

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 600°C
Temperature upto 700°C
Temperatures upto 750°C
Temperatures upto 850°C
Temperatures upto 1000°C
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 Output
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 Bessemer 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

Vaccum 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

KMs/ 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

(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.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes various 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

Thu, 25 Apr 2019 23:33:58 +0530