

Steel and Iron Handbook

Author:- B.P. Bhardwaj

Format: paperback

Code: NI259

Pages: 472

Price: Rs.1775US\$ 150

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.

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 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 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 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.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.

NIIR PROJECT CONSULTANCY SERVICES, 106-E, Kamla Nagar, New Delhi-110007, India.

Email: npcs.india@gmail.com Website: NIIR.org

Fri, 09 May 2025 06:33:34 +0000