Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

Research Project 12

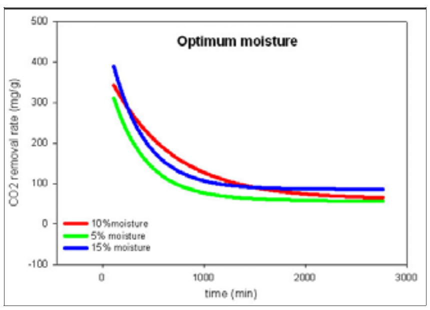
Concrete Carbonation

Project Objectives

To determine the potential of recycled concrete to act as a significant and economical method of carbon dioxide sequestration.

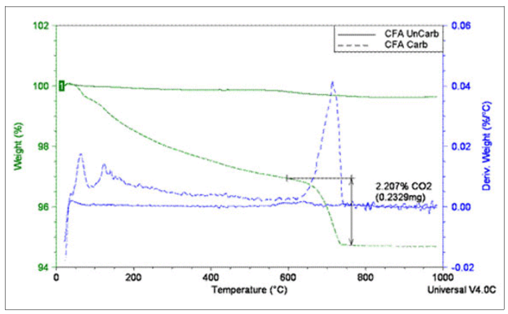
Project Description

Manufacture of portland cement for concrete buildings and pavements involves production of large quantities of carbon dioxide (CO_2), a green-house gas that contributes to global warming. Approximately half the CO_2 emitted during cement manufacture is due to consumption of fossil fuels in the high-temperature cement kiln, and half is due to evolution of carbon dioxide from raw materials such as limestone - a process called calcination. The minerals that remain in the kiln after calcination are highly reactive when mixed with water, and form the chemical basis for hardening and strength formation in concrete. However, at ambient temperatures and pressures, the calcination reaction can progress in reverse -- a process called carbonation -- as carbon dioxide from the atmo-sphere rebonds with calcium and other minerals in hydrated concrete to reform the original carbonates that are the raw materials used to make cement. In normal concrete structures, the carbonation reaction is very slow. In fact, because it can lead to premature failure of the structure, designers seek to avoid or minimize carbonation by ensuring adequate cover over reinforcing steel, carefully controlling water/cem-ent ratios, or specifying admixtures that improve concrete density. However, recycling of concrete structures for production of aggregate may speed the carbo-nation process dramatically, eventually recapturing all the CO_2 originally evolved from raw materials (but not fossil fuels). Therefore, concrete recycling may have global warming benefits that have not sufficiently been accounted for. The objectives of this project are to determine:



CO_2 removal rate in cement kiln dust over time for different moisture contents.

- How much carbon dioxide from the atmosphere can be bound in recycled concrete aggregates?
- How quickly will carbonation take place and how can it be accelerated?
- What is the potential impact on global warming?
- How does the cost of concrete recycling compare to other methods of carbon dioxide sequestration (such as deep well or ocean injection)?



In this graph, the solid lines are uncarbonated coal fly ash, the dashed lines are carbonated. The peak shows the calcium carbonate in the carbonated sample. There is none in the fresh coal fly ash material.

Project Partners

New York State's Washington County Highway Department

End Products

Guidance to federal and state agencies regarding the potential global warming benefits of concrete recycling and standards of practice intended to maximize these.

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement between the University of New Hampshire and the Federal Highway Administration, is a national center that promotes the appropriate use of recycled materials in the highway environment. Its focus is on the long-term performance and environmental implications of using recycled materials.

For detailed quarterly progress reports for Project 12, as well as all RMRC-funded research projects, please see: http://www.rmrc.unh.edu/Research/researchlevel2.asp.

Project Principal Investigator
Kevin H. Gardner Ph.D.
Dept. of Civil Engineering
Gregg Hall
University of New Hampshire
Durham, NH 03824
Tel: (603) 862-4334
Fax: (603) 862-3957
Email: kevin.gardner@unh.edu

RMRC
Gregg Hall
University of New Hampshire
35 Colovos Road
Durham, NH 03824
Tel: (603) 862-4704
Fax: (603) 862-3957
http://www.rmrc.unh.edu