Title: **Separation of High LOI Fly Ash**

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Summary

The utilization of combustion byproducts, in particular fly ash, has an important impact on the cost and environmental impact of power production from coal. Improved beneficiation and utilization schemes for high loss-on-ignition (LOI) fly ash can transform this combustion byproduct from a waste material, with associated disposal costs, to a valuable product. The utilization of power-plant-derived fly ash has been impacted by recent shifts to low-NO_x burners which can increase the carbon content of the ash above the specification for its use in Portland cement. The ability to efficiently extract high purity carbon or ash is important in the development and application of cost-effective beneficiation technologies for the production of value-added products. A focus of FETC's in-house research effort is to develop technologies for separation of the inorganic and unburned carbon phases in pulverized coal combustor fly ashes. Research activities in this area involve performing separations of combustion byproducts using either a dry triboelectrostatic or a wet agglomeration column technique.

Dry Separation of Fly Ash

Triboelectrostatic beneficiation of fly ash to remove unburned carbon has been investigated recently [1-2]. During triboelectrification, organic and mineral particles are charged with opposite polarity and separated by using an electrostatic separator. On contact with metal (copper), the organic particles become positively charged, and the inorganic mineral particles become negatively charged. The charged particles are then passed through an electrostatic separator consisting of two conducting electrodes, across which a high voltage is applied. Organic (unburned carbon) particles are attracted to the negative plate, and minerals are attracted to the positive plate. The separated samples were collected and analyzed to determine separation efficiency.

The beneficiation of coal and biomass (10 wt.% switchgrass) fly ashes with dry triboelectrostatic separation was studied. Three different types of separators - parallel plate, cylindrical and louvered plate separators - were used for this study. It is found that the quality of separation is dependent upon the nature of coal ash and the configuration of the separator utilized. Preliminary results indicate that the separators utilized in this study are not able to provide quality separation for biomass fly ash. The reasons for the poor separation of the biomass fly ash are still under investigation.

Wet Separation of Fly Ash

Several potential wet processes that can recover unburned carbon from fly ash include: (1) heavy media cyclone; (2) froth flotation; (3) selective flocculation; and (4) oil agglomeration. Of these four processes, froth flotation is the most commonly applied. Use of heavy media cyclones is economically not attractive because of the incomplete recovery of expensive magnetite used in this process. Furthermore, selective flocculation has limited application for the recovery of highly oxidized materials. Consequently, due to the particle size and highly oxidative state of these fly ashes, oil agglomeration is the method under investigation for the recovery of unburned carbon from fly ash at FETC [3].

The development of a column agglomeration process for the recovery of unburned carbon from fly ash involves the optimization of the column agglomeration process. The initial work used cyclohexane as the main agglomeration reagent for this process. The optimum standard operating conditions were determined by the quantity and quality of the recovered unburned carbon. The initial work was performed on an in-house fly ash with 9.5 wt.% unburned carbon that was generated by a pulverized coal firing combustor on-site at FETC.

The typical operation conditions for the six-foot agglomeration column are listed as follows: agitation speed, 200-600 rpm; air flow rate, 0-6000 ml/min; ash/solvent slurry feed rate, 200-1000 ml/min; and ash/solvent ratios, 1:2-1:7. Preliminary results from the initial six-foot column agglomeration of the FETC bituminous fly ash using cyclohexane have shown the technology to be very successful. At an agitation speed of 400 rpm, the ash slurry came in contact with the aqueous phase and the unburned carbon/cyclohexane agglomerate was collected from the top of the column. This agglomerate was collected on a 60 mesh screen and the solvent was recovered. An improvement in the performance of this agglomeration process was observed with the addition of air (< 300 ml/min).

In summary, the preliminary results from a six-foot column agglomeration of a FETC fly ash using cyclohexane are encouraging. Successful isolation of unburned carbon from the fly ash in yields of 50-70 % at purities of 60-70 % was achieved. The addition of air further improved the performance of the agglomeration process in both carbon yields and solvent recovery, although the purity was similar to that in the absence of air.

References

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