REMOVING CARBON FROM FLY ASH WITH AN ACOUSTICALLY AGITATED FLUIDIZED BED SEPARATOR

by

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SUMMARY

Introduction

This paper describes a fly ash beneficiation process which uses a fluidized bed gravity separator, with a high intensity acoustic field applied to the bed to enhance the separation process. The process is centered around an inclined fluidized bed, similar to a long, nearly-horizontal table. The fly ash is added at one end of the bed and fluidizing air passes upward through the distributor. As the ash flows along the length of the bed, segregation occurs. By the time the ash reaches the discharge end of the bed, the material has been separated into carbon-rich and carbon-lean streams.

The separation of the carbon particles from the inert portions of the ash occurs due to differences in density, and in some cases, sizes of the particles. The air, which flows upward through the distributor and ash, causes agitation and motion of ash particles in the vertical direction. The relatively low-density carbon particles segregate towards the top of the bed, creating a separation of the unburned carbon and inert portions of the fly ash.

The relatively fine size distribution of fly ash makes it difficult to fluidize the ash under normal conditions. In this process, loud speakers are located above the bed, creating a high intensity acoustic field. Energy from the sound waves agitates the particles and disrupts the interparticle forces. This promotes flow of the ash along the surface of the bed and improves the separation of the carbon particles from the rest of the fly ash.

Test Results

Laboratory tests were performed with ash samples of widely different properties to determine the effects of bed processing conditions and ash properties on beneficiation performance. One group of tests was performed on ash from Brayton Point Unit 3. This ash, which had previously been processed by the STI electrostatic ash beneficiation process installed at Brayton Point, consisted of the high-LOI refuse stream from the STI device. The objective of these tests was to enrich the carbon and produce an ash product which can be used directly as boiler fuel. The ash samples fed to the fluidized bed had average LOI levels of 33 and 45 percent, and product streams with 50 to 60 percent LOI at 50 percent mass recovery were produced.

As noted above, the tests with the Brayton Point ash were intended to determine if the fluidized bed can produce high carbon concentrations from the refuse from a fly ash beneficiation process. Tests have also been performed with raw fly ash (not previously beneficiated) to determine if it is possible to produce a product with sufficiently low LOI content for use in concrete. Tests were performed on fly ashes with average feed LOI levels of about 5 percent. In each case, ash products were generated with less than 4 percent LOI at product mass recoveries of 60 to 85 percent.

Ammonia Removal

Contamination of fly ash with ammonia is an emerging problem that utilities which use NH_3 injection for flue gas conditioning or SNCR or SCR for NO_x control will have to find a way to solve. When used for carbon removal, the acoustic bed process is operated with room temperature fluidizing air. However, the process can also be operated with fluidizing air at temperatures in the 300 to 400EF range for removal of adsorbed ammonia. Modifications are being made to the laboratory bed and tests are planned for the second half of 1999 to determine the effects of temperature of the fluidizing air and bed processing conditions on rates of NH_3 removal.

Ash Processing Costs

The acoustic fluidized bed provides a simple, inexpensive approach to fly ash beneficiation. Estimates of capital and operating costs show that for a unit designed to handle 25 tons of ash feed per hour, processing costs will range from $2 to $3 per product ton, depending on the properties of the feed ash and the configuration of the system.