Greening Cement-Based Products with Waste Powder Paint (WPP)

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OBJECTIVE AND SCOPE

The overall objective of the research project is to investigate the influence/interaction of the WPP, cement, supplementary cementitious materials (SCM), and chemical admixtures on the fresh, hardened, and durability properties of the cement-based products. Also, to standardize WPP application, reduce WPP getting into landfills, and conserve cement usage. The scope of the preliminary studies is limited to evaluating fresh and hardened properties of cement-based products, such as grout, with WPP.

HEAT OF HYDRATION TEST

Table 1. Test Details

- Comparing the test results (Figure 4) with the typical curve (Figure 5), a dormancy period of around 2.5 hrs was observed for all the mixtures.
- Reduction of about 22.4% and 29.1% in the maximum hydration temperature for the 10% and 20% WPP mixtures was observed, compared to 0% WPP mix.

ACCELERATION TEST

- Generally, the cement grout is expected to shrink at the early age. But during the casting of the cement grout specimens with WPP, an unusual phenomenon of cement grout expansion was observed (Figures 8 & 9).
- Equal weights of cement grout mixture were used to cast the WPP specimens. The 0% WPP specimen started shrinking after starting the test, whereas, the specimens with 10% and 20% WPP started expanding after 10 to 15 min delay (Figure 9). The expansion of WPP specimens ceased after 2.5 hrs. Considering the heat of hydration curves (Figures 4 & 5), it can be inferred, expansion occurred before initial setting.

METHODOLOGY

- The WPP is made of different types of polymers (Figure 2) and has characteristics analogous to cement admixtures. The cement-based industry has a proven track record of using fibers, polymers and polymer-modified plastic to improve concrete, grout, mortar, and masonry properties.
- About 95% of cement particles are smaller than 45 μm (PCA 2003). Hence, WPP size (Figure 3) is comparable to cement.
- WPP has three different transition temperature ranges (shown below (Graewe and Retting 2002). Hence, there is a possibility of phase-transition of WPP in cement, because cement hydration temperature may reach 60°C – 70°C.
- Glass transition temperature of WPP > 30°C – 60°C:
  - Rubber-elastic state temperature of WPP > 50°C – 100°C:
  - Melting temperature of WPP > 90°C – 190°C:

CHEMICAL AND PHYSICAL PROPERTIES

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