HR-337 Investigation of Rapid Thermal Analysis Procedures for Prediction of the Service Life of PCC

Carbonate Coarse Aggregate

Key Words: Aggregate, PCC, Rapid Thermal Analysis, X-Ray analysis,

The major objective of this research project was to use thermal analysis techniques in conjunction with x-ray analysis methods to identify and explain chemical reactions that promote aggregate related deterioration in portland cement concrete (PCC).

Twenty-two different carbonate aggregate samples were subjected to a chemical testing scheme that included:

bulk chemistry (major, minor and selected trace elements) bulk mineralogy (minor phases concentrated by acid extraction) solid-solution in the major carbonate phases crystallite size determinations for the major carbonate phases a salt treatment study to evaluate the impact of deicer salts

Test results from these different studies were then compared to information that had been obtained using thermogravimetric analysis techniques. Since many of the limestones and dolomites that were used in the study had extensive field service records it was possible to correlate many of the variables with service life.

The results of this study have indicated that thermogravimetric analysis can play an important role in categorizing carbonate aggregates. In fact, with modem automated thermal analysis systems it should be possible to utilize such methods on a quality control basis.

Strong correlations were found between several of the variables that were monitored in this study. In fact, several of the variables exhibited significant correlations to concrete service life. When the full data set was utilized (n = 18), the significant correlations to service life can be summarized as follows (a = 5 % level):

- Correlation coefficient, r, = -0.73 for premature TG loss versus service life
- Correlation coefficient, r, = 0.74 for relative crystallite size versus service life. Correlation coefficient, r, = 0.53 for ASTM C666 durability factor versus service life. Correlation coefficient, r, = -0.52 for acid-insoluble residue versus service life.

Separation of the carbonate aggregates into their mineralogical categories (i.e., calcites and dolomites)

tended to increase the correlation coefficients for some specific variables (r sometimes approached 0.90); however, the reliability of such correlations was questionable because of the small number of samples that were present in this study.