

Introduction to the construction process of alumina projects in China and overseas 中国及海外氧化铝项目建设工艺介绍

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The selection of alumina process technology is closely related to bauxite resources 氧化铝工艺技术选择与铝土矿 资源关系密切

1.1 Bauxite resources that need attention worldwide 世界范围内的铝土矿资源关注点





According to the Mineral Product Summary 2023 by the United States Geological Survey, as of the end of 2022, the world's proven bauxite reserves are approximately 31 billion tons, with a predicted resource of 55 to 75 billion tons. Among them, Africa accounts for 32%, Oceania accounts for 23%, South America and the Caribbean accounts for 21%, Asia accounts for 18%, and other regions account for approximately 6%. 根据美国地质调查局《矿产品摘要2023》 截至2022年底 全球

根据美国地质调查局《矿产品摘要2023》,截至2022年底,全球 已探明铝土矿储量约为310亿吨,预测资源量为550至750亿吨。 其中,非洲占32%、大洋洲占23%、南美和加勒比占21%,亚洲 占18%,其他地区约占6%。

1.2 The trend of changes in China's imported bauxite 中国进口铝土矿变化趋势



In 2023, China imported 99.13 million tons of Guinea bauxite and 34.55 million tons of Australia bauxite, accounting for approximately 94% of the total. The Romance of the Three Kingdoms has completely transformed into the struggle for hegemony between the two powers.

2023年, 进口几内亚铝土矿9913万吨, 澳大利亚3455万吨, 合计占比约94%。三国演义彻底转变为双雄争霸。



1.3 China's coastal refinery construction focuses on Australian and Guinea bauxite 中国沿海建厂重点关注澳矿和几矿





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Australia's bauxite is concentrated in several enriched areas, mainly consisting of mixed type bauxite of trihydrate and monohydrate, with relatively few pure trihydrate bauxite resources. 澳大利亚的铝土矿集中分布于几个富集地区,以三水铝石和一水软铝石混合型铝土矿为主,纯三水铝石型资源量比较少。6

1.3 China's coastal refinery construction focuses on Australian and Guinea bauxite 中国沿海建厂重点关注澳矿和几矿





Guinea's bauxite is widely distributed throughout the country. Among them, Lower Guinea has the richest reserves, mainly distributed in the Bok é, Kindia, and Fria regions. Among them, the Bok é region has 23 billion tons of reserves and the highest grade, belonging to the first stage; Next is Fria, with a grade of 45%, which is the second step; Kindia has a grade of 40%, making it the third tier. Bauxite in Central Guinea is mainly concentrated in Lab é, Gaoual, Tougu é, while in Upper Guinea it is mainly concentrated in Dabola. Guinea has both typical high-grade Gibbsite bauxite and mixed

bauxite with high boehmite content. 几内亚铝土矿分布广泛,在全境均有分布。其中下几内 亚储量最为丰富,主要分布于Boké、Kindia和Fria三个地 区,其中Boké地区有230亿吨储量,且品位最高,属第 一台阶;其次是Fria,品位45%,为第二台阶;Kindia品 位40%,为第三台阶。中几内亚铝土矿主要集中在Labé、 Gaoual、Tougué,上几内亚主要集中于Dabola。几内亚 既有典型的高品位三水铝石型铝土矿,也有高一水软铝 石含量的混合型铝土矿。

1.4 Using Indonesian bauxite for local factory construction 印尼铝土矿用于当地建厂





PT Indonesia Chemical Alumina





PT Bintan Alumina

WHW, PT Well Harvest Winning Alumina Refinery

The current alumina production capacity in Indonesia is 4.3 million tons, and the planned production capacity may reach 15.486 million tons, including 5.5 million tons of Chinese funded projects (Jinjiang, Shaanxi Nonferrous, Tianshan Aluminum) and 9.986 million tons of local Indonesian enterprise projects. At that time, the future alumina production capacity may reach a volume of 19.486 million tons. 当前印尼拥有的氧化铝产能430万吨,规划产能可能会高达1548.6万吨,含中资项目550万吨(锦江、陕西有 色、天山铝业)及印尼本土企业项目998.6万吨,届时远景氧化铝产能可能会触及1948.6万吨的体量。

1.5 China's bauxite resources are unable to support the development of new production capacity 中国铝土矿资源难以支持新增产能发展



俄罗斯 牙买加 沙特阿拉伯 甘他 印度尼西亚 坦桑尼亚 1% 4% 1% 6% 0% 印度 中国 5% 24% 巴西 9% 澳大利亚 几内亚 27% 21%

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The annual mining output of bauxite in China has always been more than 70 million tons, accounting for about 1/4 of the global output. The storage and extraction ratio of bauxite is far lower than the global average, and the resource guarantee is insufficient. Although there has been good progress in mineral exploration this year, it is difficult to extract and use aluminum and high sulfur mines under coal. The ore resources are difficult to meet the existing production capacity needs, and the proportion of imported bauxite has been increasing year by year. Domestic bauxite resources have no supporting effect on the newly added alumina production capacity in China.

中国铝土矿年开采量一直维持在7000万吨以上,产量全球占比约1/4。铝土矿储采比远远低于全球平均值,资源保 障度不足,虽然今年找矿取得了不错的进展,但煤下铝和高硫矿开采和使用较难。矿石资源难以满足现有产能需 要,进口铝土矿占比逐年增加,国内铝土矿资源对于国内新增氧化铝产能没有支撑作用。



The growth and transfer of alumina production capacity 氧化铝产能的增长和转移

2.1 Focus on the construction site based on the predicted increase in alumina production capacity 从氧化铝产能增长预测看建厂地关注点



According to institutional predictions, the growth of alumina production capacity in regions outside of China in 2028 compared to 2024 is mainly distributed in Africa, Indonesia, India, etc. Therefore, from the perspective of increasing alumina production capacity, we need to pay attention to the production process requirements in the following situations: 1. China's coastal areas utilize imported mines for production, with a focus on Australian and Guinea mines; 2. Utilize local mines to build factories in areas with abundant bauxite resources such as Guinea, Indonesia, India, Vietnam, and Laos; 3. Utilize Guinea mines to expand production in energy rich areas such as the Middle East; 据机构预测, 2028年相对于2024年中国以外地区的氧化铝产能增长主要

分布在非洲、印度尼西亚、印度等,因此从氧化铝产能增加的角度看, 我们需要关注以下几种情况的生产工艺需求:

1. 中国沿海地区利用进口矿生产,重点关注澳矿和几矿;

2. 在几内亚、印尼、印度、越南、老挝等铝土矿资源丰富的地区,利用 当地矿建厂;

3. 在中东等能源富集地区利用几内亚矿扩产;;;



2.2 Transfer of alumina production capacity to coastal areas of China and countries with abundant bauxite resources 氧化铝产能向中国沿海地区和拥有丰富铝土矿资源的国家转移





Due to the scarcity of domestic bauxite resources in China, China's alumina production capacity is gradually shifting towards its coastal areas, using imported bauxite for production, especially near ports in Guangxi and Hebei. Of course, there are also some cases where the layout is relatively far away from ports, near steel plants or downstream electrolytic aluminum.

受限于中国本土铝土矿资源匮乏,中国的氧 化铝产能正逐渐向中国的沿海地区转移,采 用进口铝土矿生产,其中尤其以广西和河北 的港口附近为最,当然也有部分情况采用相 对远离港口,在靠近钢铁厂或下游电解铝进 行布局的情况。

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Development Trends of Alumina Construction Projects 氧化铝建设项目发展趋势



<u>3.2 Development trend of single line production capacity</u> 单线产能发展趋势





2016.4

2021.6

<u>3.3 Attempts at low-carbon and green development</u> 低碳绿色发展的尝试







Alcoa's Pinjarra plant uses solar energy to directly calcine aluminum hydroxide 美铝Pinjarra厂太阳能直接焙烧

Saudi Arabia's Ma'aden plant uses solar energy to produce steam 沙特Ma'aden太阳能产蒸汽

Hydro Alunorte refinery switches from fuel oil to liquefied natural gas and boilers using biomass fuel 海德鲁Alunorte厂从燃料油到液化天然气、锅 炉改用生物质燃料



Rio Tinto's Yarwun plant adopts renewable hydrogen as a replacement for natural gas technology 力拓的Yarwun厂可再生氢替代 天然气的技术

<u>3.4 Development and application status of key decarbonization</u> technologies 关键脱碳技术的发展与应用现状



MVR has started to be applied in the alumina industry, and large-scale promotion depends on the price trend of electricity MVR已在氧化铝行业开始应用, 大规模推广要依赖于电的价格走 向 The technology of using electric boilers in low-temperature refineries is mature, and large-scale promotion depends on costeffective 低温工厂采用电动锅炉的技术是成熟的, 大规模推广要依赖于经济性 The industry has given great attention to electric roasting, which is still in the basic research stage. However, hydrogen roasting requires more attention to the technical and economic aspects, as well as the large-scale economic acquisition of hydrogen gas 行业内对于电焙烧给予了很大的关注,仍处于基 础研究阶段,而氢焙烧更多需要关注技术经济性 和氢气的经济大规模获取



<u>4.1 Selection of digestion conditions-temperature</u> 溶出条件选择-温度





<u>4.1 Selection of digestion conditions-other conditions</u> 溶出条件选择-其他条件







4.2 Selection of precipitation process



分解工艺选择

牌号	主要化学成分*						571c 要物理性能*		
	Al ₂ O ₃	SiO_2	Fe ₂ O ₃	Na ₂ O	CaO	灼减	比表面积	粒径小于 45 µm 含量	
	%,不小于	%,不大于				m ² /g,不小于	%,不大于		
AO-G	98.6	0.018	0.015	0.35	0.03	1.0	60	20	
AO-1	98.6	0.020	0.020	0.45	0.03	1.0	60	20	
AO-2	98.5	0.040	0.020	0.55	0.04	1.0	60	25	

	物理性能							
itár 🖂	粒度分	子布/%	安息角/ (°) ≤	磨损指数/ % ≤	α-Al _z O ₃ 含量/ % ≤	松装密度/ (g/cm³) —		
牌写	-20 µm	+150 µm ≤						
6 8 ⁸	<							
YAO-1	2.0	3	25	95	10	0.05-1.10		
YAO-2	5.0	6	35 .	25	10	0.95~1.10		
YAO-3			不作	要求				

GB/T 24487-2022

YS/T 803-2012





4.3 Agitate technology for supporting two-stage precipitation 配套两段分解的搅拌技术



With the increasing number of application cases of two-stage precipitation technology in new construction projects in China, more new mixing technologies in the aluminum industry have been practically applied in China 随着两段分解技术在中国新建项目上应用案例的逐渐增多,铝行业更多新的搅拌技术在中国得到了实际应用

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5.1 Full major forward 3D collaborative design 全专业正向三维协同设计



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3D collaborative design is increasingly being applied in the design process of new projects, and the works of SAMI have won the Bently Industrial Manufacturing Annual Glory Award twice

三维协同设计越来越多的应用于新建项目设计过程,沈阳院的作品两次荣获Bently工业制造领域年度光辉大奖²⁵

5.2 Full major forward 3D collaborative design 全专业正向三维协同设计







An alumina project in Indonesia

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Benchmarking of alumina construction projects before achieving the dual carbon target 实现双碳目标之前氧化铝建设 项目标杆







SAMI takes it as its responsibility to devote itself to research, promote technological and equipment innovation in the alumina industry, and serve the upgrading of the alumina industry! We are willing to closely cooperate with industry enterprises and move forward hand in hand!

沈阳院以潜心钻研,推动氧化铝行业工艺和装备创新,服务氧化铝行业产业升级为己任! 愿与业内 企业密切合作,携手前行!