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Commercialization Status of a Pneumatic Transport, Triboelectrostatic System for Carbon/Ash Separation

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Abstract

Much has been reported in recent years on the development of pneumatic transport, triboelectric separation technology for dry beneficiation of combustion fly ash. As an alternative to carbon burnout, floatation, or mechanical transport triboelectric methods, this approach holds the potential for combining low capital cost, low operating costs and high performance.

Solvera Controls has partnered with Tribo Flow Separations to bring this technology to full-scale commercial and technical viability. This paper will discuss the results of the first implementation of the TFS technology in a commercial power plant environment. This implementation was accomplished in collaboration with Boral Material Technologies. Processing details and test results are described relative to the combustion ashes that were processed. The overall processing protocol, system configuration, and carbon-ash separation performance are presented.

Introduction

The ASTM C-618 specification for using fly ash as an admixture in concrete requires that the loss-on-ignition (LOI) be less than 6%. With the installation of low NO_x burners, the unburned carbon in many fly ashes from coal burning utilities has increased to unacceptable levels for such cement applications. Since unburned carbon constitutes typically over 90% of the LOI for class F fly ashes, an efficient and economic beneficiation technology that removes carbon from fly ash may generate significant economic and environmental benefits for the power industry.

As an alternative to flotation or wet beneficiation and carbon burnout, pneumatic transport, triboelectrostatic beneficiation technology has emerged as a way to separate fine-sized particulate with the potential for high efficiency, low cost and no secondary waste. High LOI fly ash may be beneficiated, under dry conditions, into a low LOI ash stream for cement applications, and a high LOI or carbon-rich stream for blending with coal to recover its BTU value or as feedstock for other value-added products. The triboelectrostatic technology described in this paper uses pneumatic transport processing instead of mechanical transport processing.

The backbone of the technology was fundamental, laboratory experimentation initiated at the Center for Applied Energy Research (CAER) of the University of Kentucky in 1992. By quantitatively examining particle tribocharging and its control under gas transport conditions, the optimization of particle-particle interactions for establishing bipolar charge was understood. These experiments also showed how to efficiently separate charged particles having diameters between 0.1-500 micrometers even though turbulent flow dominated the conditions under which bipolar charge was established. Subsequently, the laboratory unit, having a feed rate of 0.5 kg/hr, was scaled-up to a prototype system having a feed rate of 250 kg/hr. This paper discusses the first demonstration of the technology at a feed rate of 1000 kg/hr for the removal of unburned carbon from coal combustion ash.

Experimental

The first demonstration of pneumatic transport, triboelectric separation technology is sited at the Jack McDonough Plant, Atlanta, Georgia. It is a collaborative project involving Tribo Flow Separations (TFS), Solvera Particulate/Stock Equipment Company (SP/SEC) and Boral Materials Technologies (BMTI). BMTI handles the ash produced at the coal combustion facility owned by Georgia Power/Southern Company; SP/SEC markets, manufactures, sells and installs the separation systems; TFS holds the license to the technology and expertise in its design and operation.

The demonstration system contains all components needed for ash transport, product generation and collection, and control of operational parameters. The separator module was installed in January and subsequently first operated in February 2001. It contains parallel plate electrodes which have a rated throughput of >1.1 x 10^5 kg/$m^3 \cdot$hr, i.e. for an equivalent volume of 1 m^3, over 110,000 kg (121 tons) of ash would be able to be processed per hour of operation. In other words, the technology employs fast-transport conditions with the ash particles under the influence of an electric field for a very short time.

Results

As of writing this Summary paper, system operation has just begun. However, initial operation show performance as good as or better than that measured for operation of prototype and smaller-scale systems at the University of Kentucky. Hence, the early results suggest that the research and development work was effective in defining and addressing scale-up issues important for technology commercialization. The processing protocol, the layout of the system, and its performance for producing low-LOI ash will be discussed in the presentation.