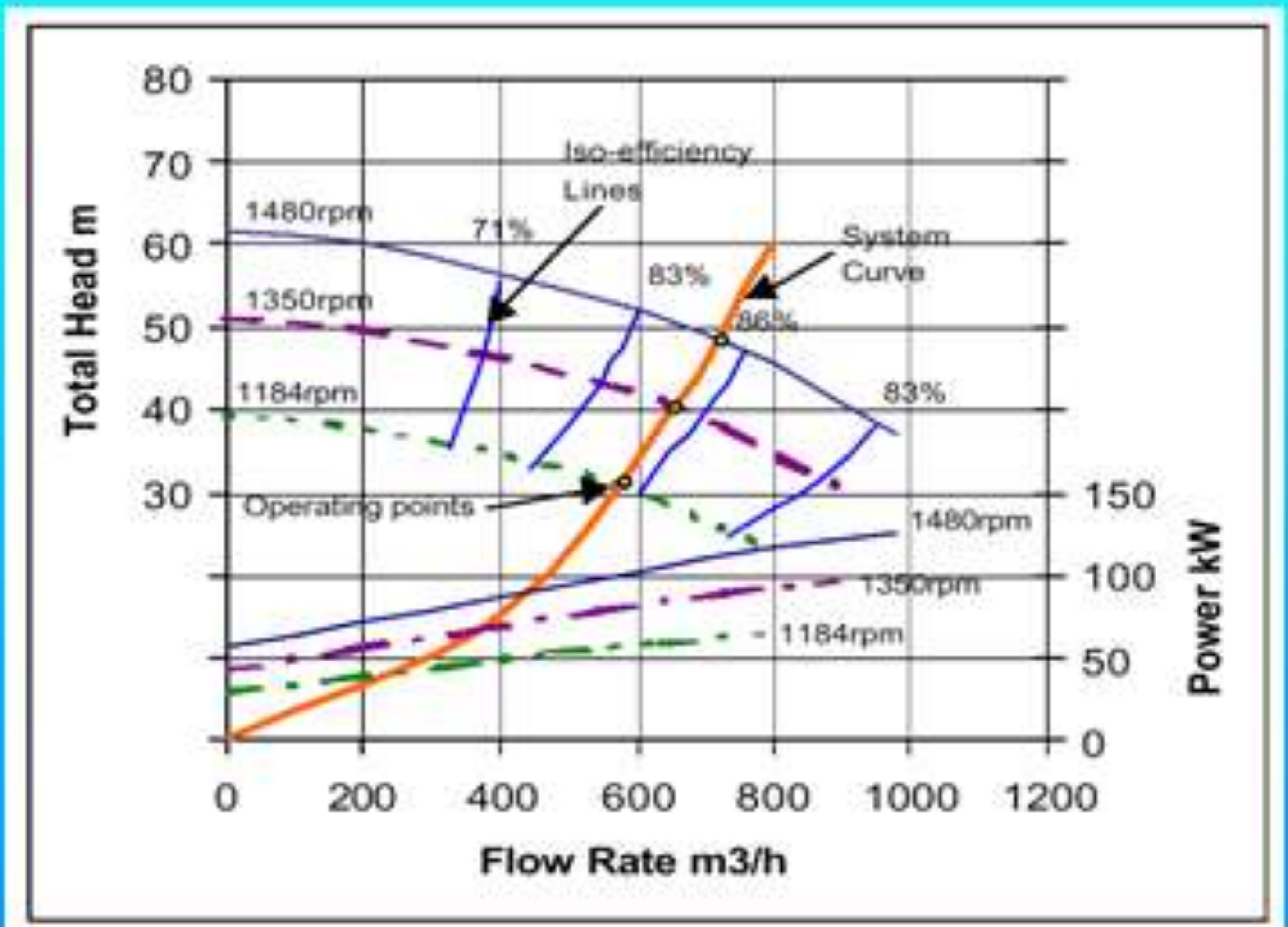
For a constant impeller diameter,

- Flow varies directly as speed
- Pump Head varies as the square of speed
- Input power varies as the cube of speed

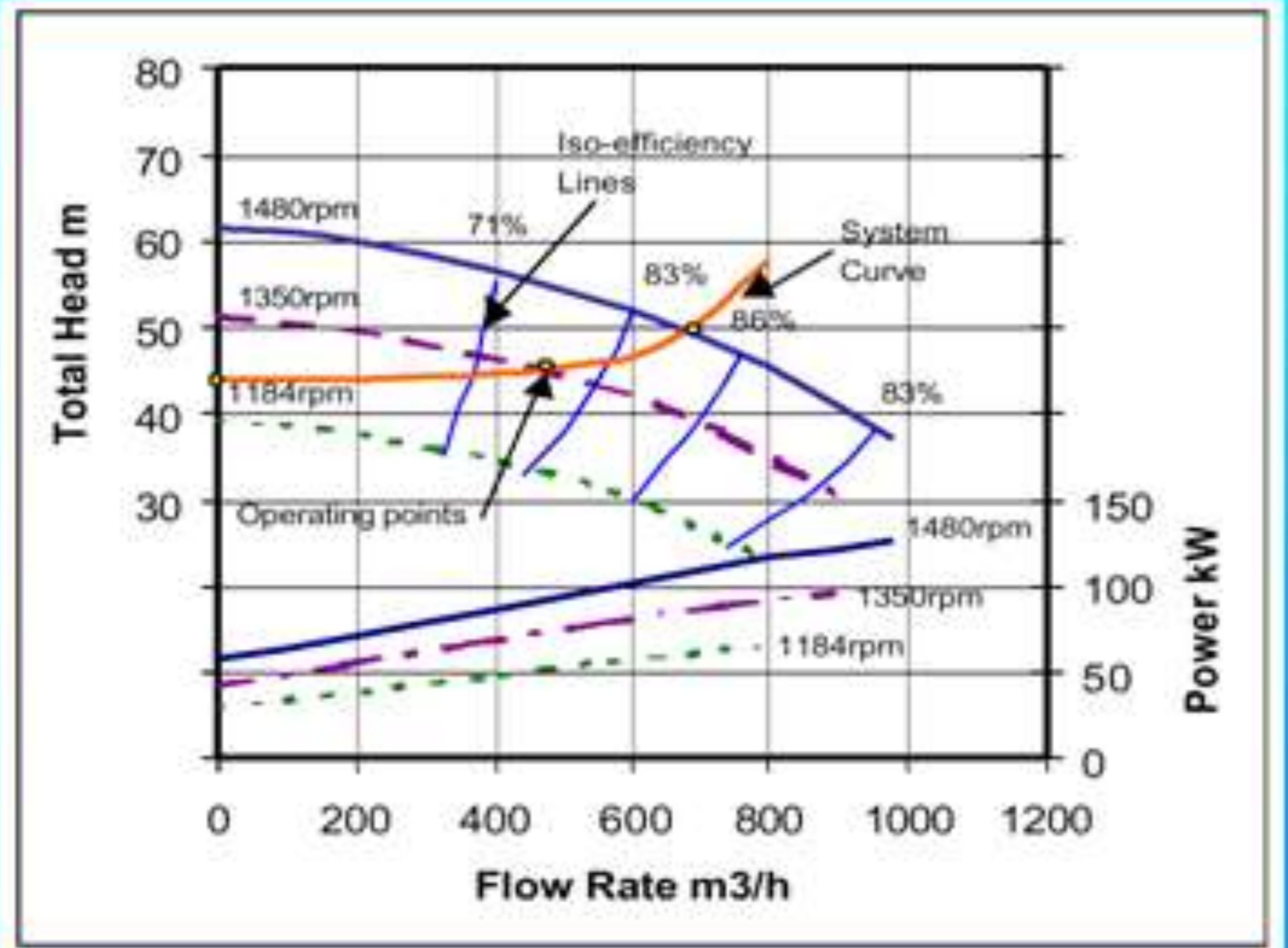
Speed variation effect



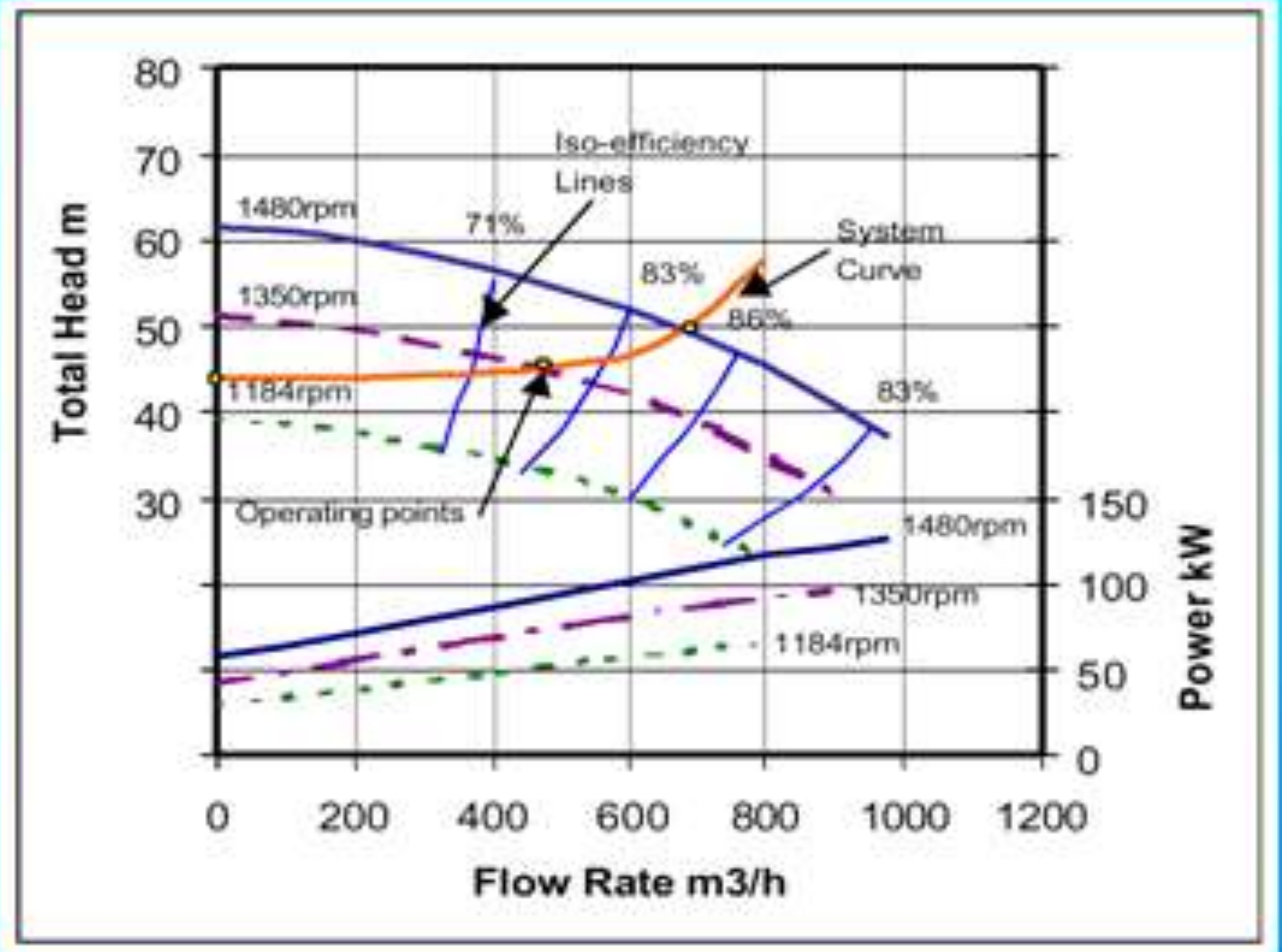
Effect of Pump Speed change (System with only frictional losses)



Effect of Pump speed change (System with High Static head)



Effect of Pump speed change (System with High Static head)

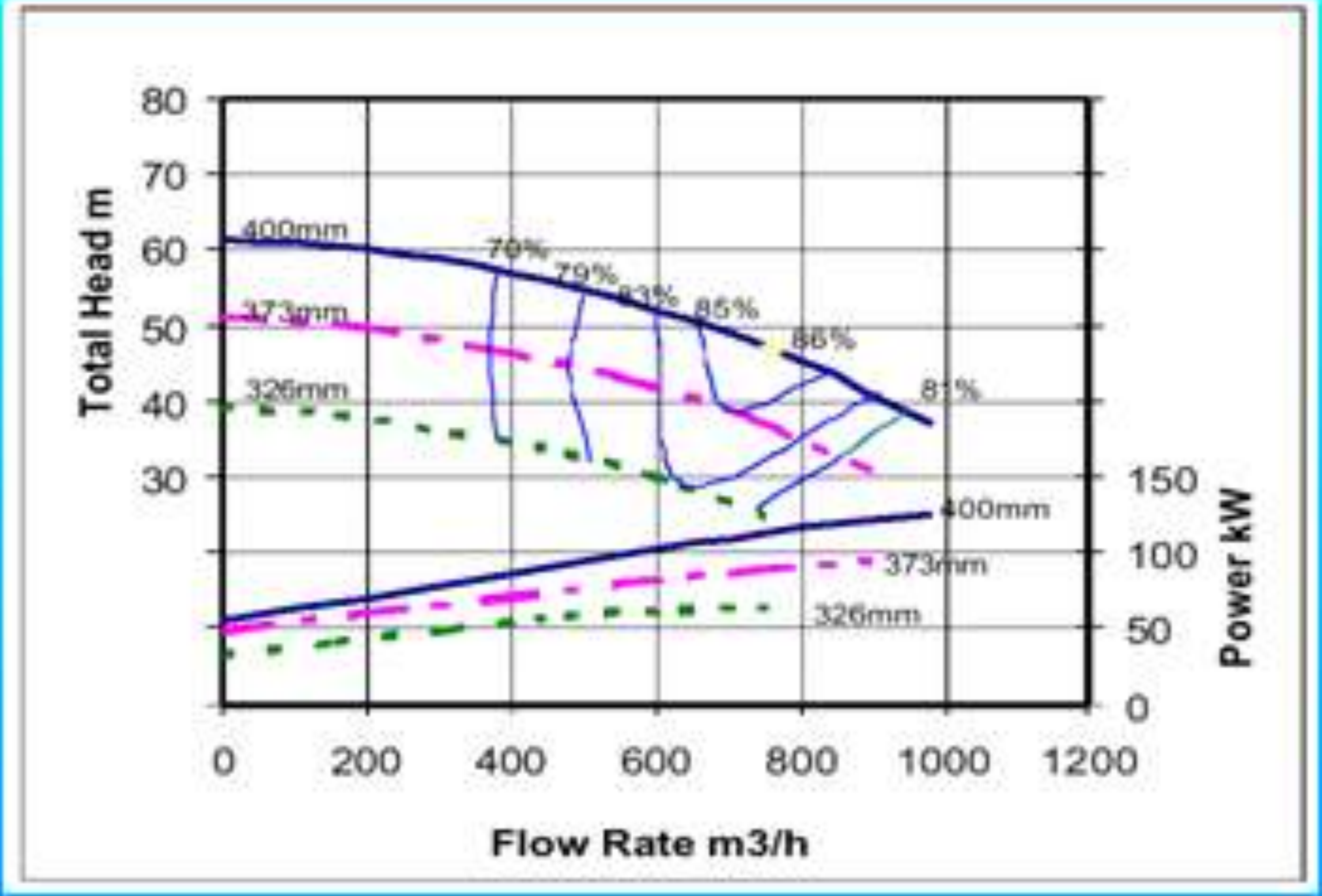


B. EFFECT OF CHANGE IN SIZE :

For a given casing with different impellers,

- **Flow varies directly as impeller diameter**
- **Pump Head varies as the square of impeller diameter**
- **Input power varies as cube times the impeller diameter**

Effect of Impeller diameter reduction



The affinity law for a centrifugal pump

Flow:

Q1 / Q2 = N1 / N2

Example:

100 / Q2 = 1750/3500

Q2 = 200 m^3/hr

Head:

H1/H2 = $(N1^2) / (N2^2)$

Example:

100 /H2 = $1750^2 / 3500^2$

H2 = 400 m

Kilowatts (kW):

kW1 / kW2 = $(N1^3) / (N2^3)$

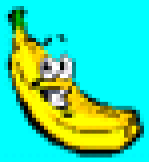
Example:

5/kW2 = 17503 / 35003

kW2 = 40

Flow Control Strategies

- Stop / start control
- Bypass valve
  - Zero savings
- Throttle output / Flow control valve
  - Increased system pressure drop
  - Move system curve and reduces efficiency
  - Effect less in flat H-Q curve
- Trim impeller
- Buy a new pump
- Variable speed drive
  - Most efficient
  - Power varies as cube of speed
  - Different flow rates without affecting efficiency



Energy conservation measures

- Conduct water balance minimise water consumption
- Avoid idle cooling water circulation in DG sets, compressors, refrigeration systems
- In multiple pump operations, judiciously mix the operation of pumps and avoid throttling
- Have 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, trim / replace impeller or replace with correct sized pump
- Remove few stages in multi-stage pump with over designed head

Energy Saving Opportunities

- ✓ Give efficiency of the pump due consideration while selecting a pump.
- ✓ Select pumps to match head flow requirements.
- ✓ Select a motor to match the load with high efficiency.
- ✓ Optimize the piping design.
- ✓ Monitor all important system parameters like: motor kW, pump head, flow temperature.
- ✓ Use pumps in series and parallel so that mismatch in system design or variations in operating conditions can be handled properly.

Energy Saving Opportunities (Contd.)

- ✓ Use variable speed drives for variations of flow due to process requirement.
- ✓ If the head flow is higher than needed by 5 to 15%, (i) The existing impeller should be trimmed to a smaller diameter, (ii) or a new impeller with a smaller diameter is to be put.
- ✓ In multistage pumps, add or remove stages to the existing pump, allowing an increase / decrease in delivered head of flow, if required.

Compressed Air Systems: INTRODUCTION

The contribution of Compressed air to the total electricity consumption may vary from very small to as high as 50% depending upon the type of Chemical industry.

Most of the industries uses compressed air for a variety of operations such as:

- For pneumatic operated equipment
- For instrumentation
- Conveying material
- As a direct input to a chemical process
- For pressure testing of vessels

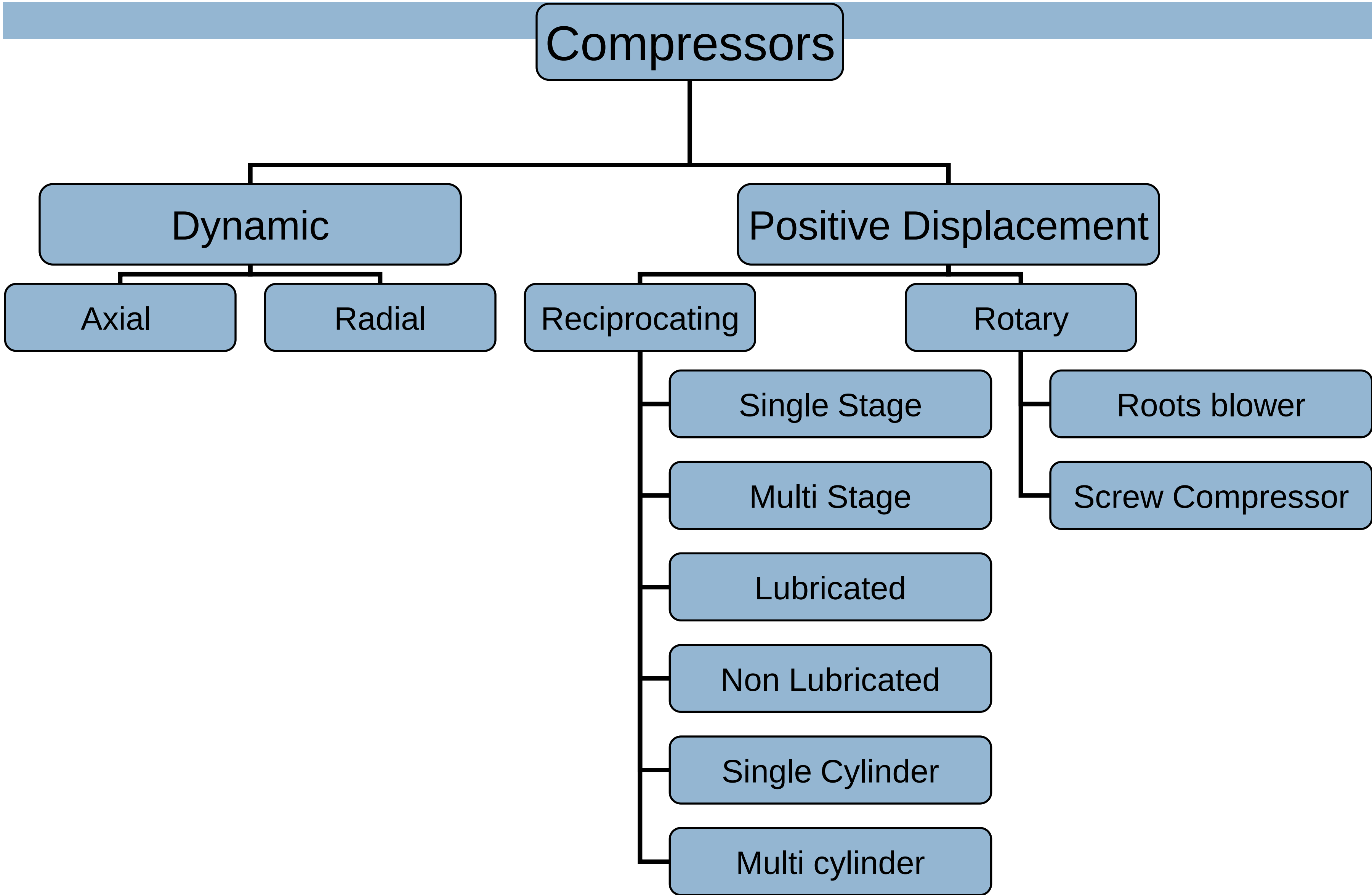
Efficiency of Compressed Air System

Only 10-30% of energy reaches the point of end-use, and balance 70-90% of energy of the power of the prime mover (Compressor, Motor and transmission) being converted to unusable heat energy and to a lesser extent lost in form of friction, **misuse** and noise.

A reduction in delivery pressure by 1 bar in compressor would **reduce the power consumption by 6-10%**

- Segregating low & high pressure air requirements
- Use of blowers in place of compressors

TYPES OF COMPRESSORS



Specific Energy （cfm / kW） is best index for comparison

- **Volumetric Efficiency**
  - **Free air delivered (m^3/min)/Compressor displacement**
  - **Compressor Displacement is given by**

= (∏ x D^2 x L x Z x n)/4

D – Cylinder bore, m

L – Cylinder Stroke, m

S – Compressor Speed, rpm

Z – 1 for single acting 2 for double acting

n – No of cylinders

Compressor Performance

- Compressor Capacity (Free air delivery)
  - Compressor Performance Capacity is the full rated air volume delivered at compressor inlet conditions of temperature, pressure and composition.
  - Factors affect the capacity are altitude, barometric pressure and temperature
- Compressor Efficiency
  - Adiabatic Efficiency
  - Isothermal Efficiency
  - Isothermal power kW = $P1 \times Q1 \times \log_e r \;/36.7$
    - P1=absolute pressure, kg/cm^2
    - Q1= free air delivered, m^3/h
    - r= pressure ratio (P2/P1) where P2 is the discharge pressure in kg / cm 2

EE Points in Location of Compressors:

- **MSL Cool air intake:** For every 4°C raise in inlet air temperature results in 1% higher energy consumption to achieve equivalent output
- **Dust free air intake:** for every 250 mm WC pressure drop increase across the suction path power consumption would increase by 2% for the same output
- **Dry air intake:**
- **Elevation:** Altitude has a direct impact on the volumetric efficiency. Compressors located at higher altitudes consume more power when compared to MSL

Cooling water Circuit & Coolers

- **Cooling Water:** Cooling water is circulated to the cylinder heads, inter coolers and after coolers to remove the heat of compression from the air. The compressor performance is affected by effectiveness of inter coolers & after coolers

- **Efficacy of inter coolers:** Inter coolers are provided to reduce the work of compression (power) by reducing the specific volume apart from moisture separation. Objective of inter coolers is to achieve isothermal compression

For every 5.5°C rise in inlet air temperature to second stage results in 2% increase in specific energy consumption

- **After coolers:** Inadequate cooling in after coolers cause improper removal of water vapor in the compressed air

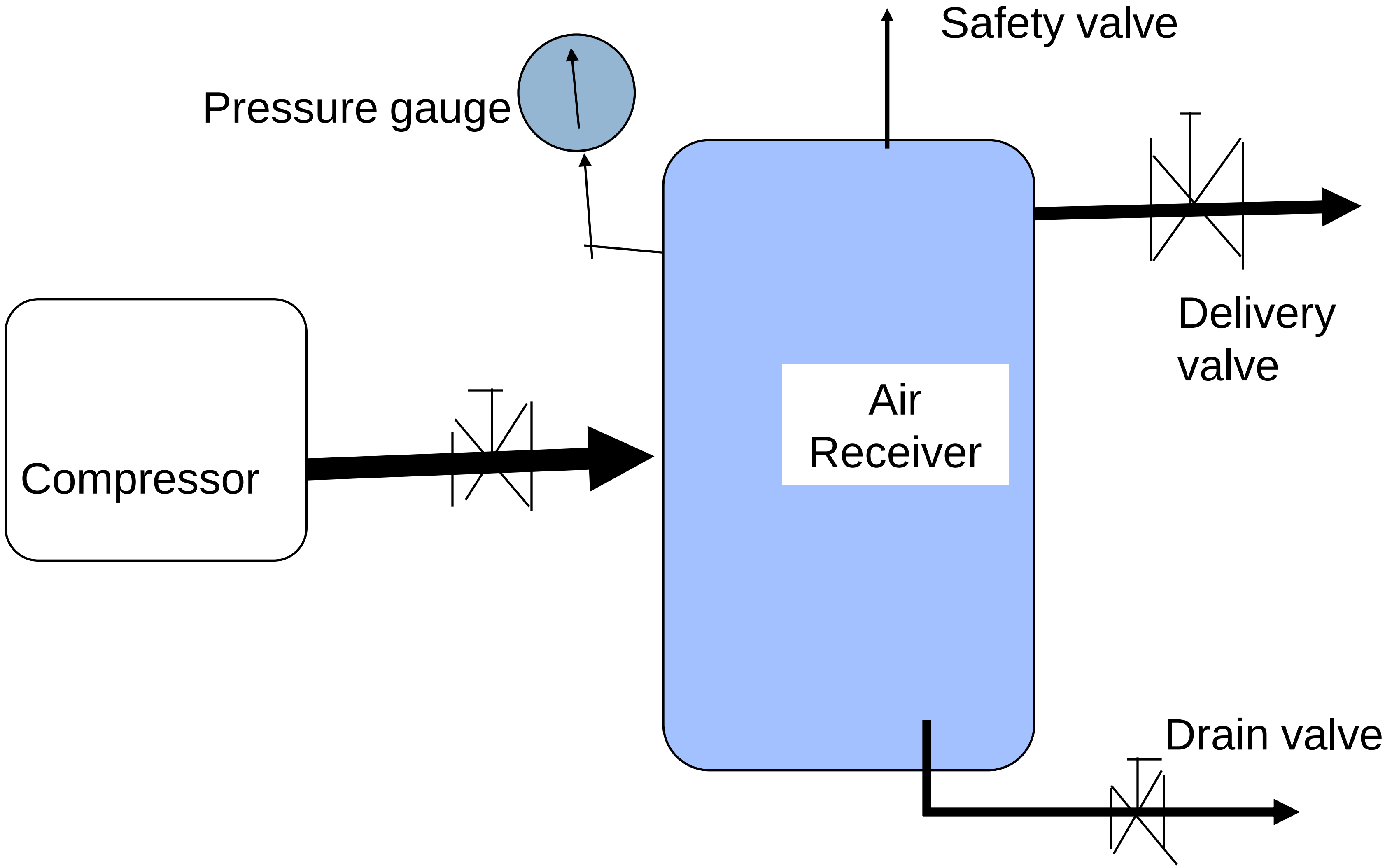
Pressure drop and Energy Savings

- **Check pressure losses throughout the system. Measure simultaneous air pressures at the receiver, branches, hoses when lines are bearing full air flows.**
- **Each 2 psig of pressure loss costs 1% of total power to compensate**
- **Acceptable pressure drop is 0.3 bar in main header's farthest point and 0.5 bar in distribution system**
- **Case –Study of GACL:**

i)0.5 bar reduction to 5.5 bar saving @ Rs.2 lac /Yr.

ii) 1.5 bar pressure drop at the farthest end reduced by changing the pipeline and reduced air header by 0.5 bar.

Compressor Capacity Assessment



Free air delivery of compressor

- Can be evaluated by substituting all values in the following formula

$$\text{FAD capacity in } Nm^3/min = \frac{P2-P1}{Po} \times \frac{V}{T}$$

V= Volume of air receiver + interconnecting pipelines in cubic meter.

T= Time taken to fill receiver in minutes

P2= Final receiver pressure in kg/cm^2 a

P1= Initial receiver pressure in kg/cm^2 a

Po= Atmospheric pressure in kg/cm^2 a

Quantification of leakage

$$\text{Leakage } L\ (m^3/\text{min}) = \frac{Q \times T}{T + t}$$

Q= Actual free air delivery m^3/min

T= On load time of compressor in minutes

t= Off load time of compressor in minutes

Energy wasted due to leakage (kWh)

= L (kW per m^3/min) X operating hours

MEASUREMENTS TO BE MADE

- Compressor pressure settings
- Motor electrical parameters during load & unload
- Air & Cooling water inlet & outlet temperatures
- Pressure drop across inter & after coolers
- Compressor loading pattern
- Compressor operating hours
- Ambient air temperature and %RH
- Actual air pressure used for equipment operation
- Pressure drop in the system and in the suction filters, dryers, etc

Capacity utilization

- **In many installations the use of air is intermittent which means the compressor will be operated on low load or low load conditions, which increase the specific energy consumption.**
- **Options available are:**
  - **Smaller compressor**
  - **De-centralization**
  - **Change of pulley sizes**
  - **Variable speed drives**

Suggestions for Air-System

- **Install ring mains, probably by adopting or paralleling existing pipe work**
- **Install air receivers to accommodate temporary heavy flow demands, to cool the compressor between load & unload**
- **Determine that the air storage volume of air receiver is ample for air requirements in your plant, to ensure safe and convenient compressor duty cycle**

Refrigeration AND Air COMPRESSORS

- **Screw Vs Reciprocating**
- **VFD on air-compressors –proven by many industries.**
- **SEC per ton of chlorine- measure & manage**
- **SEC per M3 of air- measure & manage**
- **RFID technology for reusable packing (carboys) /cylinder /drums turn out or rotation monitoring**

Motor Characteristics

1. **Motor Speed**
2. **Power Factor**

Motor Speed

- Speed of a motor is the number of revolutions in a given time frame, typically, revolutions per minute (RPM)
- Speed of an AC motor depends on the frequency of the input power and the number of poles
- Synchronous Speed (RPM) = 120 x frequency / No. of Poles
- Actual speed is less than the synchronous speed. The difference between synchronous and full load speed is called slip (measured in %)
- $$\text{Slip (\%)} = \frac{\text{Synchronous Speed} - \text{Full Load Speed}}{\text{Synchronous Speed}} \times 100$$

Motor Characteristics

Motor Speed contd...

- Speed of an AC motor is determined by the number of motor poles and by the frequency
- Theoretically, Speed of an AC motor can be varied infinitely by changing the frequency
- With the addition of VSD, the speed of the motor can be decreased as well as increased.

Power Factor

- Power Factor = cosϕ = kW/kVA
- As the load on the motor comes down, the magnitude of active current reduces but not correspondingly magnetizing current, which is proportional to supply voltage with the result that the PF reduces

Motor Efficiency

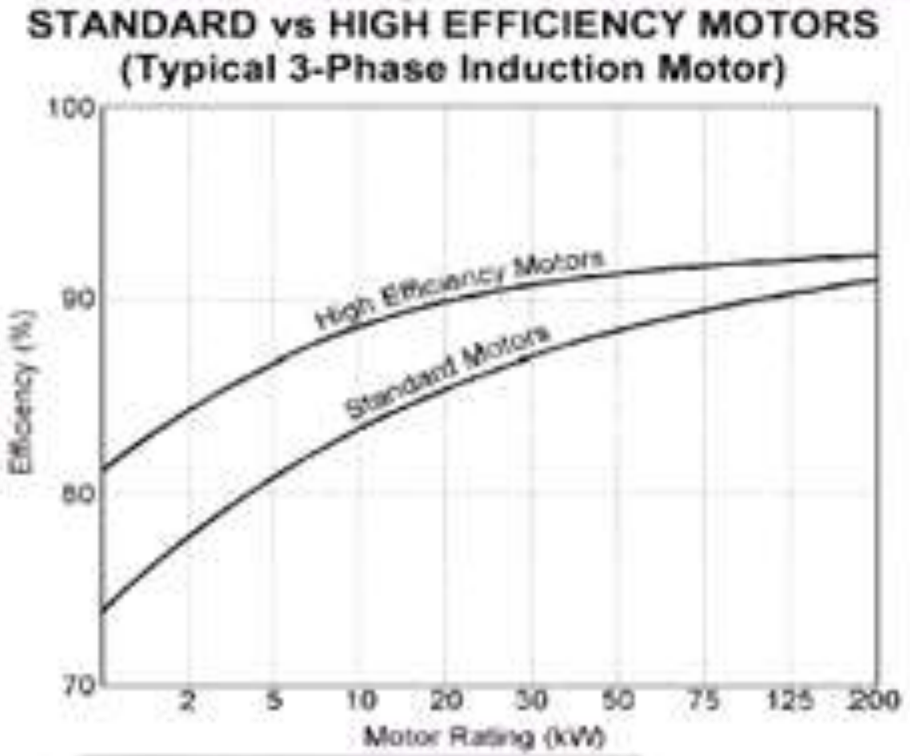
- Efficiency of a motor is determined by intrinsic losses that can be reduced only by changes in motor design.
- Intrinsic losses are of two types
    - **Fixed Losses** – independent of motor load
    - **Variable Losses** – dependent on load

Fixed Losses

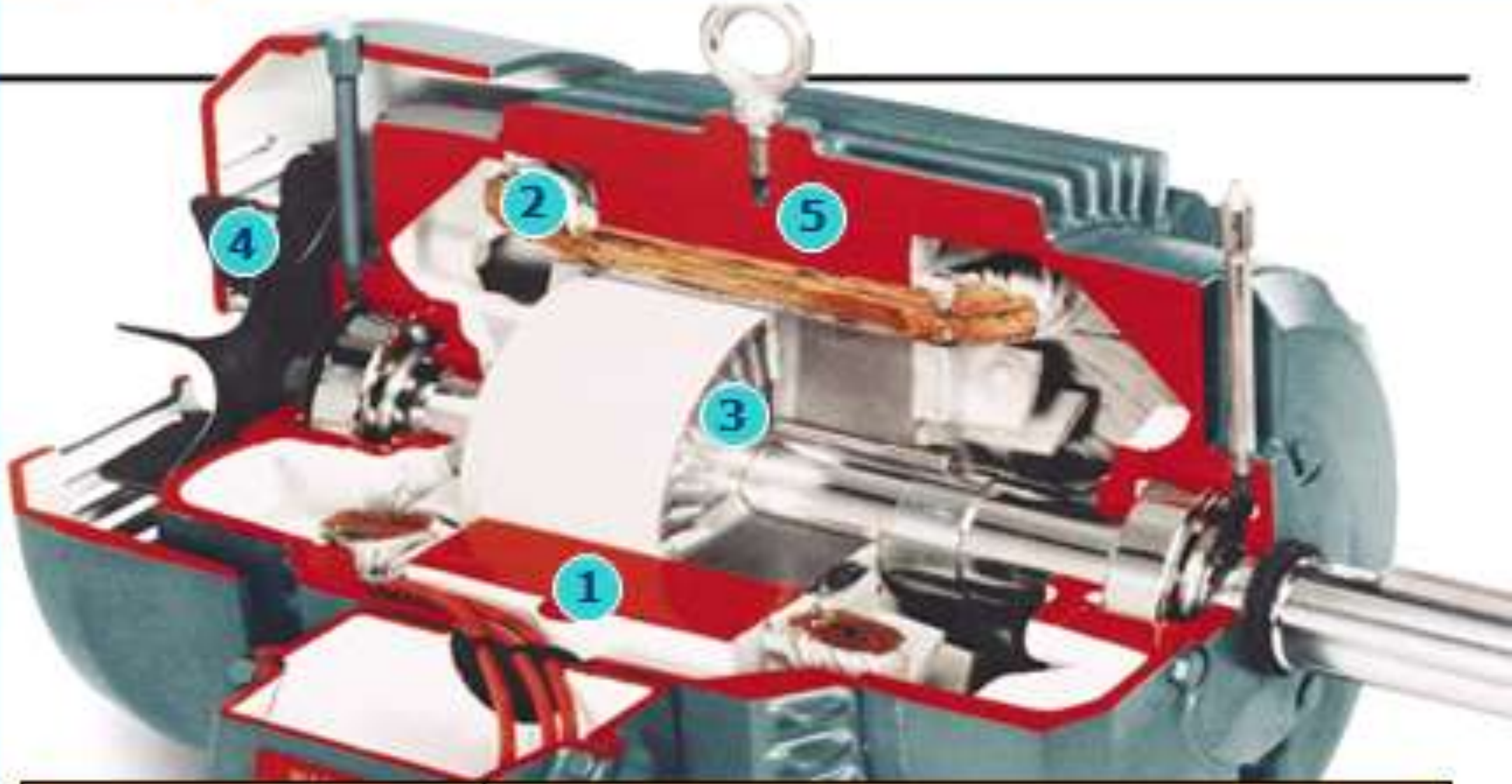
- Fixed Losses = Magnetic core losses + F&W Losses
- Magnetic core losses = Eddy current losses + hysteresis losses
- Vary with the core material, geometric and with input voltage
- F&W losses are caused by friction in the bearings of the motor and aerodynamic losses associated with the ventilation fan and other rotating parts

Energy Efficient Motors

- Energy efficient motors are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design



Energy Efficient Motors



5.Stray Load Loss	Use of optimized design and strict quality control procedures

Energy Efficient Motors

- Improvements include
  - Use of lower-loss silicon steel
  - Longer core (to increase active material)
  - Thicker wires (to reduce resistance)
  - Thinner laminations
  - Smaller air gap between stator and rotor
  - Copper instead of aluminum bars in the rotor
  - Superior bearings and a smaller fan, etc.
- Energy efficient motors are designed to operate without loss in efficiency at loads between 75% and 100% of rated capacity.
- The power factor is about the same or may be higher than for standard motors

Energy Efficient Motors

- EE Motors have
  - lower operating temperatures
  - Lower noise levels
  - Greater ability to accelerate high inertial loads
  - Less affected by supply voltage fluctuations
- Energy efficient motors cover a wide range of ratings and the full load efficiencies are higher by 3 to 7%.
- EE motors are ill suited to highly intermittent duty or special torque applications such as hoists and cranes, traction drives, punch presses, machine tools and centrifuges.
- Energy efficient motor are not yet available for multi speed motors and for special applications like flame proof operations and for low speed applications (below 750 rpm)

ELECTRIC MOTORS

Energy Efficient Motors

kW savings = kW x [$1/\eta_{old} - 1/\eta_{new}$]

η_{old} = Efficiency of Standard motor (or present motor)

η_{new} = Efficiency of Energy Efficient Motor (or new motor)

ELECTRIC MOTORS

Factors Affecting Energy Efficiency

Power Factor Correction

- Induction motors with less than unity power factor
- Capacitors connected in parallel with the motor are used to improve the PF
- Reduced kVA demand, reduced I^2R losses, reduced voltage drop and an increase on overall efficiency of the plant electrical system
- Size of capacitor required for a motor depends upon the no load reactive kVA (kVAr) drawn by the motor
- Capacitor is then selected to not exceed 90% of the no-load kVAr of the motor
- Required kVAr increases with decrease in speed of the motor

Factors Affecting Energy Efficiency

Maintenance

- Inspecting motors regularly for wear in bearings and housings and for dirt/dust in motor ventilating ducts
- Checking load conditions
- Lubricating appropriately
- Checking periodically for proper alignment of the motor and driven equipment
- Properly sized supply wiring and terminal box

Age

- Poor maintenance can cause a deterioration in motor efficiency over time
- Excessively high temperature, high dust loading, corrosive atmosphere and humidity can impair insulation properties
- Mechanical stresses due to load cycling can lead to misalignment

ELECTRIC MOTORS

Application of Variable Speed Drives

- The Speed of an induction motor is proportional to the frequency of the AC voltage and the number of poles
- If the frequency applied to the motor is changed, the motor speed changes in direct proportion
- VSD is used to convert the electrical system frequency and voltage to the frequency and voltage required to drive a motor at a speed other than its rated speed
- Basic functions of a VSD are
    - To provide power conversion from one frequency to another
    - To enable control of the output frequency

Examples

1. A 20 kW rated motor is drawing actual measured power of 14 kW. If the rated efficiency is 92%, determine the motor loading?

Motor Loading = {Measured Power / [Rated power/efficiency]} x 100

= {14 / [20/0.92]} x 100

= 64.4%

Examples

2. Estimate the percentage loading of a motor from the data given below:

- No. of poles = 4, 50 Hz
- Name plate full load speed = 1450
- Measured speed in rpm = 1475
- Nameplate rated power = 15 kW, 415 V
- Measured voltage = 400 V

Synchronous Speed Ns = 120 x 50/4 = 1500

% Loading = $\{[Ns - Nm]/[Ns - Nr]\} \times (V/Vr)^2 \times 100$

$= \{[1500 - 1475]/[1500 - 1450]\} \times (400/415)^2 \times 100$

$= \{25/50\} \times 0.93 \times 100 = 46.4\%$

Examples

4. Estimate the kW savings if a 15 kW output motor efficiency is improved from 86% to 90%.

kW savings = kW output x [$1/\eta old$ – $1/\eta new$]

= 15 x [1/0.86 – 1/0.90]

= 15 x [1.163 – 1.11]

= 0.795 kW

Summary: Energy Efficiency Tips

Focus Area

- **Energy- Fuel: Management by measurement**

  Use Reliable Instrumentation for Flow , Pressure, Temperature, Power (kWh),

- **Pumps: Optimize sizing and operation,Minimise throttling/ Use VFD after due diligence.**

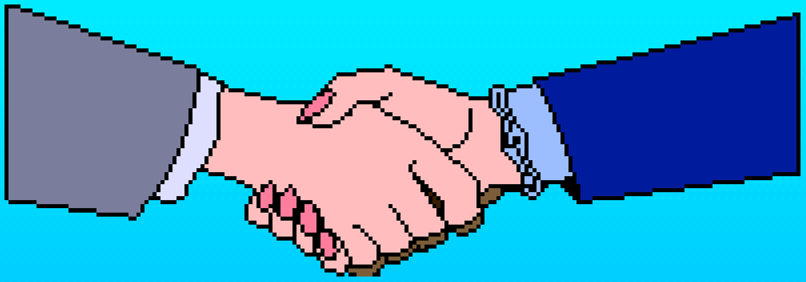
  Use polyester coating to reduce frictional losses

- **Compressors: Optimize operation, VFD deployment, Optimise for minimum discharge pressure**

Summary: Energy Efficiency Tips

- **Cooling Towers :Continuous monitoring**
- **Electric Motors: Daily on line Power monitoring Replace by EE motors in phases.Optimize sizing, Improve p.f.,**
- **Insulation :Monitoring & Maintaining**
- **Thermal Energy :Equipment Efficiency monitoring(Boilers, WHRUs),Heat Exchangers Chemical Cleaning,**
- **Renewable: Consider Wind farm option on long term basis, PV Solar for DC instrumentation**

Thank u



QUERIES ARE WELCOME