

State of Wisconsin/Department of Transportation
 RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: September 30, 2007

Program: SPR-0010(36) FFY99		Part: II Research and Development	
Project Title: <i>Detecting Deleterious Fine Particles in Concrete Aggregates And Defining Their Impact</i>		Project ID: 0092-07-02	
Administrative Contact: Nikki Hatch		Sponsor: Wisconsin Department of Transportation	
WisDOT Technical Contact: Jim Parry		Approved Starting Date: 10/1/2006	
Approved by COR/Steering Committee:		Original End Date: 10/1/2008	
Project Investigator (agency & contact): Steve Cramer (UW-Madison)		Current End Date: 10/1/2008	
		Number of Extensions: 0	

Percent Complete: 27%

Request a No Cost Time Extension (Please Select One): YES NO

Reason for No Cost Time Extension:

Project Description:

Currently, WisDOT specifications limit the fine particle content (passing the #200 sieve) of coarse aggregates to 1.5 percent by weight. There is increasing evidence that within some reasonable limits this is not an issue of the *quantity* of fine material but rather its mineralogical nature. Clays have been shown to influence the parameters controlling hydration of the cement paste and providing a structural barrier to the bond with aggregates.

The objectives of this research are to:

- 1) Develop a rapid test to detect clay particles in aggregate sources that is both indicative of their quantity and their physical and chemical nature. This is intended to indicate whether these clays are harmful or innocuous.
- 2) Quantify the impact of total (from combined coarse and fine aggregates) clay content on concrete strength development, shrinkage and porosity. Advance a fundamental knowledge of the role of clays in concrete performance so that mitigation strategies can be formed in future research.
- 3) Quantify clay content from several Wisconsin sources of aggregates to determine the relative contribution of clay fines from coarse aggregates and from fine aggregates.

Progress This Quarter:

(Includes project committee mtgs, work plan status, contract status, significant progress, etc.)

Building on work from the previous quarter, new experimental work performed with clays in different electrolytes was very promising. Good correlation was found in clays with no exchangeable cation such as kaolin and clays with one exchange cation such as calcium montmorillonite. Some deviation was found between experimental and predicted conductivity in clays with two exchangeable cations. The final conditions of the test were chosen from this work. These final conditions were 3 g of microfines suspended in two different solutions of 25 meq/L of potassium nitrate and magnesium nitrate, respectively. The final volume of the solution was 50 ml. Both, microfines and solution were in contact during 40 min prior to conductivity measurements.

The final results from research project # 0092-04-12 have revealed that the nature of the exchangeable cation plays an important role in certain concrete properties such as drying shrinkage. For example, clays with calcium as major exchangeable cation have a higher impact on the overall drying shrinkage than same clay with sodium. Therefore,

the research group was interested in developing a methodology to distinguish between these two cations. The conductivity of binary mixtures of calcium and sodium nitrate were measured in the presence of complexation agents.

Several inquiries were made with WisDOT and industry contacts to identify combined fine and coarse aggregate sources that are suspected of having elevated clay contents. At a recent TOC meeting, several strategies for obtaining aggregate were discussed and are being pursued.

Work Next Quarter:

The following activities are anticipated next quarter:

- Gather materials to begin task 2.
- Evaluate the proposed test method with gathered materials.









Circumstances Affecting Progress/Budget:

The performance of task 1 took more time than was originally estimated because of the complexity of the chemistry with more than two electrolytes and the difficulty to describe them. This is a direct result of the investigation team working in a new field for which there are few research publications to guide their work. Task 2 has fallen far behind schedule as a result of difficulties in identifying appropriate field sources of aggregates. It seems almost certain that a no-cost extension will be required because of the time lost seeking suitable aggregates for study.

Gantt Chart:

See next page

ID	Task Name	Duration	Start	Finish	2007												2008												2						
					Half 2, 2006						Half 1, 2007						Half 2, 2007						Half 1, 2008							Half 2, 2008					
					M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F		M	A	M	J	J	A
1	Deleterious Fine Particles Total Project by Federal FY	522 days	Mon 10/2/06	Tue 9/30/08	27%																														
2	Task 1: Develop aggregate screening test	190 days	Mon 10/2/06	Fri 6/22/07	74%																														
3	Initial clay conductivity tests in different electrolyte solutions	90 days	Mon 10/2/06	Fri 2/2/07	85%																														
4	Develop, verify, and refine test procedure	120 days	Mon 1/8/07	Fri 6/22/07	65%																														
5	Task 2: Demonstrate proposed test and evaluate concrete	285 days	Mon 4/16/07	Fri 5/16/08	0%																														
6	Screen Wisconsin combined fine and coarse aggregates for clays	140 days	Mon 4/16/07	Fri 10/26/07	0%																														
7	Select and obtain aggregates for concrete specimen prep	120 days	Mon 5/14/07	Fri 10/26/07	0%																														
8	Prepare and cure concrete specimens	100 days	Mon 6/25/07	Fri 11/9/07	0%																														
9	Evaluate strength and shrinkage	100 days	Mon 10/15/07	Fri 2/29/08	0%																														
10	Conduct microlevel studies	120 days	Mon 10/15/07	Fri 3/28/08	0%																														
11	Analyze project data	95 days	Mon 1/7/08	Fri 5/16/08	0%																														
12	Task 3: Reporting	510 days	Wed 10/18/06	Tue 9/30/08	40%																														
13	Prepare interim reports and TOC meetings as needed/requested	510 days	Wed 10/18/06	Tue 9/30/08	50%																														
14	Prepare final report	60 days	Mon 4/7/08	Fri 6/27/08	0%																														
15	Review, revise and submit final report	67 days	Mon 6/30/08	Tue 9/30/08	0%																														

Project: clay2006sched v2003.mpp Date: Thu 10/4/07	Task		Milestone		External Tasks	
	Split		Summary		External MileTask	
	Progress		Project Summary		Split	