Part VI. : Heat treatment
Module 4 : Quenching

4 Quenching

Quenching is the process of rapdily cooling a material from high temperature. As noted in the earlier module, this rapid cooling is achieved using quenching media.

The thickness of the material to be quenched along with the rate of cooling required helps to choose the quenching medium. The quenching medium has to be chosen carefully. If a quenching medium that cools slower than the required rate is chosen, the quench is not effective in producing the required microstructures and hence properties. On the other hand, if a quenching medium that cools faster than the required rate is used, then that can sometimes lead to defects such as warping and cracking.

There are many different types of quenching: quenching in a fine vapour or mist is known as fog quenching; if quenching is carried out directly from some other heat treatment operation (carburizing for example), it is known as direct quenching; if only some portions of a workpiece is quenched, it is known as selective quenching; and so on.

As noted earlier, quenching is also a method used to determine hardenability of materials.

Probably, the most common example of quenching is what is used in steels; an alloy quneched past the nose of the C-curve in the isothermal tranaformation diagram will undergo martensitic transformation, which, as noted will lead to high hardenss in the material.

It is also possible to rapidly quench molten metallic liquids to retain the liquid-like structure; such materials are commonly known as metallic glasses.

Quenching is generally carried out to freeze the high temperature structure or phase in the material; however, it is not always possible for the structure to be retained. As noted earlier, during quenching there could be mechanisms such as vacancies diffusing to the grain boundaries leading to PFZs (Precipitate Free Zones) that become operative.

4.1 Supplementary information

The heat transfer during quenching is very closely related to heat transfer during boiling; and, boiling is a very complicated phenomenon as far as the

energy transport is considered; see for example, the schematic boiling curve in Chapter 8 of Poirier and Geiger [3]. Poirier and Geiger also discusses the heat transfer phenomenon during quenching and their importance and we refer the interested reader to this excellent textbook.