

DEVELOPMENT OF CONCRETE UTILIZING PAPER MILL RESIDUAL SOLIDS

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ABSTRACT

This Final Report summarizes the activities associated with the first year, first phase, of the project for the development of concrete utilizing paper mill residual solids. The objective of this first phase of the project was to evaluate preliminary test data from one source of pulp or paper mill primary or secondary sludge, or deink sludge from paper recycling. Such sludge materials are generally classified as residual solids. A source of residual solids from near Green Bay, WI, was used as a component of concrete. Such concrete mixtures would be useful in many construction activities in Wisconsin (e.g., residential construction, highways, bridges, parking structures, etc.). The first year activities evaluated the hypothesis that paper mill residual solids would improve the microstructure of concrete. Testing included the characterization of the residual solids and laboratory testing of concrete incorporating the residual solids. The test program included absorption characteristics and chemical composition of the residual solids, and the measurement of various properties of mortar/concrete such as slump, air content, compressive strength, tensile strength, and flexural strength. Six different mixture proportions of concrete were produced and tested for rheological properties as well as strength. The six mixtures contained 0%, 0.2%, 0.4%, 0.6%, 1.0%, and 1.2% residual solids as a percentage of the total concrete mixture by weight. Although the compressive, tensile, and flexural strength of concrete containing the residual solids were lower than an equivalent control mixture without residual solids, the reduction was less for tensile and flexural strength than compressive strength. This indicates that such residual solids did have a positive effect on the microstructure of the concrete. The photomicrographs obtained for the concrete containing residual solids shows that the fibers were satisfactorily dispersed and bonded to the cement paste. This would tend to enhance the splitting tensile and flexural strength of the concrete. Based upon the results of this project, a more complete project evaluation as outlined in the initial proposal should be undertaken by the SWRRP. This proposed next phase (Year 2) may include pilot scale manufacturing at a ready mixed concrete producer and a future field trial project. Utilization of residual solids in concrete to improve its quality would reduce the disposal of the residual solids in landfills in Wisconsin.