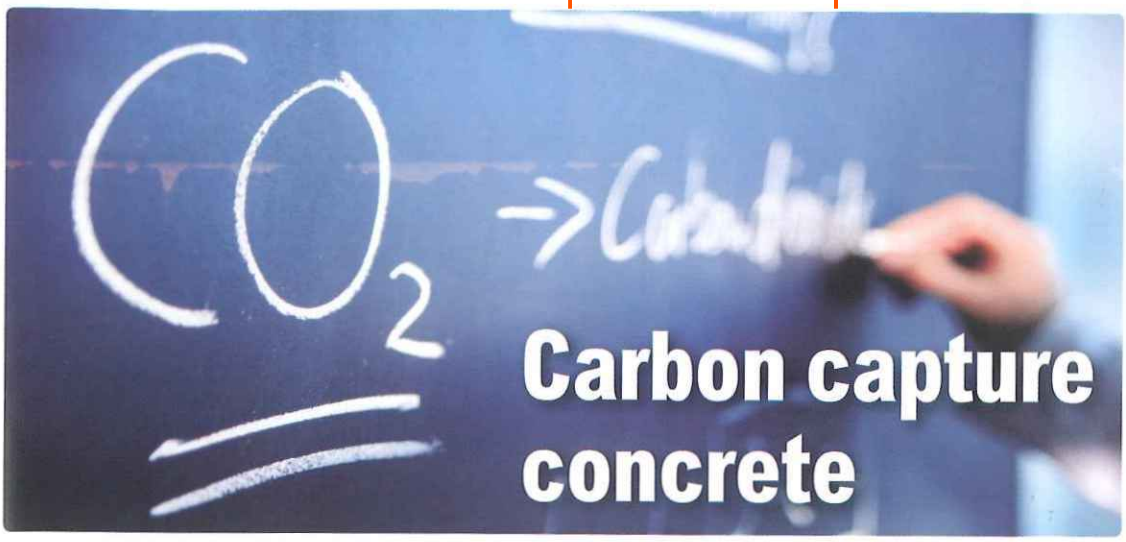

Carbon capture concrete

Professor Peter Claisse, from the Low Impact Building Centre at Coventry University, argues the case for greater research and measurement of carbon capture by concrete.

Despite the potential for carbon capture by concrete – estimated very roughly at 266 million tonnes worldwide each year – no-one has attempted to accurately measure the actual extent of sequestration. Measurement would be the basis for encouraging greater levels of capture and information for carbon trading and environmental reporting.

Actively using and monitoring carbon capture for concrete, just at current levels, will lead to expected savings of more than 150,000 tonnes of CO_2 each year in the UK (again, this is only a rough figure currently, with a very significant margin for error, up to 50%). It will also help concrete producers, under pressure to develop carbon-absorbing concrete, to offset the high carbon footprint of cement. Construction firms will benefit from customers who are prepared to pay an additional cost to demonstrate they are achieving carbon-saving targets through BREEAM or CEEQUAL.

Carbon capture is the process by which concrete, and some other materials, reacts with carbon dioxide in the air and so reduces atmospheric concentrations. The consequences of changes to concrete mix designs for levels of capture are not accurately known, so attempts to increase sequestration have no real data to support them.

Far more needs to be known across types of concrete and buildings and other structures in order to develop more high-potential materials. This can be done by recording the amount of CO_2 removed from the atmosphere through laboratory-scale tests, with samples placed in chambers in which the CO_2 concentration is maintained at atmospheric levels by introducing gas to make up for losses. The amount that is introduced will be accurately measured to give direct data for sequestration. Typically, a cementitious material would have to be tested for at least a year to give good estimates of the long-term potential. In order to access funding for researchers to undertake this work, there will need to be demand for the measurements from a range of industrial partners.

Concrete is not the only material that sequesters CO_2. Blast furnaces produce slags that contain calcium oxide, and other hot processes may also produce materials that have significant sequestration capacity, and the testing could also create an environment that is representative of the storage conditions for these materials and measure sequestration.

In theory, the potential for optimising carbon capture is huge. Assuming an average cement content of 350kg/m^3 and a total potential sequestration (if fully carbonated) of 19%, the potential total is 65kg per m^3 of concrete. Typical current values are estimated to be around 3% during the initial life of a structure, ie, 10kg.

There are some structures (such as road bridges) where it would be very bad practice (due to the corrosion risk) to try to increase it so only possibly 50% of concrete would be suitable for this.

A good example of where it could be done would be a warehouse floor, which will remain dry so the reinforcement will not corrode. If 750m^3 of concrete was placed in the floor and it was made to carbonate to 50% of its potential total, this would sequester 20 tonnes of CO_2. The strength and hardness of the floor would actually be improved by the process.

Demolition

One example of a specific area that needs more exploration is the potential of the demolition process. Carbon capture is limited in all reinforced concrete structures due to the need to protect steel reinforcement against corrosion. That means the sequestration is limited to the outer layer, typically a 40mm depth. However, when concrete is crushed for reuse as a foundation material for roads or an aggregate to make more concrete, the internal surface is exposed and leads to far more rapid sequestration and much higher levels of capture than at any other part of the life-cycle of the structure.

The carbonation reaction needs water – so it may be that wetting the crushed material could be an easy way to increase sequestration. In addition, it may well be the case that substantial potential capacity may be lost on some occasions when crushed material is encapsulated into concrete as recycled aggregate without being given the opportunity to carbonate.

Given the strict targets in the UK for reducing carbon emissions, the pressure on all forms of industry – leading to potential penalties and charges – will be increasingly intense in the coming years. Here is a clear opportunity for new and significant forms of carbon capture, and action is needed now to gather the all-important basis for measurement. ●

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