MSE-305

TTT-Diagram for Steel

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TTT diagram for eutectoid steel:

- TTT diagram is also called isothermal transformation diagram (Time- Temperature-Transformation).
- It is a plot of temperature versus the logarithm of time for a steel alloy of definite composition.
- It is used to determine when transformations begin and end for an isothermal [Constant Temperature] heat treatment of a previously austenitized alloy.
- The family of C-shaped curves at different T are used to construct the TTT diagrams.
- In this process material is cooled quickly to a given temperature before the transformation occurs, and then keep it at that temperature.
- At low temperatures, the transformation occurs sooner (it is controlled by the rate of nucleation) and grain growth (that is controlled by diffusion) is reduced.

- Slow diffusion process at low temperatures contributes to fine grained microstructure with thin-layered structure of pearlite (fine pearlite).
- At higher temperatures, high diffusion rates leads to grain growth and formation of pearlite (coarse pearlite: thick layered structure).
- At compositions other than eutectoid, a proeutectoid phase (ferrite and cementite) coexist with pearlite phase.
- TTT Diagram for Eutectoid Steel also called Isothermal Transformation Diagram.
- Time-Temperature-Transformation (TTT) diagram refers to only one steel of a particular composition at a time.
- This diagram is also called as S-curve isothermal (decomposition of austenite) diagram and Bain's curve.
- The consequence of time-temperature change on the microstructure of steel can be revealed by the TTT diagram.
- These diagrams are widely used in the calculation of the decomposition of austenite in heat-treatable steels.
- The iron-carbon phase diagram does not show time as a variable therefore the effects of different cooling rates on the structures of steels cannot be discovered.
- Although, the iron-carbon equilibrium diagram reveals on the phases and corresponding microstructures under equilibrium conditions but several useful properties of the steels can be obtained

under non-equilibrium conditions. For example TTT diagram of eutectoid steel (steel containing 0.8% Carbon).

- Austenite is stable above eutectoid temperature 727 °C.
- When steel is cooled to a temperature below this eutectoid temperature, austenite is transformed into its transformation products.
- TTT diagram relates the transformation of austenite to time and temperature conditions.
- Therefore, the TTT diagram indicates transformation products according to temperature and also the time required for complete transformation.
- First C-Curve from the left shows the start of transformation while curve on right shows the completion of the transformation.