Wisconsin Highway Research Program
Request for Proposals (FFY2007)
From the Rigid Pavement Technical Oversight Committee

Problem Title:

Detecting Deleterious Fine Particles in Concrete Aggregates

Background and Problem Statement:

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 the quantity of fine particles is not a cause for adverse problems but that the geological nature of the fine particle is important to concrete performance and should be monitored.

During the past year, this problem has been further researched and at the same time WisDOT has been conducting the California Cleanness Test (CCT) as part of a monitoring process for aggregates. Further problems have occurred in the field with some evidence and the perception of the technical personnel involved that aggregate coatings have been a contributor to the problems. Research has shown that certain types of clay particles can be very adverse to concrete in their absorption of water creating problems with the aggregate-paste interface and possible interfering with the hydration of the paste. Other clays are innocuous. Unfortunately, the CCT may not be sufficiently discerning in identifying these problem clays. In addition, experience at WisDOT has suggested that the ½ hour required to conduct the CCT per sample may be too long under the manpower constraints in WisDOT and this problem will be exacerbated if the CCT does not provide exactly the information required even if it is an improvement over the current 1.5% fine particle limit.

Previous research on fine particles and the harmful impact of clays has focused on coarse aggregate coatings. Since most coarse aggregate in Wisconsin is washed, the amount of coating is relatively small but not necessarily innocuous. In addition, to coarse aggregate coatings, clay particles can also be introduced as a minor fraction in fine aggregate. Even as a minor fraction in fine aggregate, such clay particles could be as significant or more so than the coarse aggregate coatings and yet be not readily detectable. In other situations, the fine aggregate portion may add to or interact with coarse aggregate coating to exceed innocuous thresholds.

Objectives, Scope, and Reporting:

This project will quantify the impact of total deleterious fine particle content in combined fine aggregate and coarse aggregate sources that occur in Wisconsin. It will include development of an easy to use test that will allow assessment and screening of fine and coarse aggregates for deleterious fine particles. It is intended that the developed test will be easily conducted by WisDOT personnel and others to assess the quality of aggregate materials for concrete construction. This research will involve collection of fine and coarse

aggregate samples and appropriate assessments of these aggregates and the derivative concrete specimens using mechanical, electrical and chemical tests. Upon completion of the project, the researcher will provide 85 copies of the printed final report for DOT (80) and WHRP (5) as well as one electronic copy of the final version of the report.

Specific Results Anticipated:

1. A new, easy-to-use test method to screen aggregates (fine and coarse) for deleterious fine particle content.
2. Definition of the impact of specific fine particle mineralogy's and quantities on concrete strength development and durability.

Length of Research Project and Approximate Cost to Complete

Proposals for up to two years of research and a total project cost $130,000 will be considered.

Urgency and Potential Benefits

Aggregate coatings and fine particles in aggregates continue to be anecdotally identified as the source of strength development and construction problems in concrete paving. A test that distinguishes harmful particles from innocuous particles is needed. Better definition of the distinguishing characteristics of harmful particles and their impact on concrete performance is needed to facilitate an economical supply of concrete aggregates that will reliably provide a strong and durable concrete product.