

OHIO DEPARTMENT OF TRANSPORTATION OFFICE OF PAVEMENT ENGINEERING RESEARCH IMPLEMENTATION PLAN



Title: Magnitude Assessment of Free & Hydrated Limes Present in RPCC Aggregates

State Job Number: 14676

PID Number:

Research Agency: University of Toledo

Researcher(s): Dr. Jiwan Gupta and Dr. David Dollimore

Technical Liaison(s): Aric Morse, Roger Green

Research Manager: Karen Pannell

Sponsor(s): Howard Wood

Study Start Date: 3/31/1997

Study Completion Date: 3/31/2002

Study Duration: 60 months

Study Cost: \$169,096

Study Funding Type: 80% Federal/20% State

STATEMENT OF NEED:

Aggregates obtained from recycled reinforced Portland cement concrete (RPCC) pavement used as base or subbase may produce tufa in the underdrain outlet pipes. The most likely source of the tufa is related to the fine aggregate and cement paste. It is important to study the effect of the hydration process on the availability of free or hydrated limes.

RESEARCH OBJECTIVES:

1. Document the primary source of aggregate for the Portland cement concrete pavement in the state of Ohio.
2. Characterize RPCC for tufa potential and establish the role of aggregates in RPCC for tufa forming potential
3. Study the formation of Ca(OH)_2 and CaCO_3 in the RPCC in the course of leaching by utilizing thermogravimetric analysis process and differential scanning calorimeter unit.
4. Perform kinetic analysis of the hydration process of cement paste in the production of free lime and portlandite
5. Study, under controlled conditions, the leaching of various ions, especially Ca^{2+} , from the RPCC. This can be achieved using atomic absorption spectrometry or associated techniques.
6. Develop a simple test to determine tufa potential of recycled Portland cement concrete aggregate.

RESEARCH TASKS:

1. Literature review
2. Selection of projects for study
3. Characterization of RPCC aggregates through laboratory experiments
4. Develop of field test equipment

RESEARCH DELIVERABLES:

1. Final report
2. Field test equipment

RESEARCH RECOMMENDATIONS:

- Use of RPCC aggregates should be limited to coarse aggregate size
- Determine Mg/Ca ions ratio by the ICP-AES analysis carried on the leachate. Limit the use of RPCC aggregate to a ratio of less than 0.60.
- Determine the free lime present in the RPCC aggregate, using Ethylene Glycol Test, and limit the use of RPCC aggregate to one percent or less.

PROJECT PANEL COMMENTS:

The use of RPCC pavement as an aggregate source for Items 304, 301, and 302 should be permitted. Restrictions on the use should be to allow only those pavements, which are both currently under the jurisdiction of the Department, and were constructed under ODOT specifications. The same Item 703 aggregate requirements as for virgin natural aggregate should be required for recycled aggregates.

The research results of removing all material finer than the #4 sieve are not based on any acceptable standard.

The tufa found in outlets to date is a short term phenomenon that will taper off after the first couple of years. The under drain cleanout program ODOT has initiated should suffice in keeping the under drains flowing. In most cases, the clogging is found at the outermost few feet of the under drain outlet.

IMPLEMENTATION STEPS & TIME FRAME:

OPE has produced a position paper, a portion of which is reproduced in the project panel comments above, on the use of RPCC as a base or subbase. This position paper has been forwarded to the Office of Materials Management.

EXPECTED BENEFITS:

Concrete can be recycled which reduces the need for virgin aggregate.

EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

Two other issues must be addressed before RPCC can be used as a base or subbase.

The first is the high alkali content of the material produces leachate with a high pH which may not meet EPA requirements. A test section has been constructed on I-71 to evaluate this problem. The Office of Materials Management will be monitoring this section.

The second issue is the inability of the RPCC aggregate to pass the soundness and wear test required by 703.17. This issue could be overcome by blending the RPCC with virgin aggregate.

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

Materials Management

PROGRESS REPORTING & TIME FRAME:

N/A

TECHNOLOGY TRANSFER METHODS TO BE USED:

The Final Report of the research has been distributed to 49 state transportation departments, different FHWA offices, selected national libraries, and others.

IMPLEMENTATION COST & SOURCE OF FUNDING:

N/A

Approved By:

Office Administrator:

Signature: David Humphrey Office: OPE Date: 9/23/2005

Division Deputy Director:

Signature: Howard Wood Division: Planning Date: 10/11/2005