Heat Treatment Processes

Task 1 – "**Scenario**

When manufacturing products, decisions must be made on material properties to meet the specification. These properties may not necessarily come directly from materials off the shelf and as an industrial engineer you need to make decisions on appropriate techniques to apply.

Assignment

1. As the process planner in an engineering company, you have arranged for a gear wheel to be manufactured from medium carbon steel and now need the **teeth only** to be hardened in order to resist wear when in use. You are required to provide clear written instructions to the workshop for the operation as follows:
   - Describe in detail the process of surface hardening the **teeth only** of the gear wheel.
   - Include information on the equipment and techniques to be used.
   - Use sketches and diagrams as necessary to help with your information.

2. As a manufacturing engineer, you have a quantity of 12mm square section mild steel which has to be cold formed into shape for a project. On the first component you bend into shape, many noticeable stress lines appear making the part unacceptable. To prevent this problem occurring on future parts, you conclude that the steel bar must be fully annealed before bending. You have been asked to make a record of your findings and issue them for future use.

   In a written reference guide, describe in detail the annealing process you would use. Make reference to temperature, rate of cooling and properties of the steel. Use diagrams as appropriate.

3. For the two scenarios above, you must also report to the health and safety committee. State three pieces of relevant health and safety legislation and briefly explain how they apply."

1- The process of making the teeth of a gear wheel hard, but leaving the core ductile, is called Flame Hardening, it is a type of Surface Hardening process. The process includes a flame torch to go over a piece of material that the user would want to heat. Once the material is heated at the depth that they want it to be hardened, a water/high pressured air jet would follow on behind to cool the material instantly to make it hard. What the process is doing is making the selected area hard, whilst leaving the rest of the material at its original state. The gear wheel is Medium Carbon Steel, so the carbon content is 0.5 to 0.9% Carbon, at this carbon content, the first tooth needs to be heated up to 725°C to 785°C, in the upper critical Temperature zone. When the tooth is heated to a specific depth, the flame jet goes along the tooth, with a water jet straight behind it. The water jet quenches the tooth which is rapid cooling, which produces a very hard structure known as martensite (Very hard form of steel crystalline structure). The faster the cooling is, the harder the tooth will be. Once the tooth is complete, the next tooth can be started using the same process, keep going until all the teeth are done on the gear wheel.