

The Complete Technology Book on Minerals & Mineral Processing

Author:- NPCS Board of Consultants & Engineers

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Mineral is defined as a naturally occurring solid chemical substance formed through biogeochemical processes, having characteristic chemical composition, highly ordered atomic structure, and specific physical properties. By comparison, a rock is an aggregate of minerals and/or mineraloids and does not have a specific chemical composition. Mineral resources of India are sufficiently rich and varied to provide the country with strong industrial base. The country is particularly rich in metallic minerals of the ferrous group such as iron ores, manganese etc. It has the world largest reserves in mica and bauxite. In the field of extractive metallurgy, mineral processing, also known as mineral dressing or ore dressing, is the process of separating commercially valuable minerals from their ores. Mining is the extraction of valuable minerals or other geological materials from the earth, from an ore body; the term also includes the removal of soil. Materials recovered by mining include base metals, precious metals, iron, uranium, limestone, etc. There are three methods of mining; conventional or manual mining, semi mechanised mining and mechanised mining. Geopolymerisation is the processes which can transfer large scale alumina silicate wastes into value added geopolymeric products with sound mechanical strength and high acid, fire and bacterial resistance. One of many useful applications of geopolymerisation is the immobilization of heavy metals and radioactive elements. The production of non ferrous metals from natural mineral ores is, in general, highly energy intensive. Some of the non ferrous mineral sources are bauxite, granite, magnesite, limonite etc. Limestone is a sedimentary rock composed largely of the minerals calcite and aragonite, which are different crystal forms of calcium carbonate (CaCO_3). Limestone processing includes several steps; primary crushing (jaw crusher, gyratory crusher, impact breaker), secondary crushing (cone crusher), fine grinding and pulverization, conveying, screening, washing, heavy media separation, optical mineral sorters, drying and storage. The non metallic mineral mining and quarrying industry segment covers a wide range of mineral extraction. Most of these minerals are found in abundance close to the surface, so underground mining is uncommon in this industry segment. Mineral resources of India are sufficiently rich and varied to provide the country with strong industrial base. The country is particularly rich in metallic minerals of the ferrous group such as iron ores, manganese etc. It has the world largest reserves in mica and bauxite.

This book basically deals with methods of mining, mining machineries, geopolymerisation of mineral products and waste, industrial and scientific aspects of non ferrous metals production, processing of alumina rich Indian iron ore slimes, limestone processing, limestone exploration and extraction, the mineralogy of asbestos, the use of asbestos and asbestos free substitutes in buildings, flotation column ;a novel technique in mineral processing, applications of thermal

plasma in the synthesis of covalent carbides, nitrogenous fertilizers, manufacture of ammonium bicarbonate etc.

This book is designed to describe the details of mining and processing of different minerals like alumina rich iron ore slimes, conversion of waste to a high valued product, lime stone, asbestos, coal beneficiation, gravity concentration processes to recover values from coal and ore fines and many more. The book is meant for everyone who wants to study about the subject or wants to venture into the field of mineral processing.

1. MINING

General Consideration

Mining Machineries

Methods of Mining

1. Conventional or Manual Method

2. Semi-mechanised Method

3. Mechanised Method

Mining of Other Decorative Stones

Conservation and Safety

Problems of Granite Mining

Geological Problems

Operational Problems

Environmental Problems

Status of Granite Mining in India

2. PROCESSING

General Consideration

Manual Methods

Mechanical Methods

1. Sawing

2. Polishing

3. Cutting and Polishing of Edges

4. Status of Granite Processing Industries in India

3. GEOPOLYMERISATION OF MINERAL PRODUCTS AND WASTE

Principles of Geopolymerisation

Reaction Mechanisms and Material Properties

Immobilisation of Heavy Metals and Radioactive Elements

Encapsulation of Organic Residue

Stabilisation of Mine Tailings

Concluding Remarks

4. INDUSTRIAL AND SCIENTIFIC ASPECTS OF NON- FERROUS METALS PRODUCTION

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Resources in India

The Developed Metals Industry

Environmental Aspects: Life Cycle Assessment (LCA)

Metals for Secondary Sources : The Energy Aspect

Extraction as a Separation Process

Application of Thermodynamics and Kinetics - Some Examples

R & D for the Future

Nonferrous Metallurgy at Regional Research Laboratory, Bhubaneswar

Processing of Ocean Nodules

Processing of Chromite Overburden

Concluding Remarks

5. THE IMPORTANCE OF USING A MULTIDISCIPLINARY APPROACH IN THE EVALUATION OF AMMONIA LEACHING BEHAVIOUR OF MULTIMINERAL SULPHIDES

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Research Practice/Methodology

1. Overall Aim of Leaching Studies

2. Raw Materials

3. Analysis of Feed Material, Leach Solution and Residues

4. Leaching as a process involving Parallel Reactions

5. Experimental Options and Limitations during Laboratory Studies

6. Analysis of Kinetic Data in Terms of Models

7. Selection of Experimental Conditions for Oxidative Ammonia Leaching of Multimetal Sulphides

Use of Multi-disciplinary Approach

1. Microscopic Studies

2. X-ray Diffraction (XRD) Studies

3. Thermal Analysis (TA)

4. Chemical Phase Analysis

5. Surface Area Measurements

6. Galvanic Interactions

Concluding Remarks

6. PROCESSING OF ALUMINA-RICH INDIAN IRON ORE SLIMES

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Motivation for the Beneficiation of Indian Iron Ores

Beneficiation Strategies for Indian Iron Ore Slimes

Selective Dispersion-flocculation Studies on Iron Ore Slimes

Concluding Remarks

7. CONVERSION OF A WASTE TO A HIGH VALUED PRODUCT

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Experimental

Results and Discussions

Concluding Remarks

8. DEFINITIONS AND PROPERTIES OF LIMES

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Physical Properties of Hydrated Limes

Chemical Properties of Quick and Hydrated Lime

9. ANALYTICAL TESTING OF LIMESTONE AND LIME

Physical Testing of Limestone

Limestone: Use Specifications

Limestone: Chemical Analyses

Physical Tests of Lime

Lime Materials Specifications

Lime: Chemical Analysis

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Secondary Crushing

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- Conveying
- Screening
- Washing
- Heavy-Media Separation
- Optical Mineral Sorters
- Drying
- Storage
- Portable Plants
- Environmental Controls
- Model of Ultramodern, High-Capacity Limestone Producer
- Costs
- Safety Record

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- Development of Kilns
- Vertical Kilns
- Rotary Kilns
- Coolers
- Internals
- Miscellaneous Kilns
- Chemical Analysis
- Refractory Linings
- Flexibility
- Fuels and Combustion
- Rotary Kilns
- Vertical Kilns
- Heat Balance
- Instrumentation
- Temperature
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- Equipment
- Classification of Quicklime
- Control of Kiln Particulate Emissions
- Dead-Burned Dolomite Production
- Oystershell Lime
- Precipitated Calcium Carbonate
- Hydraulic Lime
- Selective Calcination
- Manufacturing Costs
- Lime Plant Safety

12. LIMESTONE EXPLORATION AND EXTRACTION

- Exploration Criteria
- Land Use
- Zoning
- Coring
- Extraction of Limestone
- Stripping
- Disposal of Overburden
- Quarry Layout
- Mining Layout

- Drilling
- Blasting
- Loading
- Haulage
- Pumping
- Extraction without Blasting
- Environmental Controls

13. THE MINERALOGY OF ASBESTOS

- Introduction
- Definitions
- Chemical Composition
- Crystal Structures
- Serpentine Minerals
- Amphibole Minerals
- Occurrences
- Synthesis
- Optical Properties
- X-ray Diffraction Data
- Electron Optical Characteristics
- Non-asbestiform Amphibole and Serpentine Minerals

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- World Production
- Applications
- Structure
- Composition
- Chemical Reactions
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- Physical Properties of Asbestos Fibres
- Tensile Strength
- Surface Area
- Other Physical Properties
- Optical Properties
- Thermal Decomposition of Asbestos
- Amphibole Asbestos
- Chrysotile Asbestos
- Surface Properties of Asbestos
- Infrared Spectroscopic Data for Asbestos

15. THE IDENTIFICATION OF ASBESTOS IN SOLID MATERIALS

- Synopsis
- Introduction
- Sampling and Pre-treatment of Samples
- Analysis of Samples for Asbestos
- (1) Observation by Stereo-bionocular Microscope
- (2) The Action of Heat on Fibres
- (3) Optical Microscope Methods
- (4) Infrared Spectrophotometry
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16. THE USE OF ASBESTOS AND ASBESTOS-FREE SUBSTITUTES IN BUILDINGS

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(2) Lower Density Soft-surfaced Materials

(3) Sprayed Asbestos

(4) Other Asbestos-based Building Materials and Components

The Risks to Health in the Use of Asbestos in Buildings

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Labelling Schemes for Asbestos-based Building Materials

Other Safety Precautions for Building Operatives and Users

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(2) Lower Density Soft-surfaced Materials

(3) Sprayed or Floated Materials

(4) Other Building Materials and Components

The Asbestos Hazard in Perspective

The Future for Asbestos in Building

17. PROCESS MODELLING AND SIMULATION OF COAL BENEFICIATION FLOWSHEET

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Software Components

1. Coaldata.com

2. Flowdata.com

3. Coalben.com

Case Study

Discussion

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4. Use of HTS and IRMS Combination

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20. FLOTATION COLUMN – A NOVEL TECHNIQUE IN MINERAL PROCESSING

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Column Parameters and their Effect on Metallurgical Performance

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Manufacture of Ammonium Bicarbonate

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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

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