

# HIGH PURITY ALUMINA AND BOEHMITE

---

Market Research Report

**Author:** Brendan Jephcott

**Date:** October 2024



## Table of Contents

Executive Summary	2
1.0 Introduction	11
1.1 Growth of New Energy Vehicle Industry	11
1.2 Lithium-Ion Battery Technology	13
2.0 Separator Preparation and Coating	17
2.1 Separator Properties	17
2.2 Separator Preparation	21
2.3 Separator Coating	24
2.4 Alumina Separator Coating Requirements	27
3.0 Cathode and Anode Coating	29
4.0 High Purity Alumina	30
4.1 Definition and Properties	30
4.2 HPA Production Technologies	32
4.2.1 Alkoxide Route	32
4.2.2 Choline Route	33
4.2.3 “Modified Bayer”	34
4.2.4 Aluminium Chloride Hexahydrate (ACH) Process	34
4.2.5 Aluminium Solvent Extraction Process	35
4.3 Major HPA Producers (excl China)	36
4.3.1 Sumitomo Chemical Co., Ltd	36
4.3.2 Sasol Limited	37
4.3.3 Baikowski	37
4.3.4 Nippon Light Metal Holdings Co., Ltd	38
4.3.5 Advanced Energy Minerals Inc	39
4.3.6 Polar Performance Materials	39
4.3.7 Alpha HPA Limited	40
4.4 Major HPA Producers in China	41
4.4.1 Hebei Pengda New Material Technology Co., Ltd	42
4.4.2 Shanghai Gaona Industrial Co., Ltd	42
4.4.3 Zibo Honghe Chemical Co., Ltd	42
4.4.4 Xuancheng Jingrui New Material Co., Ltd	42
4.4.5 Yangzhou Zhongtianli New Materials Co., Ltd	42
4.4.6 Shandong Sinocera Functional Materials Co., Ltd	42
5.0 Boehmite	43
5.1 Crystal Structure	43
5.2 Properties	43
5.3 Boehmite Production Technology	45
5.4 Major Current Boehmite Producers	48

5.5	Anhui Estone Materials Technology Co., Ltd	49
5.5.1	Boehmite Business Unit Overview	49
5.5.2	Customers and Revenue	51
5.5.3	Cash Costs	52
5.5.4	Company Profitability	54
5.6	Shandong Sinocera Functional Materials Co., Ltd	56
5.7	Nabaltec AG	57
5.7.1	Boehmite Business Unit Overview	60
5.7.2	Customers and Revenue	62
6.0	Boehmite Market Outlook	62
	References	65
	Disclaimer	69

## Figures

Figure 1: Tesla Model 3, produced in Shanghai, China .....	11
Figure 2: China new energy vehicle annual production and sales.....	11
Figure 3: EV-Type LIB used in electric vehicles (illustrative) .....	12
Figure 4: EV-Type LIB used in electric vehicles.....	12
Figure 5: Parts of a lithium-ion battery.....	13
Figure 6: Charging and discharging of a lithium-ion battery.....	14
Figure 7: Schematics of inner structures of commercial lithium-ion batteries.....	16
Figure 8: Important performance properties of separators.....	17
Figure 9: Dry processing method to produce separators.....	21
Figure 10: Wet processing method to produce separators.....	22
Figure 11: SEM micrographs of microporous polyolefin membranes at the surfaces.....	22
Figure 12: (a) Surface and (b) cross-sectional SEM of a Celgard 2325 PP-PE-PP separator .....	23
Figure 13: China LIB wet and dry separator production output (2014-2023).....	24
Figure 14: China coating material demand (inner ring is 2019, outer ring is 2020).....	27
Figure 15: Celgard membrane coated with 2 to 5µm thickness ceramic layers.....	28
Figure 16: HPA products on display .....	30
Figure 17: HPA global markets.....	32
Figure 18: The alkoxide HPA production route.....	33
Figure 19: The choline HPA production route.....	34
Figure 20: HPA from kaolin schematic processing flowsheet .....	35
Figure 21: Alpha HPA Limited solvent extraction HPA production route .....	36
Figure 22: Baikowski HPA leaflets.....	38
Figure 23: Nippon Light Metals manufacturing process of high purity products.....	38
Figure 24: Advanced Energy Minerals schematic CLCP process flowsheet .....	39
Figure 25: Polar Performance Materials products.....	40
Figure 26: Alpha HPA SX process flowsheet.....	41
Figure 27: Schematic diagram of the crystal structure of boehmite .....	43
Figure 28: Boehmite final product .....	43
Figure 29: Estone boehmite principal processing flowsheet .....	47
Figure 30: Estone stock price history.....	49
Figure 31: Estone factory in China.....	50
Figure 32: Estone SEM boehmite product images.....	50
Figure 33: Distribution of Estone boehmite customer revenue share (2020).....	51
Figure 34: Estone boehmite product main customers.....	52
Figure 35: Boehmite cash cost distribution (2017 to 2020).....	53
Figure 36: Distribution of Estone total cash cost per tonne (2020).....	53
Figure 37: Distribution of Estone manufacturing cash cost (2020).....	54
Figure 38: Boehmite cash cost and unit selling price (2017 to 2020).....	54
Figure 39: Profitability comparison of various battery material companies (2018-2020).....	55
Figure 40: Estone pole piece coating sales revenue .....	55
Figure 41: Sinocera stock price history.....	56
Figure 42: Sinocera headquarters in Dongying City, Shandong Province, China .....	56
Figure 43: Sinocera SEM boehmite image .....	57
Figure 44: Nabaltec stock price history.....	58
Figure 45: Nabaltec Plant, Schwandorf, Germany.....	58
Figure 46: Nabaltec organisational structure.....	59
Figure 47: Nabaltec global business layout map.....	59
Figure 48: Nabaltec Product Segments.....	60
Figure 49: Nabaltec Boehmite coating applications.....	60
Figure 50: Anti-Shrinkage-Protection of PE-Separator via APYRAL® AOH 70 coating.....	61
Figure 51: Nabaltec boehmite revenues (2018 to June-2024) .....	62
Figure 52: Boehmite demand and market size forecast (2019 to 2025E).....	64

## Tables

Table 1: Requirements for lithium-ion battery separators.....	18
Table 2: Comparison of dry and wet processing methods to produce separators .....	23
Table 3: Key performance indicators for separator coating materials .....	25
Table 4: Mainstream separator coating material characteristics.....	25
Table 5: Performance comparison of inorganic and composite coating materials .....	26
Table 6: Comparison of Putailai coated separator products.....	26
Table 7: Example of HPA product chemical specifications (purity $\geq 99.99$ ).....	28
Table 8: HPA Key attributes and applications.....	30
Table 9: Classification of aluminium purity by country .....	31
Table 10: Major producers of HPA (excl China) .....	36
Table 11: Sumitomo high purity alumina products.....	37
Table 12: Alpha HPA Stage 2 HPA First Project high purity aluminium based products.....	40
Table 13: Major producers of HPA in China .....	41
Table 14: Key indicators affecting boehmite performance .....	44
Table 15: Estone boehmite production process list of raw materials and consumption .....	47
Table 16: Estone boehmite production process aluminium hydroxide requirements.....	47
Table 17: Estone boehmite production process main production equipment.....	47
Table 18: Brief Comparison of major boehmite producers used in LIB separator coating.....	48
Table 19: Boehmite products from various companies .....	49
Table 20: Estone boehmite product specifications .....	51
Table 21: Sinocera boehmite product specifications.....	57
Table 22: Nabaltec boehmite product properties.....	61
Table 23: Nabaltec boehmite product chemical analysis.....	61
Table 24: Global boehmite market size forecast (2019 to 2025E).....	63