Part VI. : Heat treatment
Module 3 : Practical aspects of heat treatment

# 3 Practical aspects of heat treatment

This module is a very sketchy outline on some aspects of heat treatment and is included here for the sake of completion. The interested reader, as noted earlier, should consult [1] for details.

## 3.1 Furnaces, fixtures, atmospheres and temperature control

Heat treatment is typically carried out in furnaces; the furnaces can be heated using fuel or by electrical resistance. Typically, heating equipments which operate at lower temperatures are called ovens; however, in this module, we call all devices used for heating materials as furnaces.

The heating in a furnace takes place either through conduction or convection or radiation or any combination of these. Generally, higher temperatures involve heating through the mechanism of radiation.

The heat transfer media in a furnace can be gaseous or liquid; there are also furnaces with fluidised bed as the heat transfer media. In some cases, the furnace might be evacuated (vacuum furnaces); it is also possible to introduce controlled gaseous atmospheres (for example, Argon, steam, dry hydrgoen, and so on) in the furnace.

The heat treatment can be carried out in two ways: either batchwise or continuously.

It is common for workpieces that are to be heat treated to be kept in fixtures, baskets and trays to avoid distortion during heat treatment.

Of course, the most important aspect of furnace operation is the control on temperature. Temperature sensors and thermocouples along with temperature controls are, probably, the most important parts of a furnace.

## 3.2 Quenching media

Quenching is the rapid cooling of a heated material. How rapid is the cooling depends on the medium used for quenching. Water, brine solution, polymer

solutions, molten salts, oils and sometimes even molten metals are used for quenching.

The rate of cooling in a quenching medium is defined with respect to water; arbitrarily, (non-agitated) water is rated at 1.0. Agitated water could reach a ranking of about 4.0. Non-agitated and agitated brine have ratings of 2 to 5, while non-agitated and agitated oil rank between 0.25 and 1.0. Thus, by choosing the appropriate media, the severity of quench can be controlled, which, in turn will decide the microstructures and hence the properties.