

Cambridge Carbon Capture

Decarbonising flue gas using CO₂ mineralisation – project experience on ships

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CCC is a Cambridge-based, early-stage venture company developing a unique, profitable Mineral Carbonation process converting serpentine rock to advanced industrial mineral products & capturing flue-gas CO₂ directly & permanently as magnesium (bi)carbonates.

- What we do
- What is mineral carbonation
- CCS on ships
- How it works
- Costs



Cambridge Carbon Capture Ltd – application snapshot Direct CO2 stripping from flue-gas; Industrial minerals from mining wastes



Industrial CCS where CCS doesn't work

Valorisation of mineral & waste assets

Largest magnesium silicate mine in the world:

- Serpentine resource ~6 billion tonnes
- World market for serpentine ~20Mt/yr
- new giga-tonne market is CCS-mineralisation
- On-site CCC manufacturing plant to convert rock to precipitated brucite, silica & Ni powders

Cleanest survey vessel fleet in the world: 84% less Nox 95% less Sox 14% less CO2 ...but CO2 comprises 99.5% of emissions.

Drivers for CO2 reduction:

- CO2 emissions legislation coming
- environmental credentials win more business
- CCC process is simple, practicable & doesn't use energy





Mineral carbonation refers to industrial conversion of silicates to carbonates, mimicking natural processes by which CO₂ is removed from the atmosphere

 $CO_2(g) + CaSiO_3$ weathering $\rightarrow CO_3^{2-}(aq) + Ca^{2+}(aq) + SiO_2$ mineralisation $\rightarrow CaCO_3(s)$

- Primary process by which carbon dioxide is removed from the atmosphere >99% world's carbon reservoir is locked in limestone & dolomite
- · Thermodynamically favourable, but kinetically slow



Industrial CCS – proven on ships

		Cost effective Removal %	Open loop @ 33 ton/hr gas load Removal %	Open loop @ 70 ton/hr gas load Removal %
	CO ₂	30 %	77%	46%
	SO ₂	> 98 %	99 %	99 %
	NOx	30 %	66%	42 %

Mg(OH)2-to-(bi)carbonate is a highly effective solution for industrial CCS

Flue gas CO2-stripper systems for ships have been commercially available since 2009 using Mg(OH)2 & magnesium in seawater: <u>CSNOx video</u>



Mineral Carbonation – multiple commercial applications





Alcoa: red mud waste stabilisation



C8S: APC wastes to building blocks



CCC: olivine-to-Mg(OH)₂ & SiO₂ for scalable CCS



CCC process: exhaust gas scrubbing (CO2, SOx, NOx, PM) (direct reaction of flue-gas with brucite (magnesium hydroxide) products for sale or to ocean)





CCC process: high value SiO2, Mg(OH)2, Ni, Cr from minerals & wastes

(alkaline digestion of serpentine or olivine to convert to brucite & silica)



CCC develops & deploys profitable solutions for industry to permanently sequester CO₂ & convert waste minerals into high-value products



- University of Cambridge Depts Materials Science & Metallurgy; Engineering
- University of Nottingham Centre of Innovation in CCS
- University of Sheffield Dept. Materials Science & Engineering
- University of Greenwich School of Science

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