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- a) Figure 1 looks as if its undergoing dry ^{Corrosion} ~~corrosion~~. Dry Corrosion occurs in hot and dry conditions. The Surface metal oxidises to its metal oxide at temperatures of 400°C +. This type of Corrosion is easily identifiable through its dark orange colour.

Figure 2 seems to be experiencing ~~Erosion~~ Erosion Corrosion. Erosion Corrosion occurs when the ^{Pipe} material is Subject to harsh working conditions such as turbulence or high velocity and flow. These conditions lead to a breakdown in the outer/inner material of the pipe which increases the speed at which the corrosion takes place.

Figure 3 looks to be experiencing Sulfur Corrosion. Iron Sulphide is produced from this type of corrosion and when ~~and~~ exposed to water can leave a dark film ~~and~~ that protects the material surface from general corrosion. Any ~~strong~~ damage to the film can lead to severe pitting underneath.

- b) The main consideration needed when evaluating the ageing of electrical control equipment is reliability. As long as the equipment continues to work over time, then minimal maintenance to ensure its functionality would be required.

Another issue would be if the ageing was affecting ~~reliable~~ performance. Breakdown frequency and costs would need to be considered to decide if more routine maintenance would need to be undertaken. Or if the breakdown frequency was too great then upgrading or replacing the equipment would need to be considered.

Finally, a ^{Small} ~~large~~ ~~more~~ Percentage of equipment fail due to age related factors. So other preventative measures such as condition based maintenance and life cycle predictions can be used.

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- 2a) Energy monitoring and targeting is a technique used to reduce an organisations Carbon Footprint. To implement change there must be steps put in place to help achieve a reduction.
- Firstly data must be gathered on where energy consumption is taking place. By having this data companies can see what areas that improvements need to be made. Usually the higher usage areas would be targeted first.
- A review of the baseline consumption needs would then need to be calculated. This figure would be the bare minimum required for the business to operate at a typical level.
- With a baseline established targets can then be set and ~~action~~ monitored to get an idea of where energy is being over or under used and corrective action can then be taken. This would be a continuous monitoring cycle which would reduce the businesses energy use in the long term by having data to reflect on.
- b) An energy audit is an audit carried out on all power consuming inventory within a business. The aim of an energy audit is to improve energy efficiency of a company. This can be done in three ways. The first way is to cut down on all unnecessary energy consumption through monitoring and targeting. The second way is to evaluate the efficiency of current practices and equipment and see if there are better options which would save energy and money in the long run. The third way is education of the work force. This solution includes ensuring all staff are ~~consciously~~ aware of their own power usage within the company and to try and limit usage wherever possible.
- As wholesale costs of energy keep rising it is vitally important that companies try to limit usage to keep business costs down.

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- 4a) The similarity between the two motors is that they are not self starting. As opposed to the 3 phase AC motor which is self starting.
- b) The fundamental operation of an AC electronic drive is to control the speed, torque and position of the driver. It also allows variable shaft speeds. This allows the user a greater range of control for the drives. The main advantage of an AC drive is that it requires less maintenance and better reliability compared to its DC counterpart.
- c) The property relied upon for transmission belts is friction. Belts can wear overtime though and lead to slippage which results in lost delivered power. Other transmission delivery systems that can overcome this issue include chain and sprocket drives which are a more compact design that can lead to less slippage. Gear drive system also ~~eliminate~~ virtually eliminate slippage.
- d) Spur gears are highly efficient and produce a lot of power. They work well at slow to moderate speeds. At high speeds however they can vibrate and become noisy.
- Helical gears are set at an angle to the axis of the gear. Because the teeth engage more gradually they engage more smoothly and tend to be quieter than spur gears. They can also transmit power through parallel or non parallel alignment. A disadvantage of helical gears is that they generate an axial thrust which has to be accounted for.

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d) cont... The addendum is the height of the tooth above the pitch circle. The Dendendum is the depth of the tooth below the pitch circle. The critical aspect to observe is that when two gears engage the ~~the~~ imaginary boundary lines of the pitch circles don't cross each other. This leads to over engagement which can lead to destruction of the gears. Subsequently if the border lines of the circles are too far apart then efficient engagement will fail to occur.

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$$e: B + D \Rightarrow \omega_B = \omega_D$$

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

$$G = \frac{\omega_A}{\omega_C} = \frac{t_B}{t_A} \times \frac{t_C}{t_D} = \frac{20}{80} \times \frac{60}{20} = \frac{3}{4}$$

$$\omega_C = \frac{100}{3/4} = \frac{400}{3} \text{ RPM}$$

$$ii) G = \frac{\omega_A}{\omega_B} \times \frac{t_C}{t_D} = \frac{20}{80} \times \frac{60}{20} = \frac{3}{4} \text{ or } 0.75:1$$

$$iii) G = \frac{\omega_A}{\omega_B} \times \frac{\omega_D}{\omega_C} \times \frac{\omega_E}{\omega_F} = \frac{\omega_A}{\omega_F} = \frac{100}{100} = 1$$

$$G = \frac{t_B}{t_A} \times \frac{t_C}{t_D} \times \frac{t_E}{t_C} \times \frac{t_F}{t_E} = \frac{20}{80} \times \frac{60}{20} \times \frac{40}{20} \times \frac{?}{40}$$

$$G = 1 = \frac{3 t_F}{80}$$

$$t_F = \frac{80}{3}$$