

PMT6I102

FERROUS METALLURGY-II

Module I

Introduction: History of steel making, principles of steel making reactions viz decarburization, desulphurization, dephosphorisation, silicon and manganese reactions.

Slag theories: Molecular and ionic theories; interpretation of the above reactions in terms of ionic theory of slags. Open Hearth steel making practices.

L.D. Process: Design of converter and lance; quality of raw materials charged, operation, control of bath and slag composition, chemical reactions involved, temperature and residual bath oxygen control, use of oxygen sensor; some characteristics of L.D blow viz. emulsion formation, slopping, maneuvering lance height for dephosphorisation and decarburization. Catch Carbon technique. Recovery of waste heat.

Module II

OBM/Q-BOP process: Concept and operation of the process. Mixed / Combined blowing processes: Oxygen top blowing with inert gas purging at bottom; oxygen top blowing with inert and oxidizing gases at bottom, oxygen top and bottom: status in India.

Electric arc furnace: Advantages, charging, melting and refining practices for plain carbon and alloy steel; uses of DRI in arc furnace and its effect on performance. UHP electric arc furnace with D.C supply, single graphite electrode, oxygen lancing, oxyfuel burner, water cooled panel and computer control. Combination of blast furnace: EAF. Duplex processes of stainless steel making using VOD, AOD and CLU.

Induction Furnace: Special features, advantages and limitation.

Module III

Deoxidation of liquid steel: Requirements of deoxidizers, deoxidation practice, stoke'slaw, use of complex deoxidizers. Inclusions and their influence on quality of steel. Killed, semi-killed and rimming steel. Secondary refining of steel: Objectives; principles of degassing different industrial process such as DH, RH, VAD, SD, LF, and ESR; limitations and specific applications.

Continuous Casting of steel: Advantages; types of machines; mould lubrication and reciprocation. Development in C.C. Technology with respect to productivity, quality and energy conservation; Near Net Shape Casting.

Pollutant emissions from steel making processes and their control. Management of wastes from steelmaking operations.

Books for reference:

1. *Ironmaking and Steelmaking Theory and Practice* by A. Ghosh and A. Chatterjee, PHI.
2. *Steel Making* by A.K.Chakravorty, PHI
3. *Physical Chemistry of Iron and Steel Manufacture* by C. Bodsworth, Longman Green & Co.
4. *Physical Chemistry of Iron and Steel Making* by R.G.Ward, ELBS and Edward Arnold 1962.
5. *The Making Shaping and Treating of Steel (Steelmaking Volume)*, R.J.FruehN (ed.), The AISE Steel foundation.
6. *Electric Furnace Steel Making: Design, Operation & Practice, Vol. I &II*, by C.E.Sims (ed), Interscience.
7. *Theoretical Principles of Electric Steel Making* by V.Atanseyev, Mir Publishers, Moscow
8. *Introduction to Modern Steel Making* by R.H.Tupkary, Khanna Publishers, New Delhi 1977.
9. *Principles of Secondary Processing and Casting of Liquid Steel* by A.Ghosh, Oxford &IBP 1990.
10. *Electrometallurgy of Steel and Ferro-Alloys, Vol I*, by F.P.Edneral, Mir Publishers.
11. *Proceeds of International Works hop on Environmental and Waste Management in Iron and Steel Industries, Dec 2 – 3, 1999, NML Jamshedpur.*

(Practical)

Suggested list of experiments:

1. *Flow sheets for different steel making processes*
2. *Charge calculation in steel making*
3. *LD Slag characterization using XRD.*
4. *Oxidation of sponge iron.*
5. *Decomposition kinetics of Dolomite.*
6. *Study of different parameters of EAF*