Information sheet

Biomass and municipal solid waste fly ash and Accelerated Carbonation Technology

Carbon8 Systems is the inventor and owner of a chemical process called Accelerated Carbonation Technology (ACT) that uses CO_2 to carbonate and treat a wide variety of industrial / thermal by-products and residues. The technology turns industrial by-products such as fly ash, filter cakes, APCr, steel slags, and cement kiln and bypass dusts into mineralised products that can be sold as aggregates in a number of construction related applications, or in some cases as a granulated fertiliser.

ACT has been delivering results for over 10 years in centralised waste treatment carbonation plants, and is now also available in a unique, containerised solution – the CO_2ntainer.

The CO_2ntainer

In early 2018 Carbon8 Systems developed its modularised solution using the ACT process. This can be located on-site where the ash or other by-products are produced, eliminating the need for costly and carbon emitting haulage and using CO_2 captured directly from the flue gas.

The CO_2ntainer can treat up to 12,000 tonnes of residues – aimed at the quantity produced a single site – processing them as they are generated and capturing CO_2 as it is emitted.

Carbon8 Systems demonstrated the first $CO_2$2ntainer at a CRH plant near Toronto, Ontario. This proved direct CO_2 capture, as well as the ability to make two marketable products: a manufactured aggregate, and a mineral-rich fertiliser. The container was subsequently deployed at a cement works in the UK. In 2019, Carbon8 Systems signed its first global licencing deal with a large French cement company.

Carbon8 Systems' technology can also be provided at larger, centralised plants, with a capacity of more than 40,000 tonnes and the ability to treat residues from multiple sites. The technology is proven at industrial scale and is licensed to three full installations in the UK.

CO_2ntainer deployed at a cement plant

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Thermal residues: Biomass and municipal solid waste fly ash

The technical challenges and financial burden associated with handling thermal residues, particularly those produced by incinerating biomass and municipal solid waste, drive high demand across the global market for alternative methods of treating fly ash.

Carbon8 Systems' technology treats various industrial residues and the company has been assessing the effects of carbonation on thermal residues since 2010, as part of both a UK government-funded project on Carbon Dioxide Capture (CarbATTACT) and a European Intereg-funded project (SAPI CO_2). This work uses the ash to manufacture a lightweight aggregate as well as considering its potential to permanently capture CO_2. As part of these projects, Carbon8 Systems has tested a large number of biomass and municipal solid waste fly ash samples, publishing its findings in diverse papers and reports.

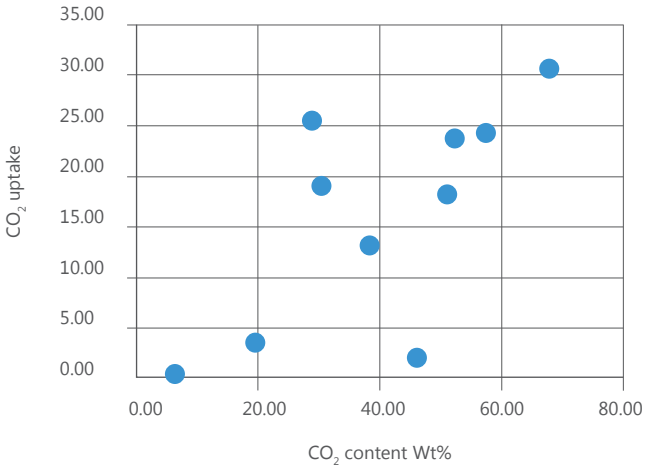
Characteristics of biomass and municipal solid waste fly ash treated with ACT:

- The reactivity (CO_2 uptake) of biomass and municipal solid waste fly ashes depends on the type of feedstock being burnt and the design of the plant, which means CO_2 uptake varies from 2% to 30% by weight.
- Biomass and municipal solid waste ashes can be used to capture CO_2 directly from flue gas.
- The reactivity of the ash depends on its chemical composition, particularly its calcium content, which varies with temperature of burn as well as the feedstock.
- Aggregate for bound application has been successfully manufactured from fly ash, with properties comparable to other secondary aggregate.
- CO_2 for carbonation can be obtained directly from flue-gas or landfill gas.
- Carbonation reduces the pH of the biomass and municipal solid waste fly ash and also reduces the availability of heavy metals such as zinc or lead.

Aggregates have been successfully manufactured from these residues and can be repurposed in a number of applications such as:

- Ready-mix concrete
- Aggregate blocks
- Pipe bedding
- Road construction.

CO_2 uptake of different biomass ashes



Pellets manufactured from biomass ash (1cm grid)

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Information sheet

Steel Slags and Accelerated Carbonation Technology

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CO_2ntainer deployed at a cement plant

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Thermal residues: steel slags

The technical challenges and financial burden associated with handling steel slags drives high demand across the global market for alternative treatment methods of treating them. Carbon8 Systems' technology can be used to treat various industrial residues, and the company has been studying the effects of carbonation on steel slags since 2000, testing a large number of samples and publishing results in diverse papers and reports.

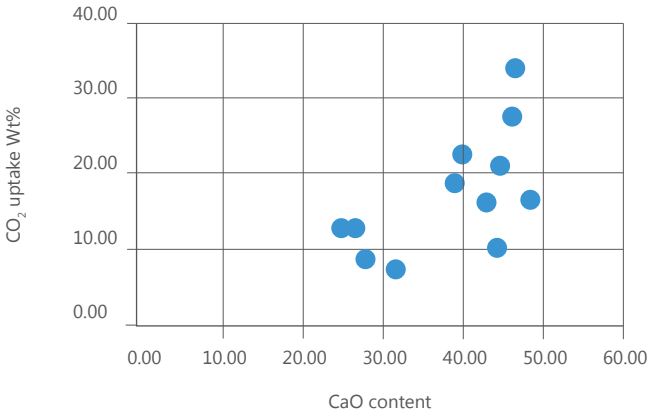
Characteristics of steel slags treated with ACT:

- Steel slags can be used to capture CO_2 directly from flue gas.
- CO_2 uptake varies from 7.5% to 34% by weight.
- Stainless steel slag, in particular, has a high CO_2 uptake, and R&D work is being conducted on validating the uptake of other slag types.
- Self-pulverising or falling slags react well with the ACT.
- ACT reduces the pH of the slags and the availability of heavy metals such as barium or chromium present in the slags.
- The carbonation process also reduces the problems of expansion due to lime un- soundness in the slags when used as an aggregate.

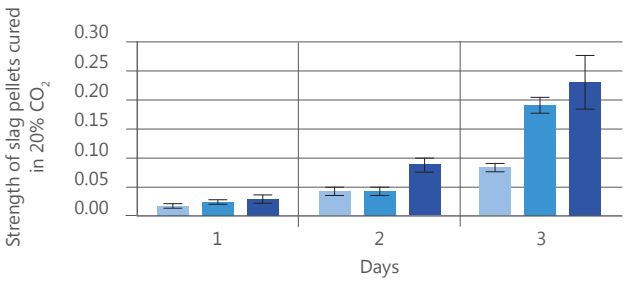
Aggregates have been successfully manufactured from steel slags and can be repurposed in a number of applications such as:

- Ready-mix concrete
- Aggregate blocks
- Pipe bedding
- Road construction.

CO_2 uptake of different steel lags



Strength of LD Slag Pellets cured in 20% CO_2



Carbonated pre-formed cylinder of AOD slag (25.2 Mpa strength)

Carbonated LD-Slag pellets (<15mm)

Pellets manufactured from AOD slag

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Cement residues and Accelerated Carbonation Technology

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The CO_2ntainer

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Thermal residues: cement kiln dust and cement bypass dust

The technical challenges and financial burden associated with handling cement residues, such as cement bypass dust and cement kiln dust, drives high demand across the global market for alternative treatment methods of treating them. Additionally, the cement industry is one of the largest emitters of carbon dioxide, contributing to 8% of total global carbon dioxide emissions.

Carbon8 Systems' technology can be used to treat various industrial residues, and the company has been studying the effects of carbonation on cement residues since 2000, testing a large number of samples and publishing results in diverse papers and reports. The company is currently in commercial discussions with a number of global cement companies.

Characteristics of cement residues treated with ACT:

- Cement residues can be used to capture CO_2 directly from flue gas.
- CO_2 uptake varies from 6% to 34% by weight.
- ACT reduces the pH of cement residues and also reduces the availability of heavy metals such as chromium or lead.

Aggregates have been successfully manufactured from cement residues and can be repurposed in a number of applications such as:

- Ready-mix concrete
- Aggregate blocks
- Fertiliser/soil improver
- Pipe bedding
- Road construction.

Typical properties of CBD aggregate

Surface saturated density (ssd)	2.02
Oven dried density (odd)	1.69
Apparent density (apd)	2.53
Water absorption	20
Loose bulk density	1.032
Aggregate impact value	35

Granulate manufactured from CBD

Pellets manufactured from CBD

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