3.5 Heat Treatment

Heat treatment describes the process of heating and cooling metals in a controlled manner. This allows changes to be made to the properties of the metal, such as increasing its hardness or reducing its brittleness.

Hardening and tempering

Increasing the hardness of steel is only possible where the steel contains more than 0.4% carbon. Full effects of hardening are only possible where the carbon content is over 0.8%. It is necessary to increase the hardness of steel used to make tools such as scribers, drills and punches. Tools like these must therefore be made from medium carbon steel or silver steel.

Annealing

As a metal is worked or deformed by bending, rolling or hammering, its structure changes. Its hardness increases as a result of this cold working and it becomes more difficult to work. To ease this, the material needs to be annealed. Annealing restores the initial structure of the material by relieving internal stresses.

Annealing involves heating the material to a certain temperature (depending what the material is) and being allowed to cool.

Case hardening

The only way to harden mild steel that does not contain much carbon is to case harden it.

To case harden material, it is heated to a cherry red colour, dipped into carbon powder and left to cool. This is repeated three or four times. The final time the metal is quenched in water.

Process	Advantages	Disadvantages
Hardening and tempering	Allows the hardness of a material to be increased for specific purposes	Once hardened most products need to be tempered Product has to be cleaned so that the colours can be seen Cannot harden steel which has a carbon content below 0.4%
Annealing	Allows materials to be softened which will enable further deformation to take place	Surface produces a scale when being heated and cooled which is difficult to clean
Case hardening	Only the external surface can be hardened, leaving the centre core still quite soft in comparison	Process has to be repeated several times in order to make a significant difference.