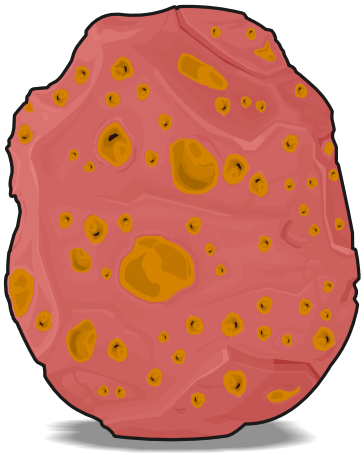
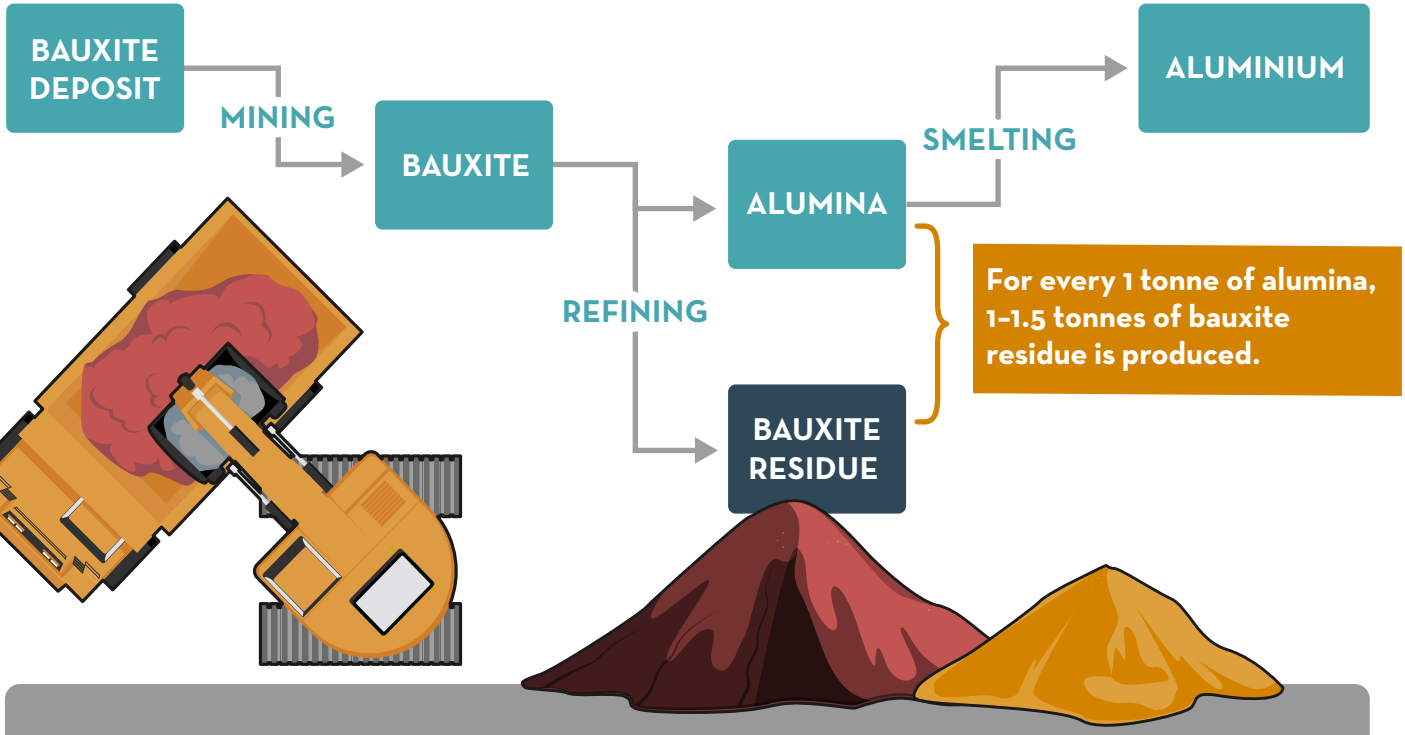
INTERNATIONAL ALUMINIUM

BAUXITE RESIDUE: AN INTRODUCTION



Since the start of large-scale alumina production, Bauxite Residue has been a by product. Looking towards the future, the industry seeks to close the circularity loop through more sustainable use of bauxite residue.

WHAT IS BAUXITE RESIDUE?



Bauxite residue is a waste product from the aluminium production process.

Rich in iron and aluminium, bauxite residue is produced through the extraction of alumina from bauxite, typically through the Bayer process.

The composition of bauxite residue depends on the source and the extraction process.

VOLUMES

10 billion tonnes by 2050

Bauxite residue can be a significant contributor to industrial symbiosis. International Aluminium Institute's dynamic material flow model indicates that, by 2050, there could be a bauxite residue global inventory of 10 billion tonnes.

AVAILABILITY

Demand for aluminium is expected to grow, with supply coming from both primary and recycled sources. This means bauxite residue will continue to be generated and available for industrial symbiosis. Bauxite residue can be used as an alternative raw material in industrial processes especially where traditional materials may become scarcer.

Visit international-aluminium.org/resources/bauxite-residue for more information.

Acknowledgements: Research leading to these results has received funding from the European Community's Horizon 2020 Programme (H2020/2014-2019) under Grant Agreement No. 776469 (REMOVAL). This publication reflects only the author's view, exempting the Community from any liability. Project website: https://www.removal-project.com/

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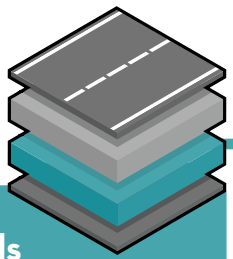
BAUXITE RESIDUE: KEY APPLICATIONS

Cement

3 million tonnes

It is estimated that 3 million tonnes of bauxite residue are used annually in the production of Portland Clinker Cement. The industry is also working to advance the application of bauxite residue in supplementary cementitious material.

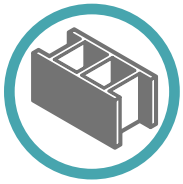
Bauxite residue



Roads

When bauxite residue is dewatered, compacted and mixed with a suitable binder, it can make a building material for haul roads.

This has been the case in the South of France, near the Gardanne Refinery, and for a highway near to the Pinjarra Refinery in Western Australia.



Brick production

Bricks composed of 90% bauxite residue have been made. These are fired at a temperature of 1000°C.

Soil amelioration

Bauxite residue's alkaline properties when blended with sandy soils can be beneficial in improving water retention and nutrient utilisation. This has been seen at Alcoa's sites in Western Australia.

Landfill covering

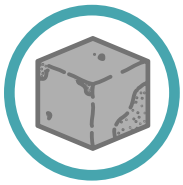
Bauxite residue can be used for landfill covering thanks to its impermeability. This has been done in Southern France at Gardanne.

Iron production

High iron oxide content of bauxite residue of up to 60% has led to collaboration on the innovation of techniques to improve its economic viability. The use of bauxite residue for iron was seen in war time when minerals were harder to access.

Phosphate removal

Treated bauxite residue has been shown to be effective at removing phosphate. In China, partial neutralisation has been achieved with 99% removal of phosphorous in water.



Geopolymer

Geopolymers are a substitute in some applications, and have a number of advantages over ordinary Portland cement, including a lower CO_2 footprint.

Rare earth extraction

A wide range of rare earth elements are common in bauxite residue. As economically viable extraction techniques develop, valuable materials can be removed but the remaining residue will still need to be managed.

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WHERE IS BAUXITE RESIDUE USED?

The sustainability of the Bayer Process, when used to manufacture alumina, has been a topic of interest for many years, leading researchers to investigate the practical uses of bauxite residue – a substantial waste product from this process.

Studies have revealed the value of bauxite residue for different purposes. In recent years, its application has been used in areas such as cement production, road construction and soil improvement.

Estimates reveal that anywhere from 2.5 to 5 million tonnes of bauxite residue is recycled each year.

PROCESSING OF BAUXITE RESIDUE

The below chart shows how bauxite residue is processed by three aluminium companies in three countries: Ukraine, Greece and India.

	MYKOLAYVIV	MYTILINEOS	HINDALCO
COUNTRY	**Ukraine**	**Greece**	**India**
MAXIMUM USAGE (KTPA)	**250**	**85**	**2,000**
MAXIMUM DISTANCE TO CEMENT PLANT (KM)	**1,200km***	**1,200km***	**1,200km***
PROCESSING AND OTHER CONSIDERATIONS	Residue is blended by the producer for consistency and solar-dried to reduce moisture content.	Residue is press-filtered and solar-dried by the producer to reduce moisture content. It is used as a clinker raw meal substitute in levels between 1.5-3.0% weight.	Residue is press-filtered by the producer to reduce content. Bauxite residue used in Portland Cement Clinker as a replacement for laterite, lithomarge and sub-grade bauxite.
CHEMICAL PROPERTIES	15% Al_2O_3, 47% Fe_2O_3 and 3.3% Na_2O	15% Al_2O_3, 42% Fe_2O_3, 7% SiO_2, 12.5% CaO, 6% TiO_2, and 3% Na_2O	17% SiO_2, 17% Al_2O_3 and 36% Fe_2O_3

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