EXPERIMENT NO.8

Object: *To temper a specimen and to find out difference in hardness due to tempering.*

Materials and Equipment: Carbon steel specimen (0.6% Carbon), box type heat treatment furnace, Rockwell hardness tester, pair of tongs, quenching bath, abrasive paper etc.

Theory: Heat treatment may be defined as a sequence of heating and cooling operations designed to get desired combination of properties. Before heating, microstructure of steel consists of ferrite, pearlite and cementite. During heating, a number of changes in the microstructure of steel take place. At lower critical temperature, pearlite changes to austenite. This transformation is completed at higher critical temperature. After the formation of austenite, steel is cooled at a definite cooling rate according to the properties desired. At higher cooling rate, formation of bainite and martensile take place, whereas a slower cooling rate leads to formation of ferrite and cementite.

Tempering is achieved by heating previously hardened steel to a temperature below the lower critical temperature for 1 to 2 hours followed by air cooling. Tempering temperature varies from 100^0C to 680^0C depending on requirement.

Procedure:

1. **Hardening of specimen:** Switch on the box type furnace and adjust temperature to 820^0C. When the temperature of the furnace has reached 820^0C, introduce the specimen into the furnace. Keep the specimen in the furnace for about 30 minutes. Then remove the specimen from the furnace with the help of a pair of tongs and quenched immediately in the quenching bath (Brine or 10% sodium chloride solution in water). Dry the specimen with the help of a piece of cloth and then rub off the scale by using an abrasive paper. Measure the Rockwell hardness and record the hardness in the observation table.

2. **Tempering the hardened specimen:** For tempering the hardened specimen, place it into the furnace kept at about 400^0C and hold it there for about 30 minutes. Now remove it from the furnace and quench it in the quenching bath. Clean it, measure its hardness and record it in the observation table.

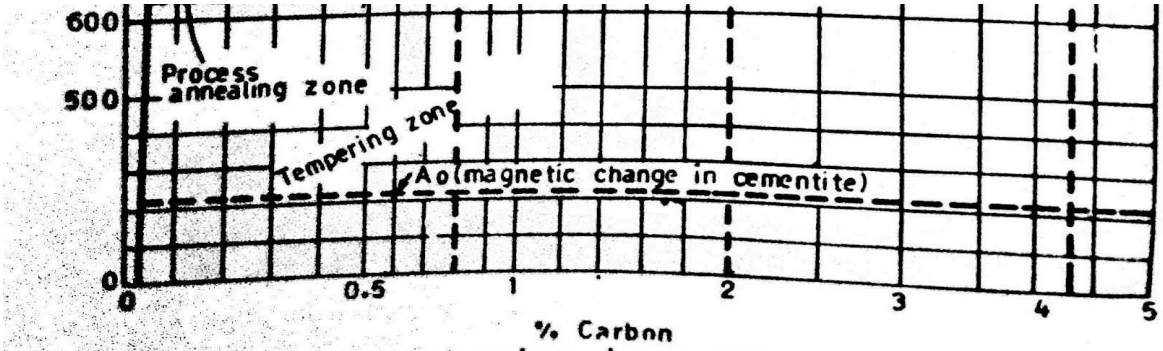


Fig 7.1 Heat treating zones on iron—iron carbide equilibrium diagram.

Observation:

Rockwell hardness number before tempering	Rockwell harness number after tempering				
	1	2	3	4	Mean

Precautions:

1. Never operate the furnace bare footed.
2. While placing or taking out the specimen from the furnace, use safety gloves and fire tongs.
3. Fire tongs should be dry and grip the specimen firmly.
4. Heating the specimen should be done to require temperature, as overheating the specimen may spoil it.