CHARACTERIZATION OF GLASSY PHASES IN FLY ASH BY PARTICLE SEM

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ABSTRACT

As part of a larger program to characterize fly ashes used in the FHWA pooled fund study on the Development of Performance Properties of Ternary Mixes TPF-5(117), three fly ashes were characterized by particle Scanning Electron Microscopy(PSEM). This method was used to collect X-ray fluorescence intensity data, and size and shape parameters for approximately 10,000 grains at 2000x magnifications corresponding to 0.20 - 25.0 μm particles. This length scale is the size range of typical fly ash grains. The system was set to select glass particles for analysis based on their circularity (aspect ratio ≤ 1.3) and particle size (< 25 μm). Each selected particle was analyzed for 16 elements: Na, Mg, Al, Si, P, S, K, Ca, Fe, Ti, Fe, Ni, Zr, Ba, Ce, and Pb. The PSEM technique provides a wealth of information that can be visualized in a number of ways. The simplest is the one-dimensional frequency histogram plot of individual elements. Two-dimensional scatter plots of the oxide percentage vs. particle size are useful for identifying the clustering of specific oxides into certain particle size ranges. To visualize more than two oxides in the same plot, triaxial diagrams, based on glass science principles, use axes of: SiO_2+Al_2O_3+Fe_2O_3 (network formers), CaO+MgO (network modifiers) and Na_2O+K_2O. These reveal clustering of particles into characteristic patterns of chemical composition. These clusters could provide the basis for a more meaningful classification system of fly ashes than the ASTM C-618 categories of Class C and Class F.