Characterization of Differing Forms of Unburned Carbon Present in Fly Ash

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ABSTRACT

Although the unburned carbon is known to preclude the use of fly ash in the cement industry, very little is known about the properties of this material and any information regarding its characteristics is watched closely by the utility industry. It is generally known that the ASTM LOI specification is not sufficient to identify the suitability of a fly ash for the cement industry, since this criterion only gives a rough approximation to the carbon content of a sample and does not directly correlate with its capacity to adsorb air-entrainment agents. In fact, prior petrographic examinations of a number of fly ashes have shown that the unburned carbon is not visually uniform. Three distinctive microscopically forms have been identified: inertinite, isotropic coke and anisotropic coke. Concentrates of these differing forms of unburned carbon have been generated from two high-carbon-content fly ash samples using a novel methodology, that includes density gradient centrifugation (DGC). The highest purity fractions from these separations have been extensively characterized by several analytical techniques, including thermogravimetric, CHN and surface area measurements. The elemental analyses show that the three types of unburned carbon consist primarily of C (>96%). The H/C atomic ratios are < 0.04, indicating a high degree of condensation. While the BET (N_2-77K) surface areas are relatively low (10-50 m^2/g), there seems to be a strong relationship between surface area and density. The relative capacity of these differing carbon forms to adsorb air-entrainment agents will also be reported.