

# The Complete Technology Book on Aluminium and Aluminium Products

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Aluminium, the second most plentiful metallic element on the earth, became an economic competitor in engineering applications as recently as the end of 19th century. It was become a metal for its time. Aluminium possesses many characteristics that make it highly compatible with recycling. It is resistant to corrosion and it thus retains a high level of metal value after use, exposure, or storage. Once produced, it can be considered a permanent resource for recycling, preferably in to similar products. It is essentially a soft and weak metal which has to be strengthened by alloying with suitable elements. The elements which are added to aluminium in appreciable quantities to increase its strength and improve other properties are surprisingly limited to only four, namely, magnesium, silicon, copper and zinc. These are added singly or in combination. It is theoretically 100% recyclable without any loss of its natural qualities. It is the most widely used non ferrous metal. The applications of aluminium are grown in many fields for example; electric conductors, windows and building components, aircraft, foil packaging etc. It has a major role in packaging industry especially in pharmaceuticals. It includes different types of packaging; unit packaging, bunch wrapping, strip packaging, thermoformed unit packaging and sachets Aluminium alloys with a wide range of properties are used in engineering structures. Aluminium alloys are divided into two major categories; casting compositions and wrought compositions. Further differentiation for each category is based on the primary mechanism. The most commercially mined aluminium ore is bauxite, as it has the highest content of the base metal. The primary aluminium production process consists of three stages. First is mining of bauxite, followed by refining of bauxite to alumina and finally smelting of alumina to aluminium. India has the fifth largest bauxite reserves with deposits 5% of world deposits. Indian share in world aluminium capacity rests at about 3%; it will touch almost 13% to 15% of the growth rate.

This book basically deals with aluminium production, heat treatable and non heat treatable alloys, properties of cast aluminium alloys, testing of liquid & solidification contraction of aluminium alloys, trends in the improving economic use of aluminium, laboratory investigation of carbon anode consumption in the electrolytic production of aluminium, alumina extraction from a pennsylvania diaspore clay by an ammonium sulfate process, the recovery of alumina from its ores by a sulfuric acid process, initial softening in some aluminium base precipitation hardening alloys, basic properties of aluminium foil, how to select a flexible foil packaging laminate, printing on aluminium foil, designing aluminium foil packs etc.

The present book covers the need within the industrial and academic communities for up to date information about production of aluminium and extrusion process due to the ever increasing use of this technology. The book provides concepts in the different areas of extrusion technology. It is hoped that its presentation will be very helpful to new entrepreneurs, technocrats, research scholars, libraries and existing units.

## 1. GENERAL INTRODUCTION

Aluminium Production

Production Statistics

Aluminium Alloys

Heat-Treatable and Non-heat-Treatable Alloys

Properties

Manufactured Forms

Standardized products

Engineered Products

Finishes

Mechanical Finishes

Chemical Finishes

Electrolytic Finishes

Non-Electrolytic Coatings

Product Classifications

Building and Construction Applications

Containers and Packaging

Transportation

Electrical Applications

Consumer Durables

Machinery and Equipment

Other Applications

## 2. PROPERTIES OF CAST ALUMINIUM ALLOYS

201.0

4.6Cu-0.7Ag-0.35Mn-

0.35Mg-0.25Ti

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

204.0

4.6Cu-0.25Mg-0.17Fe-0.17Ti

Commercial Name

Applications

Mechanical Properties

206.0, A206.0

4.5Cu-0.30Mn-0.25Mg-0.22Ti

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Chemical Properties

Fabrication Characteristics

208.0

4Cu-3Si

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

238.0

10.0%Cu-4.0%Si-0.3%Mg

Commercial Names

Specifications

Applications

242.0

4Cu-2Ni-2.5Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Electrical Properties

Thermal Properties

Fabrication Characteristics

295.0

4.5Cu-1.1Si

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

296.0

4.5Cu-2.5Si

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

308.0

5.5Si-4.5Cu

Commercial Names

Specifications

Chemical Composition

Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics

319.0

6Si-3.5Cu

Commercial Names  
Specifications  
Chemical Composition

Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics

332.0

9.5%Si-3.0%Cu-1.0%Mg

Commercial Names  
Specifications

Applications  
Mechanical Properties

336.0

12Si-2.5Ni-1Mg-1Cu

Commercial Names  
Specifications  
Chemical Composition

Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics

339.0

12.0%Si-1.0%Ni-1.0%Mg-2.25%Cu

Commercial Names  
Applications

354.0

9Si-1.8Cu-0.5Mg

Commercial Name  
Specifications  
Chemical Composition

Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Fabrication Characteristics

355.0, C355.0

5Si-1.3Cu-0.5Mg

Specifications  
Chemical Composition  
Applications

Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics  
356.0, A356.0  
7Si-0.3Mg  
Specifications  
Chemical Composition  
Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Radiation Effect on Properties  
Fabrication Characteristics  
357.0, A357.0  
7Si-0.5Mg  
Specifications  
Chemical Composition  
Applications  
Mechanical properties  
Mass Characteristics  
Thermal Properties  
Fabrication Characteristics  
359.0  
9Si-0.6Mg  
Specifications  
Chemical Composition  
Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Fabrication Characteristics  
360.0, A360.0  
9.5Si-0.5Mg  
Specifications  
Chemical Composition  
Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics  
380.0, A380.0 8.5Si-3.5Cu  
Specifications  
Chemical Composition  
Applications  
Mechanical Properties  
Mass Characteristics  
Thermal Properties  
Electrical Properties  
Fabrication Characteristics

383.0

10.5Si-2.5 Cu

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

384.0, A384.0

11.2Si-3.8Cu

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

390.0, A390.0

17.0Si-4.5Cu-0.6Mg

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

413.0, A413.0

12Si

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

443.0, A443.0, B443.0, C443.0

5.2Si

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

514.0

4Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass characteristics

Thermal properties

Electrical properties

Fabrication Characteristics

518.0

8Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass characteristics

Thermal Properties

Electrical Properties

520

10Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

535.0, A535.0, B535.0

7Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Chemical Properties

Fabrication Characteristics

712.0

5.8Zn-0.6Mg-0.5Cr-0.2Ti

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

713.0

7.5Zn-0.7Cu-0.35Mg

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Chemical Properties

Fabrication Characteristics

771.0

7Zn-0.9Mg-0.13Cr

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

850.0

6.2Sn-1Cu-1Ni

Commercial Names

Specifications

Chemical Composition

Applications

Mechanical Properties

Mass Characteristics

Thermal Properties

Electrical Properties

Fabrication Characteristics

### 3. PHYSICAL METALLURGY OF ALUMINIUM ALLOYS

Aluminium-Magnesium Alloys

Al-Si alloys

Al-Cu alloys

Hardness Data for Al-3.8% Cu Alloy

Aluminium-zinc alloys

Complex Alloys

Aluminium-Zinc-Magnesium Alloys

Al-Cu-Mg alloys

Al-Mg-Si alloys

Effect of Plastic Deformation on Precipitation

Intermetallic Compounds and their Effects

Corrosion of Aluminium Alloys

### 4. TESTING OF LIQUID & SOLDIFICATION CONTRACTION OF ALUMINIUM ALLOYS

1. Derivation of Correlations

2. Experimental procedure



### 3. Results and Discussion

#### 5. TRENDS IN THE IMPROVING ECONOMIC USE OF ALUMINIUM

1. Reduction in Dimensions and Weight
2. More Efficient Use of Metal
3. Improvements in Methods of Protection
4. New Concepts in Design

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Development of Welding Techniques and Weldable Alloys

Welding Processes

Development of Alloys

Conclusion

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Materials

Anode Carbon

Electrolyte Materials

Apparatus

Procedure

General

Operation at Different Current Densities

Operation at Different Temperatures

Operation at Different Electrolyte Compositions

Results

Effect of Anode Current Density

Effect of Electrolyte Temperature

Effect of Carbon Baking Temperature

Effect of Electrolyte Composition

NaF/AlF<sub>3</sub> Ratio

Alumina Content

Calcium Fluoride Content

Sodium Chloride Content

Graphite and Coke

Mechanism of Anode Consumption

Erosion of Particles of Coke from the Active Anode Surface

Formation of CO

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Related Literature

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Procedure

Results and Discussion

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Mixing and Pelletizing

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Leaching and Primary Crystallization  
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Conclusion

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Experimental Procedures  
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Nature of Ore  
Particle Size  
Pulp Density and Liquor Concentrations  
Temperature  
Time  
Excess Acidity  
Control of Impurities  
Silica  
Titanium  
Other trivalent Metals  
Bivalent Metals  
Univalent Metals  
Phosphate  
Recycling Operations  
Digestionâ€™Modification  
Reduction  
Hydrolysisâ€™Calcination  
Acid Regeneration  
Calcination  
Liquid-Solid Separations  
Digestion  
Modification Residue  
Modified Liquor  
Hydrolysis  
Costing  
Raw Materials  
Energy  
Equipment

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Earthing Tests  
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Dissussion  
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Range of Softening  
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Conclusion

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Strength  
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Polyester (Terylene)  
Polythene  
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Note  
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For Toiletries  
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Flexography  
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Sachets

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General Description

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Absorption of Sulfur Dioxide

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Absorption of Sulfur Dioxide

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General

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## 25. THE FLUORINE PROBLEM IN

## About NIIR

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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.

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