

**SUSTAINABLE DEVELOPMENT FOR THE FOREST PRODUCTS INDUSTRY:
USE OF WOOD ASH IN CONCRETE AND FLOWABLE SLURRY**

By Tarun R. Naik and Rudolph N. Kraus

Reference: CBU-2003-01

ABSTRACT

The Wisconsin forest products industry generates approximately one million dry tons (or approx. 1.8 million cubic yards) of wood ash per year. Disposal of wood ash in landfills costs Wisconsin industry significant direct cost plus unknown future liabilities due to environmental concerns related to such materials in landfills. The initial manufacturing technology for use of wood ash generated by the forest products industry in structural-grade concrete and flowable slurry (Controlled Low Strength Materials, CLSM) was demonstrated through an initial laboratory evaluation followed by prototype manufacturing and full-scale manufacturing.

Three different CLSM mixtures and four different concrete mixtures were first developed and tested in the laboratory. The CLSM mixtures were evaluated for density, bleed water, settlement, and compressive strength. Concrete was evaluated for fresh concrete properties including slump, air content, and unit weight; and concrete temperature were measured and recorded for each mixture. Concrete specimens were cast for various tests.

Based the results of the lab manufacturing, four concrete mixtures and three CLSM mixtures were manufactured at a commercial ready-mixed concrete plant. One concrete mixture was proportioned without wood ash, and three concrete mixtures contained wood ash. CLSM mixtures contained between 797 and 573-lb/yd³ wood ash, and cement content varied between 87 and 134 lb/yd³. Fresh CLSM properties such as air content, flow, unit weight, temperature, and setting were measured. Compressive strength of CLSM was also evaluated through the age of 182 days. The wood ash content in the four concrete mixtures was approximately 0, 7.5, 12.5 and 17.5%. Fresh concrete properties were measured for each mixture. For each concrete mixture, concrete specimens were cast for compressive strength, splitting tensile strength, flexural strength, and resistance to freezing and thawing, and drying shrinkage. Compressive strength and splitting tensile strength were measured through the age of 91 days.

Full-scale manufacturing of CLSM and concrete mixtures was carried out at a ready-mixed concrete plant. Three series of CLSM mixture proportions were manufactured. The mixtures used for the full-scale manufacturing for CLSM series consisted of five to seven batches of approximately nine cubic yards per batch. Four series of concrete mixtures were also manufactured. Each series of concrete mixtures consisted of three to four batches of approximately nine cubic yards of concrete. The CLSM mixtures were used as a base course material with the concrete mixtures used as log-yard storage pavement. Test specimens were also cast at the time of manufacture. Fresh concrete and CLSM properties were evaluated, and specimens for hardened properties were evaluated. CLSM was evaluated for compressive strength, while the concrete was evaluated for compressive strength, flexural strength, splitting tensile strength, drying shrinkage, and resistance to freezing and thawing. Hardened CLSM and concrete properties were

evaluated through the age of one year. The condition of the concrete pavement was also evaluated one year after construction. The pavement was found to be in excellent condition.