European Aluminium
ANYTHING BUT BASIC

POSITION PAPER

INCLUSION OF *"CARBONATED INDUSTRIAL BY-PRODUCTS/RESIDUES"* IN ETS DELEGATED ACT ON CCU PERMANENT EMISSIONS STORAGE

July 2024

The background

The European Union's commitment to reducing carbon emissions is exemplified by the recent amendment to the Emissions Trading System (ETS) as outlined in Directive 2023/959. The "Permanent CCU Delegated Act", currently open for Public Consultation until 16 July, provides a significant opportunity to further this commitment by recognising emissions reductions from stored carbon that does not re-enter the atmosphere.

This position paper proposes the addition of "**carbonated industrial by-products/residues**" to the list of products considered to permanently chemically bind greenhouse gases in the Annex of the Delegated Regulation, with a specific focus on processed bauxite (also known as bauxite residue or red mud) generated by alumina refineries (See our proposed text below).

ANNEX

Products considered to permanently chemically bind greenhouse gases

1. Mineral carbonates used in the following construction products:

(a) carbonated aggregates used unbound or bound in mineral based construction products;

(b) carbonated cement constituents used in concrete or other cement-based products;

(c) carbonated concrete, including blocks, pavers or aerated concrete;

(d) carbonated bricks or tiles.

(e) ***carbonated industrial by-products/residues (New)***

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Mapping the production and availability of processed bauxite across Europe

Processed bauxite is an alkaline by-product material generated during the Bayer process, the primary industrial method for refining bauxite ore to produce aluminium oxide. This material is a mix of oxides of iron, aluminium, silicon, calcium, sodium, and other elements. In Europe, about 5.5 million tonnes of processed bauxite are generated annually from six active alumina refineries (one of them is currently suspended), which produce approximately 6 million tonnes. Most of the European processed bauxite is contained in special facilities known as residue storage areas. It is worth noting that the cumulative stockpile of processed bauxite in the EU currently exceeds 250 million tonnes on a dry basis[1].

Unlocking carbon sequestration potential in processed bauxite

The mineral carbonation of processed bauxite offers an alternative for permanently sequestering CO_2. Processed bauxite has two characteristic that can be taken advantage of:

- Firstly, the liquor contains sodium hydroxide, able to efficiently capture CO_2 as dissolved CO_2 from a flue gas or from the atmosphere.
- Secondly, the solids contain calcium, able to precipitate the dissolved CO_2 from the liquor in the form of stable solid calcium carbonate.

There are two main approaches to carbonating processed bauxite:

- **"Passive carbonation"** which involves exposing it to atmospheric CO_2, allowing it to undergo gradual neutralisation and carbonation over time[2]; and
- "**Active carbonation"** which involves directly injecting CO_2 to accelerate the carbonation process[3].

The international literature on active carbonation indicated that processed bauxite can capture between 17 kg and 53 kg CO_2 per tonne of material (residue) depending on the reaction time[4],[5] and on the residue liquor (sodium aluminate) concentration and the residue solids calcium content.

In turn these residue parameters depend on the quality of the bauxite processed and on the bauxite processing conditions. With passive carbonation only a fraction of the available calcium in the residue solids will eventually, over time, react with atmospheric CO_2 to calcium carbonate. CO_2 sequestration in that case is estimated to be in the range of 2 to 15 kg CO_2 per tonne of processed bauxite, depending on the method of disposal apart from the afore mentioned bauxite quality and processing related parameters.

Therefore, carbonating processed bauxite provides a way to permanently sequester CO_2 through the formation of stable calcium carbonate compounds. To fully utilise the CO_2 absorption capacity of the residue liquor, another calcium

1 European Aluminium, 2024. Industry & Market Data. https://european-aluminium.eu/about-aluminium/aluminium-industry/ (accessed on 04 July 2024)

2 Khaitan et al. Field Evaluation of Bauxite Residue Neutralization by Carbon Dioxide, Vegetation, and Organic Amendments, ACSE, J. Environ. Eng. 136.10: 1045-1053

3 Khaitan et al., Mechanisms of neutralization of bauxite residue by carbon dioxide, J. Environ. Eng. 2009.135:433-438

4 Braga et al., Use of bauxite residue (red mud) as CO2 absorbent, Tailings 2018, 5th International Seminar on Tailings Management

5 Vishwajeet S. Yadav et al., Sequestration of carbon dioxide (CO2) using red mud, J. of Hazardous Materials 176 (2010) 1044-1050

and/or magnesium source (e.g. seawater, brines from oil and gas winning, gypsum mined or from flue gas desulphurisation) can be introduced if appropriate.

Carbonated processed bauxite can enable the development of added value and sustainable products for other energy intensive industries

Carbonated processed bauxite presents valuable opportunities for cement applications as well as construction purposes (incl. building materials for non-structural applications, such as roads) by providing sustainable alternatives to traditional cement constituents and reducing carbon emissions of the final products[6][7].

Utilising this industrial by-product in relevant applications enhances the performance characteristics of construction materials while contributing to environmental sustainability. The integration of carbonated processed bauxite supports circular economy principles, promotes resource efficiency, and aligns with broader environmental stewardship goals. By transforming it into a valuable resource, these innovative applications advance sustainable construction practices and contribute to European efforts to mitigate climate change.

Conclusions and Recommendations

We urge the European Commission to broaden the scope of the Permanent CCU Delegated Act to include "**carbonated industrial by-products/residues**".

By promoting carbon sequestration within processed bauxite via such inclusion in the Delegated Act, alumina refineries in Europe affected by the EU ETS would have an economic incentive to provide to the cement industry a more sustainable alternative to reduce the carbon footprint of their products, while increasing industrial resource efficiency across both industries, with both environmental and economic benefits.

This would not only advance the circular economy but also align seamlessly with the EU's ambitious climate goals. Such an initiative would bolster sustainable practices and drive innovation in the alumina industry. Within this framework, recommendations should prioritise exploring the adoption of public procurement policies that promote low-carbon products. Additionally, there should be continued support for certifiable accounting practices and initiatives to advance research, development, and deployment of CO_2 utilisation technologies. These efforts are crucial for future contributions towards achieving a net-zero CO_2 emissions economy.

[6] Al-Saqlawi et al., The carbonation of Bauxite Residue: A Techno-Economic Scoping Study
[7] Bobicki et al., Carbon capture and storage using alkaline industrial wastes, Prog. Energ. Combust. 2023.38: 302-320

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