

50X1-HUM

Title: DESCRIPTION OF THE BOOK "METALLURGY OF LIGHT METALS" by

Professor-Doctor A. I. Belyayev

50X1-HUM

Source: Metallurgiya legkikh metallov, Gosudarstvennoye nauchno-
tekhnicheskoye izdatel'stvo literatury po chernoy i tsvetnoy
metallurgii, Russian book, 1944

CONFIDENTIAL

CONFIDENTIAL

DESCRIPTION OF THE BOOK "METALLURGY OF LIGHT METALS"

Professor-Doctor A. I. Belyayev

The book deals with the fundamentals of metallurgy of aluminum, magnesium, beryllium, calcium, sodium and lithium, i.e., light metals most essential in the national economy.

It is accepted as a textbook for higher technical schools and may be used for reference by engineers of metallurgical plants.

Table of Contents

	<u>Page</u>
Preface	7
Introduction	8

Section One

METALLURGY OF ALUMINUM

I. Properties of Aluminum, its Role in Industry and History of Production	
1. Properties of Aluminum and its Importance in Contemporary Industry	14
2. History of the Metallurgy of Aluminum	18
II. Aluminum Ores	
3. Geochemistry and Mineralogy of Aluminum	25
4. Types of Aluminum Ores, Their Genesis and Deposits	27
A. <u>Production of Alumina</u>	
III. General Review of Production Methods for Alumina	
5. Alumina as a Material for Electrolysis	38
6. Certain Physicochemical Properties of Alumina	39
7. Classification of Alumina Production Methods	43
IV. Properties of Aluminate Solutions	
8. Stability of Aluminate Solutions	47

CONFIDENTIAL

	<u>Page</u>
9. Nature of Aluminate Solutions	48
10. System $Al_2O_3 - Na_2O - H_2O$	52
V. Production of Alumina by the Bayer Process	
11. History of the Bayer Process	57
12. General Technology of the Bayer Process	58
13. Preliminary Treatment of Bauxite	60
14. Leaching of Bauxite according to Bayer	61
15. Separation of Aluminate Solution from Red Mud	78
16. Decomposition of Aluminate Solution	80
17. Calcination of Aluminum Hydroxide	90
18. Evaporation and ^{and} Concentricization of Diluted Caustic Liquor	96
19. Cycle of the Bayer Process in the System $Na_2 -$ $- Al_2O_3 - H_2O$	97
20. Bayer Process with Application of Soda-Lime Leach- ing	100
21. Information on Industrial Experience in Producing Alumina by the Bayer Process	101
VI. 22. History of the Fusion Method	108
23. General Technological Outline of the Fusing Proc- ess	109
24. Fusing Bauxite with Sodium Carbonate and Limestone in a Rotary Furnace	111
25. Leaching of Fused Mass	119
26. Desilicization of Aluminate Solutions	125
27. Carbonization of Aluminate Solutions	128
VII. Production of Alumina from Slags	
28. Nature and History of the Method	136
29. Technology of Producing Alumina from Slag of Cal- cium Aluminate	141

CONFIDENTIAL

CONFIDENTIAL

	<u>Page</u>
30. Production of Alumina from Slags in the Hoyanger Plant	146
VIII. <i>Production of Alumina by Acid Methods</i>	
31. Sulfuric Acid-Ammonia Method	149
32. Hydrochloric Acid Method	154
33. Nitric Acid Method	157
34. Sulfurous Acid Method	160
IX. Production of Alumina by Electrothermal Methods	
35. Hall Process	162
36. Haglund Process	165
X. Production of Alumina from Complex and Low-Grade Aluminum Ores	
37. Extraction of Alumina from Complex Ores	168
38. Extraction of Alumina from Low-Grade Ores	176
B. <u>Production of Fluorides</u>	
XI. Production of Cryolite and Other Fluorides	
39. Requirements Applicable to Cryolite	179
40. Natural Cryolite	181
41. Manufacture of Synthetic Cryolite	183
C. <u>Manufacture of Electrodes</u>	
XII. Manufacture of Carbon Electrodes	
42. Purpose of Electrodes and Their Classification	204
43. Application of Carbon Electrodes in the Metal- lurgy of Light Metals	206
44. Raw Materials Used in Electrode Production	208
45. Technological Outline of Manufacture of Carbon Electrodes	211
46. Preliminary Crushing of Solid Carbonaceous Mate- rials	212
47. Calcination of Solid Carbonaceous Materials	212
48. Grinding and Screening Solid Carbonaceous Mate- rials	220

CONFIDENTIAL

	<u>Page</u>
49. Mixing Solid Carbonaceous Materials with Binders	223
50. Pressing of Electrodes	227
51. Baking of Green Electrodes	236
52. Machining. Consumption of Materials	248
XIII. Manufacture of Graphitized Electrodes	
53. Properties of Graphitized Electrodes	249
54. Theory of the Graphitizing Process	250
55. Technology of the Graphitizing Process	253
D. <u>Electrometallurgy of Aluminum</u>	
XIV. Theory of the Electrolytic Process in Cryolite-Alumina Fused Baths	
56. Outline of the Process	260
57. Electrolyte and Its Properties	261
58. Fundamentals of the Electrolytic Process	270
59. Voltage of Decomposition of Electrolyte Components	275
60. Mechanism of the Electrolytic Process	284
61. Electrode Processes	291
62. Influence of Various Factors on the Electrolytic Process in Cryolite-Alumina Fused Baths	309
XV. Construction of Aluminum Electrolytic Cells	
63. Development of the Construction of Aluminum Electrolytic Cells (Pots)	316
64. Construction of Modern Pots	320
65. Conception of Thermal Balance and Voltage Balance of an Electrolytic Cell	331
66. Arrangement of Pots in a Pot Room	336

CONFIDENTIAL

CONFIDENTIAL

	<u>Page</u>
XVI. Technology of Electrolytic Production of Aluminum	
67. Supply of Electrolytic Cell with Direct Current	339
68. Starting Electrolytic Cells	343
69. Performance of Cells After Starting	349
70. Performance and Care of Cells During Normal Operations	351
71. Faults in the Performance of Cells	370
72. Production Factors of the Electrolysis Process	374
XVII. Purification of Aluminum	
73. Impurities in Aluminum and Their Effect on the Quality of Metal	375
74. Classification of Commercial Aluminum	377
75. Aluminum Refining by Chlorination	379
76. Aluminum Refining by Remelting in an Electric Furnace	380
XVIII. Regeneration of Electrolyte	
77. Flotation of Carbon Skimmings	390
78. Gas Trapping and Processing	392
XIX. Electrolytic Refining of Aluminum	
79. General Theoretical Aspects	400
80. Technology of Electrolytic Refining	404
81. Properties of High-Pure Aluminum	413
82. Corrosion Resistance	419
83. Summary of Properties of High-Pure Aluminum	421
84. Application of High-Pure Aluminum	421
XX. Electrolytic Production of Aluminum Alloys	
85. Certain Physicochemical Properties of Cryolyte-Oxide Oxide Fused Baths	425
86. Reduction of Oxides in Aluminum Bath	432
87. Technology of Electrolytic Production of Aluminum Alloys	433

CONFIDENTIAL

CONFIDENTIAL

	<u>Page</u>
XXI. Electrothermics of Aluminum and Its Alloys	
88. Electrothermics of Aluminum	442
89. Electrothermics of Aluminum Alloys	444
90. Technology of Production of Silicocaluminum by Electrothermal Method	446
91. Electrothermal Silicon	451
 <u>Section Two</u> 	
METALLURGY OF MAGNESIUM	
XXII. Properties of Magnesium, Its Role in Industry and History of Production	
92. Properties of Magnesium and Its Role in Con- temporary Industry	455
93. History of the Metallurgy of Magnesium	458
XXIII. Magnesium Ores and Raw Materials	
94. Geochemistry of Magnesium	463
95. Types of Magnesium Raw Materials and Their Preparation	464
XXIV. Production of Anhydrous Magnesium Chlorides	
96. Production of Anhydrous Magnesium Chloride	474
97. Production of Anhydrous Carnallite	481
XXV. Theory of Electrolysis of Fused Magnesium Chlorides	
98. Nature of the Process	485
99. Properties of Electrolyte	485
100. Influence of Various Factors on the Elec- trolytic Process in Magnesium Chloride	490
XXVI. Technology of Electrolysis of Magnesium Chlorides	
101. Construction of Magnesium Baths	496
102. Operation of Magnesium Baths	500
XXVII. Obtaining Magnesium by Electrolysis of Its Oxide and Alloys With Other Metals	
103. Obtaining Magnesium by Electrolysis of Its Oxide	504

CONFIDENTIAL

CONFIDENTIAL

	<u>Page</u>
104. Obtaining Magnesium Alloys by Electrolysis	508
XXVIII. Refining of Magnesium	510
105. Impurities in Commercial Magnesium	510
106. Refining Magnesium by Remelting with Fluxes	511
107. Refining Magnesium by Sublimation	512
XXIX. Thermal Methods for Production of Magnesium	
108. Reduction of Magnesium Oxide with Carbon	515
109. Reduction of Magnesium Oxide with Carbonless Agents	518

Section Three

METALLURGY OF OTHER LIGHT METALS

XXX. Metallurgy of Beryllium	
110. Properties of Beryllium and Its Application	523
111. Raw Materials for Production of Beryllium	525
112. Production Technology of Metallic Beryllium	527
XXXI. Metallurgy of Calcium	
113. Properties of Calcium and Its Application	532
114. Production Technology of Metallic Calcium	534
XXXII. Metallurgy of Sodium	
115. Properties and Application of Metallic Sodium	538
116. Production Technology of Metallic Sodium	539
XXXIII. Metallurgy of Lithium	
117. Properties and Application of Lithium	542
118. Obtaining Metallic Lithium	542

- E N D -

- 7 -

CONFIDENTIAL