C^4S^* Research and Development Project

*C^4S: Calcium Carbonate Circulation System for Construction

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Summary

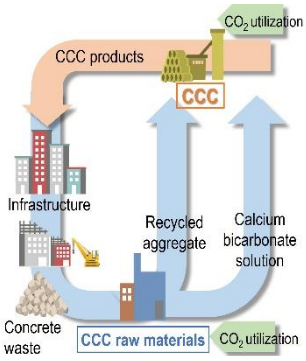

Fig.1 Resource circulation


Fig.2 First produced CCC

Cement concrete is an indispensable construction material for social capital development, but its production uses a large amount of limestone, which is a finite natural resource, and emits a large amount of CO_2. The ratio of limestone reserves to production is about 100 years, and about 7% of 33 billion tons of CO_2 emitted annually worldwide comes from cement production. To fundamentally solve the problems of resource depletion and CO_2 emission in cement concrete, in this project, Ca in cement concrete accumulated as a construction is regarded as a potential unused resource capable of capturing CO_2. By developing a technology to regenerate cement concrete demolition waste and CO_2 in the air as calcium carbonate concrete (CCC), and putting it into practical use as a main construction material to replace cement concrete. Consequently, a new resource recycling structure, calcium carbonate circulation system for construction (C^4S) will be realized (Fig.1).

Developments are being conducted for an efficient crushing method and an efficient CO_2 capture and storage method for cement concrete waste to establish a process for producing calcium bicarbonate solution and CCC aggregate with optimum particle size distribution and optimum carbonation rate. In addition, calcium bicarbonate solution is flowed between the recycled aggregate particles in a close state, calcium carbonate crystals are precipitated by controlling temperature, pH and evaporation rate, and the regenerated aggregate particles are bonded to each other to form CCC (Fig.2), and a series of efficient reaction control technologies is being investigated. Furthermore, various studies are being conducted to implement C^4S in society on design methods for CCC materials and structure, evaluation of various performances of CCC, data preparation and system establishment toward standardization of CCC and C^4S, design of resource recycling scenario for C^4S, and analysis of $LCCO_2$ reduction effect in the new supply chain created by C^4S. Through these series of research and development, it is shown that CCC is expected to have performance equal to or better than conventional concrete, CO_2 in the atmosphere is expected to be efficiently captured and stored, and the energy required for a series of manufacturing processes does not matter.

With the realization of C^4S, concrete that has captured CO_2 will be recovered and circulated as CCC, and CCC will be recycled as a main construction material many times with low energy. As a result, global warming will be greatly suppressed and the global environment will be regenerated.

Targets by 2030

FY2022: CCC with compressive strength of $12N/mm^2$ or larger will be realized at the concrete test specimen level (cylinder with a diameter of 10mm and a height of 20mm).

FY2024: CCC with compressive strength of $30N/mm^2$ will be realized at the concrete test specimen level, and about $1m^3$ CCC structural members with compressive strength of $12N/mm^2$ or larger will be realized at a pilot plant.

FY2029: Achieve CCC structural members with the same performance as conventional concrete, that is, compressive strength of $30N/mm^2$, and start general supply of CCC low-rise buildings with seismic resistance and durability.

Implementation

The University of Tokyo, Hokkaido University