

# The Complete Book on Non-Ferrous and Precious Metals with Electroplating Chemicals

**Author:-** Dr. H. Panda

**Format:** paperback

**Code:** NI256

**Pages:** 558

**Price:** Rs.1975US\$ 200

**Publisher:** NIIR PROJECT CONSULTANCY SERVICES

Usually ships within 5 days

Non-ferrous metals are those which don't have any iron content. These are specified for structural applications requiring reduced weight, higher strength, nonmagnetic properties, higher melting points, or resistance to chemical, atmospheric corrosion and also for electrical and electronic applications.

A precious metal is a rare, naturally occurring metallic chemical element of high economic value. Although they have industrial uses, they are better known for their uses in art, jewellery and coinage. Depending on the end use, metals can be simply cast into the finished part, or cast into an intermediate form, such as an ingot, then worked, or wrought, by rolling, forging, extruding, or other deformation process.

Electroplating is a procedure that uses electrolysis to apply a thin layer of a metal over the surface of another metal. Electroplating chemicals are used to change the surface properties of an object such as abrasion and wear resistance, corrosion protection, lubricity, etc. This chemical is widely demanded in automotive, electronics, telecommunications, aerospace and precision engineering industries. This handbook explains different extraction and production processes with flow diagrams of various non ferrous and precious metals.

Major contents of the book are Silver, Gold, Copper, Complex salts of copper, silver and gold, magnesium, chromium, platinum group of metals, nickel, zinc, lead, aluminium, mercury, cobalt, sodium, sodium chloride, soda ash, sodium sulfate, glauber salt, hydrochloric acid, sodium silicate, sodium sulfides, sodium thiosulfate, sodium bisulfate, anhydrous, sodium hyposulfite, liquid chlorine, hydrides of boron, silicon, sulfuric acid, nitric acid, ammonium nitrate, hydrazine, hydrogen cyanide, melamine, amines, aniline, isocyanates, phosphorus, tin, ferroalloys, manganese, bismuth, cerium, phosphoric acid, tungsten, niobium and tantalum etc.

It will be a standard reference book for professionals, entrepreneurs, engineers, those studying and researching in this important area and others interested in the field of non ferrous, precious metals and electroplating chemicals.

## 1. SILVER

Extraction by Chloridizing Roasting

Extraction by Cyanidation

Recovery from Base Metal Ores

Parke's Process

Silver Production in India

Silver Nitrate

Industrial Applications

Photography

2. GOLD

Extraction of Gold

Amalgamation Process

Chlorination Process

Cyanidation Process

Gold Extraction in India

Compounds of Gold

3. COPPER

Uses

Harmful Impurities in Copper

Pyrometallurgical Extraction of Copper

Sources of Copper

Extraction of Copper from Sulphide Ores

Concentration

Roasting

Smelting

Converting

Slagging Stage

Blister Formation Stage

Refining

Fire Refining

Electrolytic Refining

Newer Processes for Copper Extraction

Flash Smelting

Continuous Copper Production

WORCRA Process

Noranda Process

Mitsubishi Process

Smelting Furnace

Slag-cleaning Furnace

Converting Furnace

TORCO Segregation Process

Energy Concepts in Copper Smelting

Hydrometallurgy of Copper

Ferric Chloride Leaching

Leaching of Low-Grade Ores

Leaching of Roasted Sulphide Concentrates

Production of Copper in India

Indian Copper Complex

Khetri Copper Complex

Compounds of Copper

4. COMPLEX SALTS OF COPPER, SILVER AND GOLD

Complex Compounds of Silver

Complex Salts of Gold

5. MAGNESIUM

Uses

Nonstructural Uses

Alloying  
Deoxidation and Desulphurization  
Modifying Structure of Graphite in Cast Irons  
Pyrotechnics and Photography  
Cathodic Protection  
Structural Uses  
Magnesium Ores  
Methods of Magnesium Extraction  
Magnesium from Sea-Water  
Pidgeon Process  
Equipment and Operation  
Reaction Mechanism  
Energy Required for the Pidgeon Process  
Magnotherm Process  
Magnesium Production in India  
NML Process  
CECRI Process  
Magnesium  
Dow Process  
Electrolysis of Magnesium Chloride

## 6. CHROMIUM

Uses  
Occurrence  
Metal Extraction  
Electrolytic Chromium  
Chrome Alum Process  
Chromic Acid Process

## 7. PLATINUM GROUP OF METALS

Extraction of Platinum Group Metals  
Compounds of Platinum

## 8. NICKEL

Uses  
Extraction of Nickel by Pyrometallurgy  
Extraction from Sulphide ores  
Nickel Sulphide Ore Processing at Sudbury (Canada)  
Smelting of Nickel Concentrate  
Carbonyl Process for Refining Nickel  
Electrolytic Refining of Nickel  
Extraction of Nickel from Oxide Ores  
Pyrometallurgical Processing  
DTA (Differential Thermal Analysis) of Lateritic Ores  
Selective Nickel Reduction  
Reduction Smelting  
Ferronickel Production  
Matte Smelting  
Pyrometallurgical Processing followed by Hydrometallurgy  
Ammoniacal Leaching  
Other Leachants  
Pyrometallurgical Processing followed by Carbonylation  
Hydrometallurgy  
Hydrometallurgy of Nickel Sulphide Concentrates  
Other Metals from Sulphide Ores  
Compounds of Nickel

## 9. ZINC

Uses

Extraction of Zinc

Sources of Zinc

Pyrometallurgical Extraction of Zinc

Horizontal Retort Reduction

Vertical Retort Reduction

Hydrometallurgical Extraction of Zinc

Imperial Smelting Process (ISP)

Production of Other Metals by ISP

Lead Recovery

Precious Metals Recovery

Copper Recovery

Arsenic, Antimony, and Bismuth Recovery

Tin Recovery

Cadmium Recovery

Zinc from Lead Slags by Slag Fuming

Production of Zinc in India

HZL Debari Plant

Treatment of Complex Sulphides of Lead, Copper and Zinc

Gravity Concentration

Differential Flotation

Retort Distillation

Electrolysis

Liquation

Rectification

Lead Blast Furnace Smelting

Selective Roasting

Reverberatory Smelting

Hydrometallurgical Treatment of Complex Sulphides

Solvent Extraction

Compounds of Zinc and Cadmium

## 10. LEAD

Uses

Extraction of Lead

Occurrence

Treatment of Ore and Production of Metal

Treatment of Base Bullion

Drossing

Parke's Process for Desilverization of Lead

Dezincing

Debismuthizing

Electrolytic Refining

Modern Developments in Lead Smelting

Outokumpu Flash Smelting

Direct Smelting in Converter

Flash Smelting with Oxygen

KIVCET Process

WORCRA Process

Q-S Process

TBRC (Top-Blown Rotary Converter) Smelting

Production of Lead in India

Tundoo Plant

Tundoo Blast Furnace

Lead Refining

Compounds of Lead

1. Lead monoxide or litharge  $PbO$

2. Red lead,  $Pb_3O_4$

3. Lead dioxide,  $PbO_2$

4. Basic Lead Carbonate or White Lead,  $Pb(OH)_2 \cdot 2PbCO_3$ —Dutch Process, Carter's Process, Electrolytic Process

11. ALUMINIUM

Uses

Aluminium Ores

Extraction of Aluminium

Bayer Process for Alumina Production

Factors Affecting Bayer Process

Hall-Heroult Process

Decomposition Potential of  $Al_2O_3$  Dissolved in Cryolite

Influence of Hydrogen or Methane Injection at Anode

Actual Decomposition Potential

Electrolytic Reduction Cell

Cell Operation

Role of Cryolite in Electrolysis

Theory 1

Theory 2

Factors Influencing Electrolysis

Electrolytic Refining of Aluminium

Methods of Treating Low-Grade Ores

Lime Sinter Process

Deville-Pechiney Process

Serpeck Process

Production of Aluminium in India

The Alumina Plant at Hindalco

The Reduction Plant at HINDALCO

Environmental Considerations in Aluminium Production

Newer Processes for Aluminium Production

ALCOA Process

Toth Process

ALCAN Process

Properties of Aluminium: Physical

Compounds of Aluminium

Ceramics Industry

12. MERCURY

Extraction of Mercury

Compounds of Mercury—Experimental evidences to show that mercurous ion is  $Hg^{2+}$

13. COBALT

Compounds of Cobalt

14. SODIUM

Production of Sodium

Downs's Process

15. SODIUM CHLORIDE

16. SODA ASH

Soda Ash, The Commercial Sodium Carbonate

Solvay Process

Soda Ash from Other Sources

Soda Ash Related Products

17. SODIUM SULFATE

Salt Cake

18. GLAUBER SALT

19. HYDROCHLORIC ACID

20. SODIUM SILICATE

Bormine and Bromides

21. SODIUM SULFIDES

22. SODIUM THIOSULFATE

23. SODIUM BISULFITE, ANHYDROUS

24. SODIUM HYPOSULFITE (HYDROSULFITE)

Caustic Soda and Chlorine

Electrolysis of Brine

The Electrolytic Cell

Purification of the Salt Solution

Diaphragm Cells

Concentration of the Caustic Liquor

The Mercury Cell

Hydrogen Disposal

Other Processes for the Production of Chlorine

25. LIQUID CHLORINE

Bleaches

26. HYDRIDES OF BORON

Historical

Methods of Preparation

Properties

Chemical

Oxyacids of Boron

Orthoboric Acid,  $H_3BO_3$

Properties

Borax,  $Na_2B_4O_7 \cdot 10H_2O$  Preparation

Properties

Perboric Acid and Perborates

Preparation

Properties

Structure

Industrial Applications

27. SILICON

Hydrides of Silicon

Silicon Tetrahydride, Silicane, or Monosilane,  $SiH_4$

Preparation

Properties

Silicoethane, Disilicane, or Disilane,  $Si_2H_6$

Properties

Silicopropane, Trisilicane or Trisilane,  $Si_3H_8$

Preparation

Properties

Silicobutane, Tetrasilicane or Tetrasilane,  $Si_4H_{10}$

Silicopentane,  $Si_5H_{12}$  and Silicohexane,  $Si_6H_{14}$

Silico-acetylene,  $(Si_2H_2)_n$

Structural Considerations

Short Note on Silicones

Structure of Silicates

Simplest Silicates  
Mixed Silicates  
Three Dimensional Networks—Felspar and Zeolites  
Water Softening  
Regeneration  
Ultramarine  
Halogen Compounds of Silicon  
Silicon Tetrafluoride  $\text{SiF}_4$   
Hydrofluosilicic Acid,  $\text{H}_2\text{SiF}_6$   
Silicon Tetrachloride  
Active silica  
28. SULFURIC ACID  
Uses of Sulfuric Acid  
Kinds of Acid  
The Manufacture of Sulfuric Acid  
Development of the Sulfuric Acid Industry  
The Chamber Process for Making Sulfuric Acid  
The Contact Process  
29. NITRIC ACID  
Processes  
Uses of Nitric Acid  
30. AMMONIUM NITRATE  
31. HEXAMETHYLENETETRAMINE  
32. HYDRAZINE  
Manufacture  
Stabilization  
33. UREA  
Uses of Urea  
34. HYDROGEN CYANIDE  
35. ACRYLONITRILE  
36. MELAMINE  
37. AMINES  
38. ANILINE  
39. ISOCYANATES  
Other Nitrogen Compounds  
40. PHOSPHORUS  
Manufacture of Phosphorus  
Modern Electric Process  
Manufacture in India  
Purification  
Smithel's Cold Flame  
Luminescence  
Manufacture of Red Phosphorus  
Hydrides of Phosphorus  
Phosphorus Trihydride, or Phosphine  $\text{PH}_3$   
Properties  
Phosponium Iodide,  $\text{PH}_4 \text{I}$   
Hydrogen Hemiphosphide,  $\text{P}_2\text{H}_4$   
Hydrogen Diphosphide,  $\text{P}_{12}\text{H}_6$   
Other Hydrides of Phosphorus  
Oxides of Phosphorus  
Phosphorus Tetroxide,  $\text{P}_4\text{O}$   
Properties

Phosphorus Hemtoxide, P<sub>2</sub>O

Phosphorus Trioxide, P<sub>4</sub>O<sub>6</sub>

Properties

Structure

Phosphorus Tetroxide, P<sub>2</sub>O<sub>4</sub>

Preparation

Properties

Phosphorus Pentoxide, P<sub>2</sub>O<sub>5</sub>

Modes of formation

Preparation

Manufacture

Properties

Chemical

Industrial Applications

Structure

Oxyacids of Phosphorus

Hypophosphorous Acid, H<sub>3</sub>PO<sub>2</sub>

Properties

Detection

Evaluation

Phosphorous Acid, H<sub>3</sub>PO<sub>3</sub>

Preparation

Properties

Constitution

Pyrophosphorus Acid, H<sub>4</sub>P<sub>2</sub>O<sub>5</sub>

Preparation

Properties

Constitution

Metaphosphorous Acid, (HPO<sub>2</sub>)<sub>n</sub>

Preparation

Properties

Hypophosphoric Acid, H<sub>4</sub>P<sub>2</sub>O<sub>6</sub>

Preparation

Structure

Orthophosphoric Acid, H<sub>3</sub>PO<sub>4</sub>

Manufacture

Thermal Process

Volatilization Process

Properties

Constitution

Orthosphates

Preparation

Detection

Evaluation

Pyrophosphoric Acid, H<sub>4</sub>P<sub>2</sub>O<sub>7</sub>

Preparation

Properties

Constitution

Metaphosphoric Acid, (HPO<sub>3</sub>)

Preparation

Permonophosphoric Acid, H<sub>3</sub>PO<sub>5</sub>

Perdiphosphoric Acid, H<sub>4</sub>P<sub>2</sub>O<sub>8</sub>

Halogen Compounds of Phosphorus



Phosphorus Trichloride  
Phosphorus Pentachloride,  $PCl_5$   
Phosphoryl Chloride,  $POCl_3$

#### 41. TIN

Uses

Concentration of Tin Ores  
Smelting of Tin Concentrate  
Reverberatory Furnace Smelting  
Rotary Furnace Smelting  
Refining of Tin  
Pyrometallurgical Refining of Tin  
Electrolytic Refining of Tin  
Compounds of Tin

#### 42. FERROALLOYS

General Methods of Producing Ferroalloys  
Beneficiation  
Carbon Reduction  
Aluminothermic Reduction  
Analysis of Aluminothermic Reduction of Manganese Ores  
Aluminothermic Process Versus Carbothermic Process  
Refining of Ferroalloys  
Production of Individual Ferroalloys  
Ferromanganese  
Ferrosilicon  
Ferrochromium (Ferrochrome)  
Charge Chrome  
Ferrotitanium  
Ferrotungsten  
Ferromolybdenum  
Ferrovanadium  
Compounds of Iron

#### 43. MANGANESE

Uses

Electrolytic Manganese  
Compounds of Manganese

#### 44. ANTIMONY

Extraction of Antimony

#### 45. BISMUTH

Extraction of Bismuth

#### 46. CADMIUM

Production of Byproduct Cadmium

#### 47. CERIUM

Compounds of Cerium

#### 48. PHOSPHORIC ACID

Production of Elemental Phosphorus and Phosphoric Acid  
Industrial Phosphates  
Wet-Process Phosphoric Acid

#### 49. INDIUM

Properties

Methods of Manufacture

Commercial Grades

Indium Compounds

Oxides

Chlorides  
Bromides  
Iodides  
Fluorides  
Sulfides  
Sulfates  
Nitride  
Other Salts  
Indium Alkyls  
Other Organic Indium Compounds  
Methods of Analysis

Procedure

## 50. TUNGSTEN

Uses

Occurrence and Extraction

## 51. VANADIUM

Uses

## 52. NIOBIUM AND TANTALUM

Sources of Niobium and Tantalum

Extraction of Niobium and Tantalum

Niobium and Tantalum in India

## 53. MOLYBDENUM

Molybdenite Roasting

## 54. TITANIUM

Sources of Titanium

Treatment of Ilmenite for Upgradation

Electric Smelting of Ilmenite

Acid Leaching of Ilmenite

Halogenation of Ilmenite

Upgradation Processes

Smelting of Ilmenite: Sorel Process

Direct Acid Leaching of Ilmenite

Hydrochloric Acid Digestion of Ilmenite

Sulphuric Acid Digestion of Ilmenite

Solid-State Reduction of Ilmenite Followed by Iron Removal

Preferential Chlorination of Ilmenite

Chlorination of  $TiO_2$

Production of Metallic Titanium by Reduction of Titanium Tetrachloride

Kroll's Process

Production of Ductile Titanium

Theory of Titanium Chloride Reduction by Sodium (Hunter's Process) and Magnesium (Kroll's Process)

Sodium Reaction

Magnesium Reduction

## 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.

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](mailto:npcs.india@gmail.com) **Website:** [NIIR.org](http://NIIR.org)

Sat, 17 May 2025 09:14:24 +0000