



Project Title	ReConcrete
Industry Partner	Heidelberg Materials AG, Global Research, Development & Innovation
Industry Sector	Cement and Lime
Technology Pathway (Primary)	Materials efficiency & industrial symbiosis Alternative materials & more efficient processes Carbon Capture & Storage / Utilisation
NIM Pillar	Technology Demonstration
Source	NIM Awards 2025
Description	<p>Concrete is the world’s most widely used construction material, essential for infrastructure due to its strength, versatility, and affordability. However, its production consumes vast natural resources and emits significant CO₂, especially from the hard-to-abate manufacture of cement. With global demand for cement projected to rise—particularly in developing regions—addressing concrete’s environmental impact is urgent.</p> <p>To reduce emissions, the industry is increasingly adopting supplementary cementitious materials (SCMs) like fly ash, slag, and calcined clays, which partially replace traditional cement. While these measures help, full decarbonization will require advances such as carbon capture and storage. However, none of these approaches can mitigate the large consumption of natural materials needed for concrete production.</p> <p>ReConcrete project addresses both the decarbonization and the resource preservation challenges. It is achieved by harnessing the full recyclability of concrete and of cement, including the process CO₂ emissions. ReConcrete technology comprises three novel steps:</p> <ol style="list-style-type: none">1. Selective separation of waste concrete, which effectively recovers sand and gravel in their original qualities, together with a new product – the so-called Recycled Concrete Paste (RCP) – enriched with the hydrated cement fraction.2. Enforced carbonation harnessing the natural ability of cement hydrates to bind CO₂ resulting in a low-energy process capturing CO₂ from a raw flue gas and mineralizing it in RCP in a form of stable calcium carbonate, effectively resulting in a CCS process.3. Use of RCP after carbonation to partially replace the energy and CO₂-intensive clinker in cement production. Upon carbonation, a reactive phase, the so-called alumina-silica gel also forms, turning it into a reactive SCM. <p>ReConcrete enables closing the material and CO₂ loop of concrete, contributing to sustainable concrete production.</p>
Innovations Employed	Common concrete recycling is based on a simple crushing producing low-quality materials mainly used in low-grade applications such as road base. The selective separation developed liberates and cleans the aggregates from the adhered cement



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paste, resulting in a quality comparable to virgin aggregates. The cement paste is recovered as a standalone product, RCP.

CO₂ mineralization using recycled concrete has been proposed. However, existing approaches primarily focus on using recycled aggregates, i.e. particles with size in millimeters. These carbonate very slowly. CO₂ uptake achieved under realistic conditions is hence low, in single % by weight. Additionally, the product remains a low-value aggregate, posing challenges to the underlying business case. RCP, a fine powder typically smaller than 100 µm, carbonates rapidly. The carbonation potential of hydrated cement can hence be almost fully realized. The product, carbonated RCP, is used as an SCM with a far higher value than aggregates.

Dimension of Novelty

Company & Country

It was new on the international market.

Innovation Collaboration

In-house

External Partners

The innovation was developed internally. However, the upscaling and deployment were supported by external partners (equipment providers). It was especially Fives FCB (France) for the selective separation technology and Christian Pfeiffer (Germany) for the enforced carbonation technology.

Intellectual Properties

The enforced technology and also the use of carbonated cRCP in certain cement compositions is protected by a series of international patents owned by Heidelberg Materials. Licencing is possible (one licensee at the moment).

Equipment for the selective separation and the enforced carbonation is also patented, partially by the equipment suppliers and partially by Heidelberg Materials.

IP Links

Timetable & Progress

Since 2017 lab studies and IP protection

Since 2020 – first industrial trials and technology upscaling

Spring 2024 – commissioning of the first-of-its-kind selective separation plant with capacity of up to 100 tons waste concrete per hour near Katowice, Poland

May 2025 – commissioning of the first enforced carbonation reactor demonstrator with a capacity of 1.5 tons RCP per hour at Goradze cement plant, Poland

June 2025 – EU LIFE funded project for the first commercial-scale reactor for enforced carbonation started in Lixhe cement plant, Belgium

Financing (Public/ Private)

Public funding

a) BMBF (Germany) funded project “C2inCO₂” to support technology development, 2020-2024

b) EU Horizon project “Carbon4minerals”, partially financing the demonstrator reactor at Goradze

c) EU LIFE project “CEMLOOP XL” supporting the first commercial reactor in Lixhe, Belgium

Finance Links



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Project Phase TRL

TRL 6 to 8

The selective separation has TRL of 8, the enforced carbonation TRL of 7 given the scale above. The use of carbonated RCP in cement production is reaching TRL of 6.

Problems to be Solved and Risks to be Managed

Technology development, especially upscaling of equipment ultimately operating at capacities of tens tons per hour and using a highly variable feed such as demolished and waste concrete has been challenging. The risks were that using lab-made equivalent materials and down-scaled processes will not result in efficient equipment at the commercial scale. This is especially pronounced in the recycling business which has intrinsically low margins while handling highly complex materials.

Current regulation on the product side, limiting the use of recycled aggregates in concrete irrespective of their quality is another challenge. An update to the respective standard which will address this issue is due in Poland in H2 2025.

Recycling market is highly localized and optimized as the generated value and margins are low. Implementing a new business model required for scaling of ReConcrete has remained a challenge.

Preliminary or Final Results Achieved

ReConcrete approach is scientifically well understood, efficient technologies are developed and piloted at industrial and/or commercial scale. The underlying business was model proven.

- Selective separation technology is rolled out, confirming the low energy needed and high quality of products. It was confirmed that waste concrete can be completely reused for concrete and cement production.
- Enforced carbonation technology was demonstrated at industrial scale, confirming the high CO₂ uptake (± 150 kg CO₂/t RCP) and low energy needed (less than 40 kWh/t RCP). It was confirmed that process emissions from the original cement can be practically completely stored back in RCP.
- Reactivity of cRCP has been verified in laboratory tests and by casting concrete demonstrators at full scale. In the cements developed, up to about 70% CO₂ emissions has been reduced compared to the industrial benchmark.
- A first commercial project is under realization (Lixhe, Belgium), proving the economic viability.

CO₂ Emissions Reduction Potential - Implementation and Future Market

As cement and concrete are similar worldwide, ReConcrete can be deployed globally. Technically, ReConcrete could be applied to waste concrete volumes corresponding to about 50% of current concrete volumes. This can be the case in developed countries where concrete market remains at similar levels since several decades. However, the aforementioned level of deployment requires changes to standards, legislation regarding recycling practices, landfill costs, customers' habits and overall market. The current implementation strategy focuses on selected micro-markets around urban centers.

At the level of individual cement plants, a CO₂ reduction in the range 10-30% can be achieved. Assuming 20% of carbonated cRCP in cements, overall clinker factor of 60%, uptake of 150 kg CO₂/t RCP and 850 kg CO₂ emissions per ton of clinker, the enforced



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carbonation can mineralize about 6% of plant's emissions and additional 20% of emissions will be avoided by using carbonated RCP to replace clinker.

Market Positioning

ReConcrete commercialization and rollout is ongoing. Currently, there is a handful of projects of different maturity on 3 continents. This includes 2 projects by the licensee. The most advanced project is a cooperation with fiber cement producer in Belgium, supported by EU LIFE funding. Here, a 10 t/h reactor should be installed at HM's Lixhe plant. A detailed feasibility study and engineering is ongoing.

Overall, HM plans to rollout ReConcrete in its key markets near urban centers, including partnerships with local companies especially in the domain of waste management. In parallel, HM's IP is getting monetize by selling licenses to third parties. Currently, one world-wide license has been granted and discussions with two more potential licensees are ongoing.

Project Location

Germany, Poland, Belgium

Project & Technology Links

"REPRINT ICR 2022-09 Heidelberg Materials MB" - a paper giving more details about ReConcrete technology

<https://www.sciencedirect.com/science/article/abs/pii/B9780443265662000155> - a book chapter describing circularity, CO2 mineralization beyond ReConcrete. It provides state-of-the-art and a general overview. The chapter is accessible under the link (not uploaded, contact us if you need a copy).

"HM GCCA ReConcrete-V4" a short video describing ReConcrete process and showing the industrial facilities for selective separation and enforced carbonation

<https://www.cemnet.com/News/story/172719/heidelbergcement-s-reconcrete-360-wins-award.html>

Zajac, M.; Skocek, J.; Skibsted, J.; Ben Haha, M. CO2 Mineralization of Demolished Concrete Wastes into a Supplementary Cementitious Material - a New CCU Approach for the Cement Industry. *RILEM Tech Lett* **2021**, *6*, 53-60.

<https://letters.rilem.net/index.php/rilem/article/view/141>

Technology Links

<https://www.heidelbergmaterials.com/en/co2-mineralization-of-demolished-concrete-wastes>