PUMPING SYSTEMS

- **Consequently, in these applications pump efficiency does not necessarily decline during periods of low flow demand.**

PUMPING SYSTEMS

- By analyzing the entire system, however, the energy lost in pushing fluid through bypass lines and across throttle valves can be identified.

PUMPING SYSTEMS

- Another system benefit of VFDs is a soft start capability. During startup, most motors experience in-rush currents that are 5 - 6 times higher than normal operating currents.

PUMPING SYSTEMS

- This high current fades when the motor spins up to normal speed. VFDs allow the motor to be started with a lower startup current (usually only about 1.5 times the normal operating current).

PUMPING SYSTEMS

- **EXAMPLE OF PUMP EFFICIENCY CALCULATION**
- **A chemical plant operates a cooling water pump for process cooling and refrigeration applications. During the performance testing the following operating parameters were measured;**
- **Measured Data**
- **Pump flow, Q 0.40 m3/ s**
- **Power absorbed, P 325 kW**
- **Suction head (Tower basin level), h1 +1 M**
- **Delivery head, h2 55 M**
- **Height of cooling tower 5 M**
- **Motor efficiency 88 %**

PUMPING SYSTEMS

- **EXAMPLE OF PUMP EFFICIENCY CALCULATION**
- **Type of drive Direct coupled**
- **Density of water 996 kg/ m3**
- **Pump efficiency**
- **Flow delivered by the pump 0.40 m3/s**
- **Total head, h2 -(+h1) 54 M**
- **Hydraulic power 0.40 x 54 x 996 x 9.81/1000 = 211 kW**
- **Actual power consumption 325 kW**
- **Overall system efficiency (211 x 100) / 325 = 65 %**

PUMPING SYSTEMS

SYSTEM CURVE

- Location of equipments
- The Refrigeration plant is located at +0.00 level and the Process plant condensers are located at +15 M level.
- One cooler having a design pressure drop of 1.9 kg/cm2 is located at the 0.00 level (ground level). Other relevant data can be inferred from the earlier section.

PUMPING SYSTEMS

- **The step-by-step approach for determining system resistance curve is given below.**
- **Step-1 Divide system resistance into Static and dynamic head**
- **Find static head;**
- **Static head (Condenser floor height) ; 15M**
- **Find dynamic head;**
- **Dynamic Head = Total Head – Static Head**
- **Dynamic head = (54-15) = 39 M**

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- **STEP-2 Check the maximum resistance circuit**
- **Resistance in the different circuits is as under**

PUMPING SYSTEMS

S.no	System	Condenser loop resistance, M	Reactor loop resistance, M	Cooler loop resistance, M
1.	Supply line from pump	15	10	15
2.	Static head	15	5	Nil (cooler at ground level)
3.	Equipment	5	5	19
4.	Return line from equipment to CT	15	10	15
5.	Tower head	-	-	5
6.	Total	50	30	54

It can be noted that at full load the condenser and cooler circuits offer the maximum resistance to flow.