Steel and Iron Handbook

Author: B.P. Bhardwaj
Format: Paperback
ISBN: 9789381039304
Code: NI259
Pages: 472
Price: Rs. 1,775.00  US$ 150.00
Publisher: NIIR PROJECT CONSULTANCY SERVICES
Usually ships within 5 days

Modern civilization as people know it would not be possible without Iron and Steel. Iron has been a vital material in technology for well over three thousand years. However, since ancient times, steel is made by alloying iron with carbon to produce a harder, stronger metal that will take a much keener edge. Owing to its intense connections with core infrastructural segments of the economy, steel industry is of high priority and importance. Steel has probably the widest range of applications of any material. The wide range of alloy compositions, mechanical properties and product forms available make it a versatile material that is used in components and products that may be small or large, high-tech or low-tech, everyday or specialist.

In an introduction to modern steel making, an attempt has been made to cover, as the space would permit, the entire field of steel making with equal emphasis on the general practices and the underlying principles. This book is intended as a resource and as an introduction to the layman about our most important metal system. This book provides basic information covering every aspect of iron and steel production as well as a practical aid for workers engaged in the field. After an introduction that deals with the history and production of iron and steel, the rest of the book examines their physical properties and metallurgy.

Beginning with a brief introduction to the ferrous alloys and metals, types and production of cast iron, production of compacted Graphite Irons, Ductile Iron, Malleable Cast Iron and current status of steel making together with the reasons for obsolescence of Bessemer converter and open hearth processes, the book moves on to: elaborate the physiochemical principles involved in steel making; explain the operational principles and practices of the modern processes of primary steel making (LD converter, Q-BOP process, and electric arc furnace process); provide a summary of the developments in secondary refining of steels; discuss principles and practices of ingot casting and continuous casting of steels; discusses the defects in the steel produced and also the remedies for their removal. This book provides considerable information in an easily assimilable form and makes an ideal introduction to the complex subject of steel technology.

Contents

1. INTRODUCTION
   Type of Ferrous Alloys
   Specifications and Properties
   Applications and Uses
2. TYPES OF FERROUS METALS
   Carbon Steel
   Free Cutting Steels
   Plain Carbon Steels
   Limitations of Plain Carbon Steels
Alloy Steels
Effects of Alloying Elements in Steel
Classification of Alloy Steels
(a) Classification according to Chemical Composition
(b) Classification according to Structural Class
(c) Classification according to Purpose
Silicon Steels
Chrome-Silicon-Manganese Steels
(1) Low Alloy Manganese Structural Steels
(2) High Alloy Manganese Steels
Plain Nickel Steels
Nickel-Chrome Steel
Molybdenum Steel
Stainless Steels
(a) Classification on basis of alloys present
(b) Classification on the basis of microstructures
Spring Steels
Heat Resisting Steels
Magnetic Steels
Tool Steels
Bearing Steels
Cast Steels
Structural Steels
Cast Irons
Types of Cast Irons
Grey Cast Iron
White Cast Iron
Chilled Cast Iron
Mottled Cast Iron
Malleable Cast Iron
Ferrochromium
Ferromanganese
Ferromolybdenum
Ferronickel
3. TYPES OF CAST IRON
Properties of Cast Iron
Tensile Strength
High Compressive Strength
Low Melting Point
Resistance to Deformation
Resistance to Oxidation
Grey Cast Iron
Composition
Properties
Uses
White Cast Iron
Composition
Properties
Uses
Malleable Cast Iron
Composition
Properties
Uses
Ductile (Nodular) Cast Iron
Composition
Properties
Uses
Casting of Cast Iron
Alloy Cast Iron
Heat Resisting Cast Iron
Temperatures upto 600ºC
Temperature upto 700ºC
Temperatures upto 750ºC
Temperatures upto 850ºC
Temperatures upto 1000ºC
Corrosion Resistant Cast Irons
Wear Resistant Cast Irons
Low alloy Cast Irons
Ni-Hard Irons
High CR-MO Irons
High Chromium Irons
Physical Properties of Cast Irons
Cast Iron Microstructure Anomalies and Their Causes
(1) Anomalies Associated with Solidification
(2) Anomalies Resulting from Processing After Solidification
(3) Other Anomalies
High-Chromium White Iron
Grey Iron
Ductile Iron
Compacted Graphite Iron
Malleable Iron
Unalloyed White Iron Microstructures
Microstructures
(a) Microstructure of Graphite
Flake Graphite in Grey Iron
Nodular Graphite in Ductile Iron
Temper Graphite in Malleable Iron
(b) Microstructure of Matrix
4. FOUNDRY PROCESS OF CAST IRON
Cupola Melting
Cold Blast Cupola Operation
Coke
Fluxes
The Metallic Charge
Harmful Materials
Size of Metallic Charge Materials
Cupola Charge Calculation
Cupola Out Put
Emissions from Cupolas
The Long Campaign Hot Cupola
The Cokeless Cupola
Electric Melting
The Channel Furnace
The Coreless Induction Furnace
Charge Materials
Alloy Recovery
Slag Removal
Refractories for Coreless Induction Furnaces
Operating Systems
Fume Extraction
Shop Floor Control of Metal Composition
5. INOCULATION OF GREY CAST IRON
   Introduction
   Ladle Inoculation
   Control Methods
   Late Stream Inoculation
   Mould Inoculation
6. PRODUCTION OF COMPACTED GRAPHITE IRONS
   Introduction
   Production of Compacted Graphite Iron
   Foundry Properties of Compacted Graphite Iron
   Application of Compacted Graphite Irons
   Properties of Compacted Graphite Irons
7. PRODUCTION OF DUCTILE IRON
   Treatment Methods Include
   Melting Ductile Iron Base
   Cupola Melting and Duplexing
   Induction Furnace Melting
   Pure Magnesium Converter Process
   Cored Wire Treatment
   In-The Mould Treatment
   Inhibiting Elements
   Inoculation and Fading
   Specifications for Ductile Cast Iron
   Heat Treatment of Ductile Iron
   Stress Relief
   Breakdown of Carbides
   Annealing to Produce a Ferritic Matrix
   Normalising to Produce a Pearlitic Matrix
   Hardened and Tempered Structures
   Austempered Ductile Iron (ADI)
   Casting Ductile Iron
8. MALLEABLE CAST IRON
   Introduction
   White Heart Malleable
   Black Heart Malleable Iron
   Specifications for Malleable Cast Irons
9. MANUFACTURE OF STEEL
   Cementation Process
   Crucial Process
   Bessemer Process
   Advantage and Disadvantages of Bessmer Converter
   Open Hearth Process
   Electric Process
   Advantages of the Electric Furnaces
   LD Process
   Duplex Process
   Kaldo Process
10. PRINCIPLES OF STEELMAKING
Introduction
Thermodynamics of Refining
Carbon Reaction
Phosphorus Reaction
Silicon Reaction
Manganese Reaction
Sulphur Reaction
Kinetics of Refining
Reactions at Slag-Metal Interface
Carbon Reaction
Mechanism of Oxygen Transport and Kinetics of Carbon-Oxygen Reaction
Importance of Decarburisation Reaction
Thermal Principles of Refining
Thermal Efficiency of Steelmaking Processes
Conventional Pneumatic Processes
Conventional Open Hearth Process
Refining by Oxygen
Preheating of Charge in Steelmaking
Deoxidation of Steel
Thermodynamics of Deoxidation
Kinetics of Deoxidation
Mechanism of Deoxidation
Deoxidation Practice
Plain Carbon Steel Production
Alloy Steel Production
Tapping Temperature
Production of Ingots by Casting
Control of Refining
11. SLAGS
Slag Properties
Theories of Slags
Molecular Theory
Ionic Theory
12. RAW MATERIALS FOR STEELMAKING
Sources of Metallic Iron
Pig Iron
Steel Scrap
Sponge Iron or DRI
Scrap Proportion in Charge
Scrap Preparation
Oxidising Agents
Fluxes
Sources of Heat
Chemical
Electrical
Deoxidisers and Alloying Additions
Furnace Refractories
Storage Facilities
Mixer (Inactive)
Pretreatment of Hot Metal
Acid Burdening of Blast Furnace and External Desulphurisation
Basic Burdening of Blast Furnace and External Desiliconisation
Modern Approach to Pre-treatment of Hot Metal
13. LAYOUT OF STEELMAKING SHOP
Location
Size
Lay-Out

14. MODERN STEELMAKING
Modern Steelmaking-History
Modern Steelmaking—Bofild Steel Making
Modern Steelmaking OBM/Hybrid Steelmaking
Installation Cost Advantage
Product Quality
Production Rate
Modern Steelmaking—Electric Arc Furnace (EAF) Steelmaking
Design Modification
Process Modification
Charge Modification
Modern Steelmaking—Induction Furnace Steelmaking

15. OPEN HEARTH SHOP
Furnace Construction
Reaction Chamber
Gas and Air Uptakes (Downtakes)
Slag Pocket
Gas and Air Checkers
Flues and Stack
Reversing Valves
Launder
Tilting Open Hearth Furnace
Furnace Instrumentation and Control
Materials Handling
Heat Supply
Thermal Efficiency of the Process
Types of Open Hearth Practices
Charge-Ore
Oreing Practice
Oxygen Lancing Practice
Consumable Lance
Water Cooled Lance

16. MODERN STEEL MAKING TECHNOLOGY
Introduction
Analytical Requirements
Desulfurization and Sulfide Shape Control
Dephosphorization
Homogenization
Vacuum Treatment
Continuous Casting

17. MODERN OPEN HEARTH PRACTICE
Materials Handling
Refractories
Faster Working
Heat
Charging and Heating
Refining
Blocking
Deoxidation and Finishing
Concluding Remarks
BOH Process Products
18. ELECTRIC ARC FURNACE PROCESS
Electric Heating
Electric Arc Furnace
Furnace Body
Gears for Furnace Body Movements
Roof
Electrode and Its Support
Transformer
Power Ratings and Consumption
Charging
Charge Materials
Plain Lay-out
Arc Furnace Operation
Process Types Known by their Slags
General Outline of an arc Furnace Heat
(1) Furnace Preparation
(2) Charging
(3) Melt-down
(4) Refining
(5) Finishing and Taping of a Single Slag Heat
(6) Slag off and Making Reducing Slag
(7) Finishing and Tapping of a Double Slag Heat
19. MODERN ELECTRIC ARC FURNACE
Design Considerations
Process Modifications
Charge Modifications
Improved Management Philosophy
Ultra High Efficiency Steelmaking
Design Improvements
Rapid Melting Techniques
Water cooled Panels
Bottom Tapping
Emission and Noise Control
Switch Gear
Automatic Alloy Feeder
Coated and Water Cooled Electrode
Oxygen Lance
Process Modifications
Foamy Slag Practice
Scrap Pre-heating
Coupling with Ladle Furnace
Other Process Modifications
Charge Modifications
(1) Sponge/DRI as Charge Materials
(2) Melting - Refining of Sponge Iron
Prospects of DRI-EAF Combination
Modern Arc Furnace Practice
Stainless Steelmaking
Concluding Remarks
20. INDUCTION FURNACE
Arc Furnace Practice for Carbon and Low Alloy Ingot Steels
Arc Furnace Practice for Carbon and Low-alloy Steels for Casting
Arc Furnace Practice for Tool steels and special alloy steels
Conventional Arc Furnace Practice of Stainless Steel making
Scope of the Process
21. STEELMAKING BY BASIC OXYGEN FURNACE
Steelmaking by Kaldo Process
Kaldo Plant
Heat
Process Control
Operating Results
Concluding Remarks
LD - Kaldo Process
Steelmaking by Rotor Process
Plant Design
Operation
Control
Operating Results
Concluding Remarks
22. STEELMAKING BY OXYGEN BOTTOM BLOWING
PROCESSES
OBM Process
Operation of OBM Process
Metallurgy of Bottom Blowing Process
Modern Development
Concluding Remarks
Future Prospects of OBM
Applicability Under Indian Conditions
23. LD PROCESS PLANT AND EQUIPMENTS
LD Shop
LD - Vessel
Vessel Design
The Oxygen Lance
The Hood and the Waste Gas Treatment
Vessel Lining and Wrecking Accessories
Refractories
Lining
Wrecking and Relining the Vessel
Materials Handling and Storage Facilities
Instrumentation
24. STEELMAKING BY LD PROCESS
The Charge Materials
Hot Metal
Cold Pig Iron
Fluxes
Scrap and Ore
Oxygen
Heat
Practice at Rourkela Steel Plant
Characteristics of LD Process
Process Control
Process Economics
Out put
Slag
Yield
Products

25. DEVELOPMENT IN LD PROCESS
LADAC or OLP Process
High Carbon and Alloy Steelmaking
Carbon Steels
Alloy Steelmaking
Stainless Steelmaking
LAM Process
High Percentage Scrap Melting Techniques
OG Process
LD-CL Process
Sub-Lance LD Process
Fre on Turbine
Automation and Process Control
Concluding Remarks

26. STEELMAKING BY HYBRID PROCESSES
Introduction
Hybrid Process Spectrum and Their Characteristics
Bottom Gas Purging Design
Hybrid Blowing Design Considerations
Metallurgical Superiority of Hybrid Blowing
Future of Hybrid Processes
Some Hybrid Plant Details
LBE Process
LD KG Process
LD-AB Process
LD-OB Process
STB Process
LD-HC Process
K-BOP Process
KM/ OBM-S Process
Hybrid Process at Tata Steel

27. SECONDARY PROCESS OF STEELMAKING
(A) Tundish Technology
Argon Bubbling in a Tundish
Tundish Heaters
(B) Ajax Process
(C) Tandem Furnace Process
(D) Continuous Steelmaking Processes
(E) SIP Process
(F) EOF-Process
(G) Twin Hearth Process (Dual Hearth Furnace Process)
(H) Perrin Process
(I) AOD Process
(J) VOD Process
(K) CLU Process
(L) MRP Process
(M) VAR and ESR Processes
(N) Secondary Refining Furnaces
(O) Ladle Furnace (LF)

28. GASES IN STEEL
(A) Oxygen in Steel

NIIR Project Consultancy Services (NPCS) 9/10
(B) Nitrogen in Steel
(C) Hydrogen in Steel

29. DEFECTS AND REMEDIES OF STEEL

Blow Holes
Columnar Structure or Ingotism
Segregation
Non-Metallic Inclusions
Internal Fissures and Hairline Cracking
Surface Defects
Ingot Crakes

About NIIR

NIIR PROJECT CONSULTANCY SERVICES (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.


NPCS also publishes varies process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

NIIR PROJECT CONSULTANCY SERVICES, 106-E, Kamla Nagar, New Delhi-110007, India. Email: npcs.india@gmail.com Website: NIIR.org

Sat, 18 Jan 2020 18:32:05 +0530