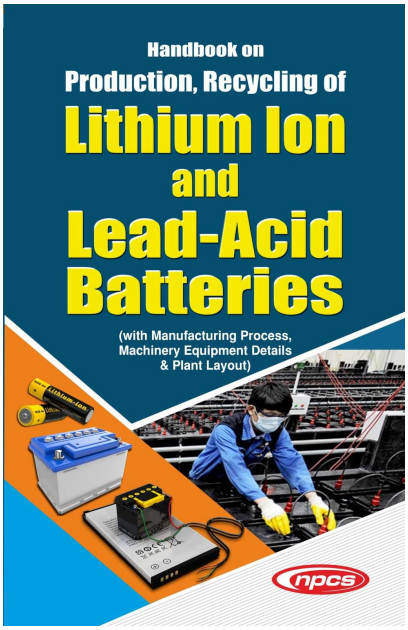
Entrepreneur India

106-E, Kamla Nagar, New Delhi-110007, India.
Tel: 91-11-23843955, +91 9097075054
Mobile: +91-9097075054
Email: npcs.ei@gmail.com, info@entrepreneurindia.co
Website: www.entrepreneurIndia.co



Handbook on Production, Recycling of Lithium Ion and Lead-Acid Batteries (with Manufacturing Process, Machinery Equipment Details & Plant Layout) (2nd Edition)

Code	NI330
Format	paperback
Indian Price	₹2999
US Price	$250

Pages	544
ISBN	9788195577507
Publisher	NIIR PROJECT CONSULTANCY SERVICES

Description

Handbook on Production, Recycling of Lithium Ion and Lead-Acid Batteries
(with Manufacturing Process, Machinery Equipment Details & Plant Layout)

India is one of the world's largest battery manufacturers. Furthermore, there is an increase in global demand for batteries, and Indian battery producers are preparing to satisfy this need. The Indian battery sector has grown by 25% year over year and is expected to increase even more in the future. Batteries, such as Sealed Maintenance Free (SMF), lead-acid, or lithium-ion batteries, now power virtually everything else on the world.
The global battery market was worth USD 108.4 billion and is predicted to increase at a CAGR of 14.1%. The increasing demand from the automotive application is responsible for the market's rise. Rechargeable batteries are utilised in non-rechargeable batteries and electric vehicles in the automobile industry. The rising global popularity of consumer electronics is expected to increase the use of lithium-ion batteries as a product category. Portable electronics, such as LCD displays, smartphones, tablets, and wearable devices like fitness bands, are in high demand, increasing market growth. Because of technical developments in terms of increased efficiency, cost-effectiveness, and product innovation, the market is predicted to rise significantly. Battery demand is likely to be driven by strict emission requirements imposed by government agencies in industrialized countries such as the United States and the United Kingdom, as well as an increasing focus on fuel efficiency.
The demand for lithium-ion batteries is predicted to increase by more than 500 percent in the future. Many predictions suggest that demand will outpace supply, virtually assuring a price increase. All of the businesses in this field have unique opportunities to invest in the future of energy storage and transportation.
The global lithium-ion battery market size was valued at USD 53.6 billion and is expected to grow at a compound annual growth rate (CAGR) of 19.0%. The market's expansion can be ascribed to the rising demand for lithium-ion batteries in electric vehicles (EVs) and grid storage, since they provide high-energy density and lightweight solutions. The market size is expected to grow due to an increase in the registration of electric vehicles.
The global lead–acid battery industry is growing significantly across the globe and it is likely to register a CAGR of 5.2% during the forecast period. Growing SLI applications

in the automobile sector, increase in renewable energy output, and rising demand for energy storage devices are some of the causes driving up demand for lead–acid batteries. As the telecom industry expands in nations like the United States, Brazil, India, and the United Kingdom, there is a growing demand for UPS systems as a backup power source, resulting in a higher usage of lead–acid batteries as a cost-effective energy source.

The book covers a wide range of topics connected to Batteries, as well as their manufacturing processes. It also includes contact information for machinery suppliers, as well as images of equipments.

A complete guide on Production, Recycling of Lithium Ion and Lead-Acid Batteries manufacture and entrepreneurship. This book serves as a one-stop shop for everything you need to know about the Battery manufacturing industry, which is ripe with opportunity for manufacturers, merchants, and entrepreneurs. This is the only book that covers Production, Recycling of Lithium Ion and Lead-Acid Batteries in depth. From concept through equipment procurement, it is a veritable feast of how-to information.

Content

1. INTRODUCTION
1.1. Principles of Operation
1.2. Primary Batteries
1.2.1. Zinc–Manganese Dioxide Systems
1.2.2. Zinc–Mercuric Oxide Battery
1.2.3. Zinc–Silver Oxide Battery
1.2.4. Lithium Batteries
1.2.5. Air-Depolarized Batteries
1.2.6. Other Primary Battery Systems
1.2.7. Storage Batteries
1.2.8. Lead-Acid Batteries
1.2.9. Alkaline Storage Batteries
1.2.10. Lithium Storage Batteries
1.3. Development of Batteries
2. BATTERY DESIGN AND FUNCTION
2.1. Lithium Ion Battery Electrochemistry and Function
2.1.1. Anode and Cathode Material Consideration
2.1.2. Cylindrical vs Prismatic Cell Design Tradeoffs
2.2. Battery Module Design Approach
2.3. Safety Considerations
3. INDUSTRIAL BATTERY OUTLOOK
3.1. The Lead-Acid Segment Expected to Dominate

the Market
3.2. Asia-Pacific to Dominate the Industrial Battery Market
4. FUTURE SCOPE OF LITHIUM ION BATTERIES
4.1. Present Day Lithium Ion Batteries
4.2. Deficiencies of Present Lithium Ion Batteries and
Likely Improvements
4.3. Li-Ion Batteries are Amazing Energy Storage Devices
4.4. The Future of Li-Ion Energy Storage
4.5. A Finite Resource
4.6. Early Li-Ion Battery Development

5. FUTURE OF LITHIUM-ION BATTERIES
AND ELECTRIFICATION
5.1. Major Trends
5.2. Technological Trends
5.3. Future Trends in Battery Technology
5.4. Conclusion
6. LITHIUM ION BATTERY
6.1. General Characteristics
6.2. Advantages
6.3. Classification
6.4. Chemistry
6.4.1. Lithium
6.4.2. Cathode Materials
6.4.3. Electrolytes
6.4.4. Cells Couples and Reaction Mechanisms
6.5. Characteristics of Lithium Primary Batteries
6.5.1. Summary of Design and
Performance Characteristics
6.5.2. Soluble-Cathode Lithium Primary Batteries
6.5.3. Solid-Cathode Lithium Primary Cells
6.6. Safety and Handling of Lithium Batteries
6.61. Factors Affecting Safety and Handling
6.7. Safety Considerations
6.8. Lithium/Sulfur Dioxide (LI/SO2) Batteries
6.8.1. Chemistry
6.8.2. Construction
6.8.3. Performance
6.9. Cell and Battery Types and Sizes
6.10.Use and Handling of Li/SO2 Cells and Batteries–
Safety Considerations

6.11. Applications
6.12. Lithium/Thionyl Chloride (Li/SOCl2) Batteries
6.12.1. Chemistry
6.12.2. Bobbin-Type Cylindrical Batteries
6.12.3.
6.12.4. Li/SOCl2 Cells, Flat or Disk-Type
7. LITHIUM-ION BATTERY APPLICATIONS
7.1. Personal Transportation Applications
7.2. Automotive Applications
7.3. Microhybrid Electric Vehicles
7.4. Hybrid Electric Vehicles
7.5. PHEVs and EREVs
7.6. Battery Electric Vehicles
7.7. Fuel Cell EVs
7.8. Bus and Public Transportation
7.9. HD Truck Applications
7.10. Industrial Applications
7.11. Robotics and Autonomous Applications
7.12. Marine and Maritime Applications
7.13. Grid and Stationary Applications
7.14. Bulk Energy Storage
7.15. Ancillary Services
7.16. Transmission and Distribution Infrastructure Services
7.17. Customer Energy Management Services
7.18. Community Energy Storage
7.19. Aerospace Applications
8. LITHIUM BATTERY MANUFACTURING
8.1 Electrode Coating
8.2. Cell Assembly
8.2.1. Prismatic Cells
8.2.2. Cylindrical Cells
8.3. Formation
8.4. Process Control
8.5. Support Services
8.6. Lithium ion Battery Pack Assembly Line Making Machine
8.6.1. Battery Cell Tester
8.6.2. Auto Paper Pasting Machine
8.6.3. Auto Sorting Machine
8.6.4. Spot Welding Machine
8.6.5. Integrated Tester
8.6.6. Charging Discharging Aging Machine

9. RECYCLING OF LITHIUM-ION BATTERIES
9.1. Repairing and Remanufacturing
9.2. Refurbishing, Repurposing, and Second Life
9.3. Second Life Partnerships
9.4. Recycling
9.5. Manufacturing Process
9.6. Manufacturing Equipments
9.6.1. Filter Press–Removal of the Black Mass
9.6.2. Filter Press–Removal of the Lithium Carbonate
9.6.3. Features
9.7. Evaporation and Heated Tank System
9.8. Clarifier
9.8.1 Features
9.9. Sludge Dryer
9.9.1. Features and Benefits
9.10. Thermal Evaporators
9.10.1. Benefits of Evaporators
9.11. Reverse Osmosis (RO)
9.11.1. Applications
9.12. Ultrafiltration
9.12.1. Attributes
9.13. Atmospheric Evaporators
10. ALUMINIUM–AIR BATTERY
10.1. Electrochemistry
10.2. Materials and Methods
10.2.1. Materials
10.2.2. Hydrogen Evolution and Half-Cell Test
10.2.3. Full-Cell Test
10.3. Results and Discussion
10.4. Aluminium-Air Battery: Discovery, Commercial Alloys and State of The Art
10.5. Discovery and Production
10.6.Commercial Aluminium Alloys
11. ALKALINE BATTERY
11.1. Electro-Chemical Description
11.2. Temperature Effects on Performance
11.3. Voltage and Capacity
11.4. Discharge Types
11.5. Shelf Life
11.6. The Shelf Life is influenced by Temperature,
Humidity and Internal Construction
11.7. Testing / Care / Warnings

11.7.1. Testing
11.7.2. Warnings
11.8. Current
11.9. Construction
11.10. Recharging of Alkaline Batteries
11.10.1. Leaks
11.10.2. Disposal
11.10.3. Alkaline Battery Recycling Industry
11.11. HOW ARE BATTERIES MADE?
12. METAL-AIR BATTERY
12.1. Anodes for Metal-Air Batteries
12.1.1 Lithium
12.1.2. Magnesium
12.1.3. Iron
12.1.4. Zinc
12.2. Cathodes for Metal-Air Batteries
12.3. Catalyst for Air Cathodes
13. LEAD-ACID BATTERIES
13.1. Introduction
13.2. Lead Batteries in Applications
13.2.1. Types of Lead-Acid Batteries
13.2.2. Typical Commercially Available Battery Units
13.2.3. Use Pattern of Lead-Acid Batteries
13.2.4. Charge–Discharge Procedures of
Lead-Acid Batteries
13.3. Non automobile Applications of Lead-Acid Batteries
13.3.1. Stationary Applications of Lead-Acid Batteries
13.3.2. Standby Applications of Lead-Acid Batteries
13.3.3. Backup Power Applications of
Lead-Acid Batteries
13.4. Automobile Applications of Lead-Acid Batteries
13.4.1. Automobile Starting-Lighting-Ignition Applications
13.4.2. Electric and Hybrid Electric Vehicle Applications
of Lead-Acid Batteries
14. LEAD-ACID BATTERIES FUNDAMENTALS,
TECHNOLOGIES, AND APPLICATIONS
14.1 Introduction
14.2 Materials and Properties
14.2.1. Porosity, Pore Size, and Pore Shape
14.2.2. Ionic Resistance
14.2.3. Electrochemical Compatibility

14.2.4. Acidic and Oxidation Stability
14.2.5. Puncture Resistance
14.2.6. Surface Area
14.3. Separator Synthesis
14.3.1. Polyethylene Separator
14.3.2. Absorptive Glass Mat Separator
14.3.3. Separator
14.3.4. Rubber Separators
14.4. Separator Structure Design and Fabrication
14.4.1. Positive Ribs
14.4.2. Negative Ribs
14.4.3. Embossed/Corrugated
14.4.4. Compression/Resiliency
14.4.5. Fabrication
14.5. Effects of Material Composition, Morphology, and Synthesis Conditions on Battery Performance
14.5.1. Antimony Poisoning and Water Loss
14.5.2. Low Electrical Resistance
14.6. Effect of Battery Operating Conditions on Separator Performance
14.6.1. Basic Condition/Extreme Shrinkage
14.6.2. Hydration Shorts
14.6.3. Extreme Oxidation
14.7. Technical Challenges, Mitigation Strategies, and Perspectives
14.7.1. High-Power Starter Batteries
14.7.2. Deep-Cycle Batteries
15. LEAD-ACID BATTERY MANUFACTURING EQUIPMENT
15.1 Casting in a Grid
15.1.1 Grid Caster
15.1.2.Strip Expansion Grid
15.1.3 Continuous Grid Caster
15.2. Production of Lead Oxide
15.2.1. Barton Pot Process
15.2.2. Ball Mill process
15.3. Paste Mixing
15.3.1. Batch Paste Mixer
15.4. Pasting
15.5. Curing
15.6. Formation

15.6.1. Formation of Positive Plates
15.6.2. Formation of Negative Plates
15.6.3. Tank Formation
15.6.4. Case Formation
15.7. Battery Assembly
15.7.1.Group Stacking
15.7.2. Alignment
15.7.3. Group Burning
15.7.4. Group Alignment
15.8. Group Insertion
15.8.1. Inspection and Terminal Alignment
15.8.2. Short Circuit Testing
15.8.3. Intercell Welding
15.8.4. Shear Testing
15.8.5. Case Cover Sealing
15.8.6. Leak Testing
15.8.7. Terminal (Post) Burning
15.8.8. Aluminum Foil Sealing
15.8.9. Acid Filling
15.8.10. Packing
15.8.11. Quality Assurance and Control
16. RECYCLING OF LEAD-ACID BATTERY
16.1. Battery Breaking
16.1.1. Historical Background of Battery Breaking
16.1.2. Modern Battery Breaking Process
16.1.3. Battery Breaking: Potential Sources of Environmental Contamination
16.2. Lead Reduction
16.2.1. Pyrometallurgical Methods
16.2.2. Hydrometallurgical Methods
16.2.3. Lead Reduction: Potential Sources of Environmental Contamination
16.3. Lead Refining
16.3.1 Pyrometallurgical Refining
16.3.2 Lead Refining: Potential Sources of Environmental Contamination
16.4. Lead Battery Recycling Plant
16.4.1. Scope
16.5 Manufacturing Equipment:
16.5.1. Battery Cutting Machines / Battery Breakers
16.5.2. Rotary Furnace

16.5.3. Pollution Control Plant
16.5.4. Refining and Alloying Pots
16.5.5. Ingoting Systems
17. ZINC-CARBON BATTERY
17.1. General Characteristics
17.2. Chemistry
17.3. Types of Cells and Batteries
17.3.1. Leclanche´ Batteries
17.3.2. Zinc Chloride Batteries
17.4. Construction
17.4.1. Cylindrical Configuration
17.4.2. Inside Out Cylindrical Construction
17.4.3. Flat Cell and Battery
17.4.4 Special Designs
17.5. Cell Components
17.5.1. Zinc
17.5.2. Bobbin
17.5.3. Manganese Dioxide (MnO2)
17.5.4. Carbon Black
17.5.5. Electrolyte
17.5.6. Corrosion Inhibitor
17.5.7. Carbon Rod
17.5.8. Separator
17.5.9. Seal
17.5.10.Jacket
17.5.11. Electrical Contacts
17.6. Performance Characteristics
17.6.1. Voltage
17.6.2. Discharge Characteristics
17.6.3. Effect of Intermittent Discharge
17.6.4. Comparative Discharge Curves—Size Effect
Upon Heavy Duty Zinc-chloride Batteries
17.6.5. Comparative Discharge Curves—Different
Battery Grades
17.6.6. Internal Resistance
17.6.7. Effect of Temperature
17.6.8. Service Life
17.6.9. Shelf-Life
17.7. Special Designs
17.7.1. Flat-Pack Zinc/Manganese Dioxide P-80 Battery
17.8. Battery Parameters

17.9. Types and Sizes of Available Cells and Batteries
18. ENVIRONMENTAL ISSUES FOR BATTERIES
18.1. Lifecycle Analysis (LCA)
18.2. Material Issues
18.2.1. Resource Availability
18.3. Environmental Impacts
18.3.1. Electrode Materials
18.3.2. Electrolyte Risks
18.3.3. Binders
18.4. Material Issues: Going Forwards
18.4.1. Energy Density
18.4.2. Alternative Materials
18.4.3. Non-Fluorinated Binders
18.4.4. Cobalt Substitution
18.5. Energy Issues: Production and Charging
18.5.1. Source Of Energy for Production
18.5.2. Roundtrip Efficiency
18.6. Lifespan
18.7. End-of-Life (EoL) treatment
18.7.1. Recycling
18.7.2. Re-Use
18.7.3. Design for Recycling and Re-Use
19. INTERNATIONAL STANDARDS AND
TESTING APPLICABLE TO BATTERIES
Standards and Safety Testing Organisations
General Battery Standards
Lithium Battery Standards
Nickel Metal Hydride Battery Standards
Nickel Cadmium Battery Standards
Lead Acid Battery Standards
Photovoltaic Battery Standards
Safety Standards
Automotive Battery Standards
Aircraft Battery Standards
Military Standards for Batteries, Software,
EMC/RFI, Safety & Quality
Radio Battery Standards
Standby Power Systems Standards
Software Standards
EMC/RFI Standards
Ingress Protection (IP) Standards

Battery Monitoring Standards
Battery Recycling and Disposal Standards
Other Related Electrical Standards
Quality Standards
20. BIS SPECIFICATIONS
21. PLANT LAYOUT AND PROCESS FLOW CHART
& DIAGRAM
22. AUTOMATED MANUFACTURING EQUIPMENT
22.1. Equipment Specifications
22.2. Kaido Winder
22.3. Hibar Equipment
22.3.1. Module 1: Bottom Tab Welding System
22.3.2. Module 2: Beading/Grooving System
22.3.3. Module 3: Sealant Dispensing System
22.3.4. Module 4: Electrolyte Filling System
22.3.5. Module 5: Top Tab Welding and Taping System
22.3.6. Module 6: Final Crimping System
22.4. Formation and Test Equipment
22.5. Machine Vision Approach and Implementation
22.5.1. Part Serial Number / Bar Code Tracking
22.6. Manufacturing Equipment Installation
22.7. Operator Training
22.8. Manufacturing Equipment Validation
22.8.1. Kaido Winder Validation
22.8.2. Hibar Resistance Welding Module Validation
22.8.3. Hibar Beading Module Validation
22.8.4. Hibar Sealant Dispensing Module Validation
22.8.5. Hibar Electrolyte Filling Module Validation
22.8.6. Hibar Electrolyte Filling System Performance Validation
22.8.7. Hibar Top Tab Welding and Taping Module Validation
22.8.8. Hibar Crimping System Validation
23. PHOTOGRAPHS OF PLANT & MACHINERY WITH SUPPLIER'S CONTACT DETAILS

- Lead Battery Recycling Plant
- Battery Automatic Plate Pasting Machine
- Lead Battery Recycling Plant
- Lithium Ion Battery Machine
- Lithium Ion Battery Tester
- Vacuum Oven
- Vacuum Drying Oven for Lithium Ion Battery
- Planetary Mixer Vacuum Jacketed

- Battery Inter-cell Welding Machine
- Automatic Battery Assembling Plant
- Battery Breaking and Separation Ds Systems
- Electrode Coating Machine
- Battery Plate Enveloping Machine
- Lead Battery Breaking Plant
- Battery Cutting Machine
- Battery Cell Spot Welding Machine
- Semi-Auto Grooving Machine for Cylindrical Cell
- Battery Heat Sealing Machine
- Battery Laser Welding Machine
- Electric Battery Lead Melting Furnace

24. Plant Layout Description for Lithium-Ion and Lead-Acid Battery Manufacturing

About Niir

NIIR Project Consultancy Services (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. Its various services are: Pre-feasibility study, New Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Preparation of Project Profiles and Pre-Investment and Pre-Feasibility Studies, Market Surveys and Studies, Preparation of Techno-Economic Feasibility Reports, Identification and Selection of Plant and Machinery, Manufacturing Process and/or Equipment required, General Guidance, Technical and Commercial Counseling for setting up new industrial projects and industry. NPCS also publishes various technology books, directories, databases, detailed project reports, market survey reports on various industries and profit making business. Besides being used by manufacturers, industrialists, and entrepreneurs, our publications are also used by Indian and overseas professionals including project engineers, information services bureaus, consultants and consultancy firms as one of the inputs in their research.