Carbon Sequestration has never been directly measured

Carbon capture or "sequestration" is the process in which concrete, and some other materials, react with carbon dioxide in the air and thus reduce atmospheric concentrations.

It is estimated that 266 million tonnes of carbon dioxide will be sequestered by the concrete produced worldwide each year; but this is only an estimate because our search of the literature indicates that nobody has actually measured it directly. The figure could have a very significant error, up to 50%. Also the consequences of changes to concrete mix designs are not accurately known, so attempts to increase sequestration have no real data to support them. We are looking for partners are keen to know how much CO_2 their business activities are sequestering or to develop and market materials with higher sequestration.

The new project

This project will measure the sequestration directly from first principles by actually recording the amount of CO_2 removed from the atmosphere. Samples will be 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.

New demolition procedures –a potential example of an easy way to capture more carbon

It is common practice to crush concrete after demolition so it can be re-used either directly as a foundation material for roads etc. or as an aggregate to make more concrete. When concrete has "carbonated", i.e. sequestered carbon dioxide, it can no longer protect embedded reinforcement from corrosion, so all reinforced concrete structures are designed so the carbonation front does not reach the reinforcement during the design life. For most structures this design is achieved, so the carbonation will be restricted to the outer cover layer, typically 40mm deep. When the concrete is crushed a large amount of internal surface will be exposed and rapid sequestration will take place. This is likely to capture far more carbon than any other part of the life-cycle of the structure, but we are not aware of any measurements of it. The carbonation reaction needs water so it may be that wetting the crushed material could be an easy way to increase sequestration. 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.

Sequestration by secondary minerals

Concrete is not the only material that sequesters CO_2. Blastfurnaces produce slags which contain calcium oxide and other hot processes may also produce materials that have significant sequestration capacity. Our apparatus will be designed to create an environment which is representative of the storage conditions for these materials and measure the sequestration. The results may then be used to certify or maximise the carbon capture.

Economic Gain

Sequestered CO_2 can be accounted for in carbon trading using the internal offset mechanism. Certified sequestration could reduce the need to buy credits or enable companies to sell them. As higher targets for carbon savings are set for the UK, it is very likely that concrete producers will be under pressure to develop carbon absorbing concrete to offset the high carbon footprint of cement. Customers will also be prepared to pay an additional cost to demonstrate that they are achieving their targets in carbon savings. Construction projects seeking BREAM or CEEQUAL certification will need proof of any sequestration that is claimed.

Environmental gain

The potential for optimising carbon capture is very large. Assuming an average cement content of 350kg 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, i.e. 10kg. Increasing this by just 3kg would save 150,000 tonnes of CO_2 per year in the UK alone. There are some structures (such as road bridges) where it would be very bad practice to try to increase it (due to the corrosion risk) 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 750 m^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.

Please contact us

We plan to install five chambers and our suppliers have indicated that the total cost for these will be approximately £100k. After this there would be costs associated with testing and running them and reporting the results. This could be funded in a number of different ways and we are happy to discuss options with any potential sponsors.

We could seek grant money to pay for the apparatus and some initial trials to confirm that the systems are working and giving accurate measurements over long periods (one of the five chambers will be used for long-term tests of the method). The industrial partners would then meet the cost of carrying out measurements on their own materials and processes. 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 receive grant funding we shall have to demonstrate that there is demand for these measurements from a range of industrial partners.

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