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2)

- a) 1) Get commitment and appoint an energy manager - make sure senior management understand the business benefits of an energy strategy and the proposed energy saving measures. This shows that the business takes energy saving goals seriously. Their role is to:

- lead energy team in their actions
- emphasise the importance of an energy strategy.

2) Understand the issues - have a clear understanding of how the business is ~~the~~ currently using energy. How energy usage compares to other businesses.

3) Plan and organise - Carry out an energy survey to see where savings can be made. Use all relevant information to produce an energy policy and identify long, medium and short targets.

4) Develop an action plan - Once targets have been identified, draw up an action plan with practical steps that need to be taken to achieve goals.

5) Involve staff - Get support for these strategies from key decision makers, senior management, and all staff.

6) Control, monitor, report — monitor performance regularly to check that progress towards energy saving goals are met. Put in place procedures to make sure systems will carry on efficiently. Let staff know how to progress towards these goals are going to keep them motivated.

b) A energy Audit is completed to carry out and determine its energy efficiency. energy efficiency means using less energy to do the same job. This audit provides a electricity consumption and energy efficiency assessment. With this information you can identify and correct any energy usage ~~issues~~ issues to cut costs. Always undertake an energy audit before implementing a renewable energy system.

It can be used to help reduce energy costs in your facility. With reduction in production costs, the competitiveness ~~and~~ of the company will be improved.

It helps reduce the dependence on foreign energy sources. Reduces environmental damage and pollution. It can reduce consumption of natural re-sources. It can increase life-span of equipment used in your facility.

Energy audits affect 3 key factors:

- Profitability through optimization
- Productivity through optimization
- Performance.

hence

3)

a)

b)

- b)
- Crystallisation
 - Corrosion processes
 - chemical reaction
 - Particulate matter in flows

- Best inc = 0.0
So, change in inc = 0.0
 $\Delta \text{inc} = 0.0$
hence a decrease
- c) • Elimination of regurgitation eddies
• Uniform flow velocitys through the tube, uniform temperature distribution
• Higher flow velocitys with lower pressure drops.
• Improving Shear stress at the heat transfer surface.
• Shell-side flow tends to turbulent flow conditions improving the temperature driving force.

10

~~11~~

d)

(i)

$$U = 350 \text{ W/m}^2\text{K}$$

$$\dot{m}_H = 0.95 \text{ kg/s}$$

$$T_{Cin} = 15$$

$$T_{Cout} = 60$$

$$T_{Hin} = 165$$

$$T_{Hout} = 135$$

$$C_{p,oil} = 2350$$

$$C_{p,water} = 4180$$

(ii)

~~$$\Delta T_{lm} = T_{Hout} - T_{Cin}$$~~
~~$$= 135 - 15$$~~
~~$$= 120^\circ\text{C}$$~~

$$\dot{Q}_H = \dot{m}_H \cdot C_{p,H} (T_{Hin} - T_{Hout})$$

$$= 0.95 \times 2350 (165 - 135)$$

~~$$T_{Hin} - T_{Cout}$$~~
~~$$= 165 - 60$$~~
~~$$= 105^\circ\text{C}$$~~

$$\dot{Q}_H = 66975 \text{ W}$$

$$\dot{Q}_H = 66.975 \text{ kW}$$

~~$$\dot{Q}_{CF} = 350$$~~

(iii)

$$\dot{m}_{\text{water}} = \frac{\dot{Q}_{\text{water}}}{C_{\text{water}} (T_{\text{c out}} - T_{\text{c in}})}$$

$$= \frac{66.975}{4180 (60 - 15)} = 0.00035 \text{ kg/s}$$

(iv) $\dot{Q} = U \cdot A \cdot F \cdot \Delta T_{\text{LM}}$ where $F = 1$

$$\begin{aligned} \Delta T_o &= T_{\text{H out}} - T_{\text{c in}} \\ &= 135 - 15 \\ &= 120^\circ\text{C} \end{aligned}$$

$$\begin{aligned} \Delta T_i &= T_{\text{H in}} - T_{\text{c out}} \\ &= 165 - 60 \\ &= 105^\circ\text{C} \end{aligned}$$

$$\text{So } \Delta T_{\text{LM}} = \frac{120 - 105}{\ln \left(\frac{120}{105} \right)} = 112.3 \text{ K}$$

$$\text{So } A = \frac{66.975 \times 10^3}{350 \times 1 \times 112.3}$$

$$= 1.70 \text{ m}^2$$

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4)

a) Similarities of AC and DC motor:

- Both have a rotor - cylindrical with shaft through axis
- Both have a stator - hollow cylinder.

b) A AC drive is a device that is used to control speed of an electric motor. The speed is controlled by changing the frequency of the electrical supply to the motor. A 3 phase voltage is connected to a motor creates a rotating magnetic field. AC motors are frequently used in a diverse range of similar consumer products due to their durability, low ~~manuf~~ manufacturing costs, affordability and ease of operation.

AC is simpler to produce than DC. It is also less expensive than DC to generate. AC systems have a higher efficiency. Waste of power is negligible for AC during transmission.

- d) Spur gears are not known to be the smoothest or quietest gears, but they are highly efficient and produce a lot of power. They run well at slow speeds, but they vibrate at high speeds.

Helical gears have teeth that are set on an angle to the gear axis. The teeth engage more gradually, and have a smoother and quieter operation than spur gears. Also have a higher load carrying capacity.

Spur gear:

advantages: Transmission efficiency
Straightforward design
Constant velocity ratio
reliability.

Disadvantages: Limited center distance
noise
Stress.

8 or 10

or 10

perform

80
3

Helical gears:

advantages: Used with parallel & non parallel shafts
more durable
high load carrying capacity

disadvantages: higher manufacturing costs
Generate large amount of thrust
higher friction

Applications:

Spur gear: Clocks, pumps, electric screwdrivers
watering systems, machinery

helical gears: conveyors, elevators, compressors
oil industry.

4
(e)

$$(i) G = \frac{\omega_A}{\omega_B} \times \frac{\omega_B}{\omega_D} \times \frac{\omega_C}{\omega_D} = \frac{\omega_A}{\omega_C}$$

$$\therefore \omega_C = \frac{\omega_A}{G} = \frac{100}{3/4} = 133.3 \text{ rpm}$$

$$(ii) G = \frac{k_h}{k_A} = \frac{k_D}{k_C} = \frac{20}{80} \times \frac{60}{20} = 3/4$$