

Q3 oil $C_p = 2350$
water $C_p = 4180$

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Q1

b) Issues to be considered when evaluating the aging ~~of~~ of ece;

- Needs to be understood what systems are safety critical
- What systems can be affected
- Check for physical damage from physical impact, surface abrasion, over heating
- Burning / Arcout
- Blockages
- Leaking
- Dry Joints.
- Software upgrade - old software not supported
- Poor surface finish of EC&I components, flange paint, corrosion resistant paint not applied correctly, paint ~~cover~~ on critical components such as sensors
- Are they safe to continue using?
- Maintenance procedures for the equipment?

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Q3

a) The shellside type design typically leads to higher fouling rates due to the proximity of tubes within the heat exchanger with the constant variation in temperature difference with expansion and contraction causes ~~fouling~~ erosion

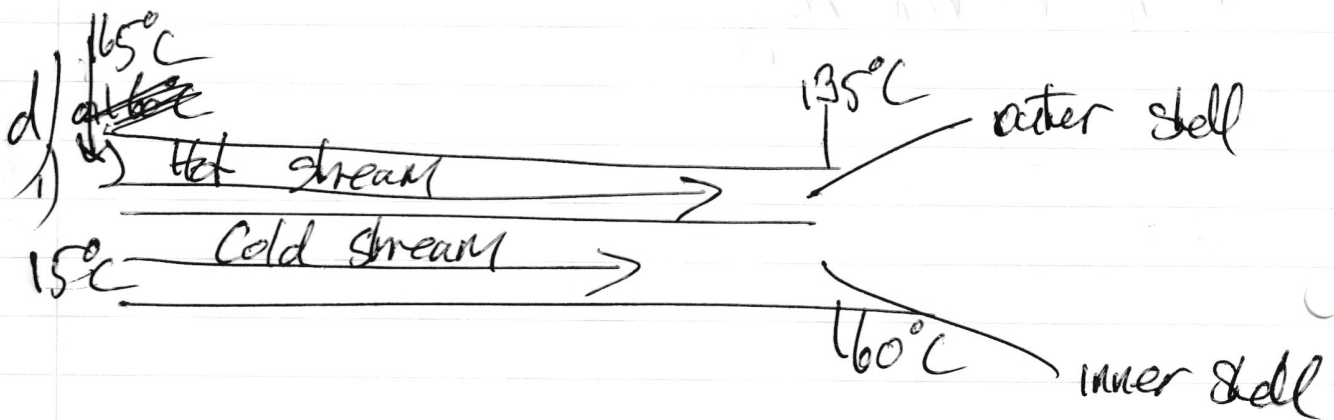
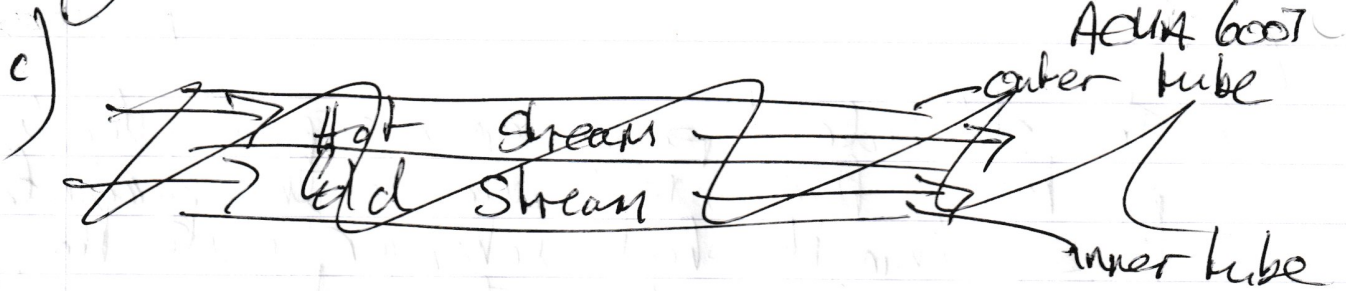
b) 4 mechanisms,

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ii $Q = UAF\Delta T_{LM}$

$$T_{H,in} = 165^{\circ}\text{C}$$

$$T_{H,out} = 135^{\circ}\text{C}$$

$$T_{C,in} = 15^{\circ}\text{C}$$

$$T_{C,out} = 60^{\circ}\text{C}$$

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

$$C_p(\text{oil}) = 2350$$

$$C_p(\text{water}) = 4180$$

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QB // Parallel = $\Delta T_o = T_{hot} - T_{cold}$
 $\Delta T_i = T_{in} - T_{out}$

$$\Delta T_o = \frac{135 - 60}{75} = 75^\circ C$$

~~Counter = $\Delta T_o = T_{hot} - T_{cold}$~~

$$\Delta T_i = \frac{165 - 15}{150} = 150^\circ C$$

$$\Delta T_{lm} = \frac{\Delta T_o - \Delta T_i}{\ln \left(\frac{\Delta T_o}{\Delta T_i} \right)}$$

$$= \frac{75^\circ C - 150^\circ C}{\ln \left(\frac{75}{150} \right)}$$

$$= 108.2^\circ C$$

Counter =

$$\Delta T_o = T_{hot} - T_{cold}$$

$$\Delta T_i = T_{in} - T_{out}$$

$$\Delta T_o = 135 - 15 = 120^\circ C$$

$$\Delta T_i = 165 - 60 = 105^\circ C$$

oil CP 2350
water CP 4180

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$$\therefore \Delta T_m = \frac{\Delta T_{out} - \Delta T_{in}}{\ln \left(\frac{\Delta T_o}{\Delta T_i} \right)}$$

$$= \frac{120 - 105}{\ln \left(\frac{120}{105} \right)}$$

$$= 112.33^\circ \text{C}$$

Parallel = ~~$Q = UA \Delta T_m$~~
 $Q = m c_p \Delta t$

$$\therefore R = \frac{Q}{c_p \times \Delta T}$$

$c_p \text{ oil} = 2350$
 $c_p \text{ water} = 4180$
 $m = 0.95 \text{ kg/s}$

$$Q = 0.95 \times 2350 \times$$

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4) AC/DC Similarities.

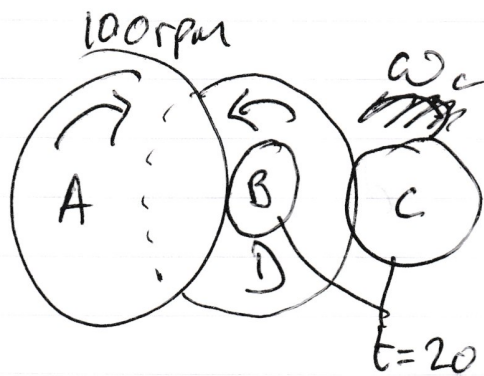
~~Most AC not~~

5) AC motors works at a fixed speed causing
it drive to work at same speed.

1. The first part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, which are based on the principle of the uncertainty of the position and momentum of the particles.

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$$\begin{aligned} A &= 80 \\ B &= 20 \\ C &= 20 \\ D &= 60 \end{aligned}$$

$$\text{Ratio} = G_{AB} \times G_{DC}$$

$$\begin{aligned} G &= \frac{t_B}{t_A} \times \frac{t_C}{t_D} = \frac{20}{80} \times \frac{20}{60} \\ &= 0.25 \times 0.3 \\ &= 0.075 \\ &= \underline{\underline{12:1}} \end{aligned}$$

Speed of gear C

$$\omega_A = 100 \text{ rpm}$$

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

$$\omega_C = \frac{\omega_A}{G} = \frac{100}{0.075} = 1200 \text{ rpm}$$

iv) overall gear ratio

$$= G = \frac{\omega_A}{\omega_B} = \frac{G_{AB}}{G_A} = \frac{d_B}{d_A}$$

~~Compound gear = A + B $\Rightarrow \omega_A = \omega_B$~~

$$\therefore G = G_{AB} \times G_{DC}$$

$$\frac{\omega_A}{\omega_D} = \frac{20}{20} \times \frac{60}{20}$$

$$= 4 \times 3$$

$$= 12 \text{ rpm} \rightarrow$$

iii) ~~G = 6~~

$$F = 40$$

$$F = 20$$

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Q2 a)

Corrosion is the degradation of material from a chemical reaction on its surface, when exposed to an environment which will support the reactions.

Fig 1 - Sweet Corrosion, or Carbon Dioxide Corrosion, Dissolves in water to create a Carbonic acid.
Iron Carbonate forms as a film on the surface. It can be a protective film above 80°C with a lower corrosive effect than at lower temps. Sweet Corrosion is seen as pitting and wall thinning.

Corrosion
and insulation

Fig 2 - Hydrogen Sulphide Corrosion or sour corrosion forms as black corrosion and is able to protect the steel surface. Any break in this coating will cause severe pitting.
Also CUI $\rightarrow$ Corrosion under insulation. Creates a crevice to trap moisture and absorb and concentrate the insulation and speeds up the corrosion process.

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Fig 3 - Atmospheric corrosion caused by being in an environment where moisture, oxygen and chemicals such as sulphate, nitrates and chlorides are present. It's like wet corrosion but moisture from the outside weather causes the moisture to be absorbed ~~the~~ or forms a thin film of moisture to enhance the corrosion process. Factors that affect the speed is the moisture levels and other components in the environment. Marine equipment experience higher corrosion ~~the~~ rates due to the water, salt and chlorine levels.