



16th INTERNATIONAL CONFERENCE ON CARBON DIOXIDE UTILIZATION

Enhanced carbonation of metered cement by solution

LIPPIATT Nicholas,^{1*} LING Tung-Chai¹

¹ College of Civil Engineering, Hunan University, Changsha, China

*nicholas.lippiatt@hnu.edu.cn

Keywords: Cement, carbonation, carbonated solution

Given current development goals, in the best-case scenario green-house gas emissions will plateau. Emissions of green-house gases must be reduced or global temperatures will increase by more than 2°C before 2030¹.

Concrete is used more than any product except water². This is why concrete is responsible for approximately 8% of global CO₂ emissions³. Ubiquitous use is the problem and a great opportunity. Carbon negative building materials are on the verge of commercialization⁴ however this technology is currently limited to prefabricated parts and aggregate production. This only constitutes approximately 30% of concrete products⁵. The other 70% requires a different technique.

When liquid CO₂ is released to the atmosphere it forms an approximately 50/50 mix of solid and gas that can be combined with a wet concrete mix. Commercial ventures offering this technique claim to be capable of sequestering 600g of CO₂ per cubic metre of concrete⁶. Academic literature claims 289g [6]. This represents a carbonation rate of 1-2%. The low value is due to the limitations of a gas diffusion-controlled process. By breaking this assumption, using a direct injection of CO₂ a carbonation rate of almost 5% can be achieved.

Using a combination of CaCO₃ and a carbonated solution to hydrate cement different carbonation

levels were achieved in cement samples:

Table 1. Strength and carbonation level

Sample	Strength (MPa)	Carbonated solution (Y/N)	CaCO ₃ (m%)
1	32.9	N	0
2	31.9	N	2
3	15.7	Y	0
4	43.5	Y	2
5	27.5	Y	2

While only in the very preliminary stages these results show great potential for strengthening cement by sequestering CO₂.

References

- [1] The Climate Action Tracker, China, 6th November 2017, available at <http://climateactiontracker.org/countries/china.html>
- [2] World Business Council for Sustainable Development Cement Technology Roadmap 2009: Carbon Emissions Reductions up to 2050 (2009)
- [3] Lord M. (2017), Rethinking Cement, Published by Beyond Zero Emissions Inc
- [4] official business website of MCI, available at mineralcarbonation.com
- [5] Monkman S, MacDonald M. (2017), On carbon dioxide utilization as a means to improve the sustainability of ready-mixed concrete, Journal of Cleaner Production 167, pp 365-375
- [6] Company website of CarbonCure available at <http://carboncure.com/faq/>, retrieved 18/01/2018