The Production of High Quality Pozzolan from Ponded Fly Ash

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Introduction

Froth flotation has been shown to be a viable method for reducing the carbon and subsequently the LOI of fly ash. APT=s patented system *FAST-FLOAT™*, developed at the University of Kentucky CAER, enhances the cost effectiveness of this approach. Commercial development of APT=s technology is initially focusing on the beneficiation of high LOI ponded fly ash. Ponded and landfilled fly ash, represent a substantial potential feedstock for wet beneficiation.

Samples have been collected from Santee Cooper=s ponds at their Winyah generating station and from East Kentucky Power Cooperative=s ponds at their Dale generating station. Although ponds differ in the relative homogeneity of their ash, neither would be capable producing a satisfactory pozzolan without pretreatment. Both contain co-disposed bottom ash aggregate which ranged from sand to golfball and even softball sized material. In addition to bottom ash, some plant debris has been found in the material.

Nature of the Ponded Material

In addition to co-disposed material, the natural sedimentation processes which take place in the pond classifies the ash. As the ash is transported in a slurry from the discharge point, the materials settle out by size in accordance with Stokes law and the prevailing hydrologic regime. In general the material closest to the discharge pipe is the coarsest, with materials deposited more distally being finer. Whether the ponds are full of water also has a bearing on the sedimentary regime, as varve like structures, reminiscent of lake sediments, are found in some cores from the pond.

Screening and Hydraulic Classification

Pre-screening ponded ash is a relatively simple method to remove coarse material from the feed. This can be readily accomplished with a stationary or mobile screening station. Dry vibratory screening has been shown to be effective for removing +1/4 inch material, which in many cases is suitable for sale as lightweight aggregate. Dry screening decks can be stacked to produce a graded product suitable for local markets. In addition, fines recovered from dry screening can be transported into the ash processing plant by conventional conveyor belts.

Effective classification of the -1/4 inch material is critical to ensure that froth flotation produces a low LOI product that meets both LOI and fineness specifications. After analyzing over 50 fly ash samples from a variety of sources, the majority were found

to contain a substantial proportion of coarse (+100 mesh) carbon. This coarse carbon fraction typically contained 35 to 45% C. While froth flotation is certainly capable of removing this coarse carbon, it is much simpler and less expensive to remove it by classification.

While flotation has been shown to be effective for removing carbon, it provides limited control of fineness. A distinct advantage of classification is that it allows for the removal of coarse ash as well, thereby providing control of the fineness of the low LOI flotation product produced by flotation. This is particularly important when processing ponded ash. When mining a pond section that is particularly coarse, it is necessary to classify the ash to ensure that fineness is maintained. It is much simpler to do so prior to flotation when the ash is in a dilute slurry.

A commercially available hydraulic classifier, the Lewis Econosizer, was evaluated. The hydraulic classifier will separate particulate as fine as 325 mesh. Material is fed to the classifier by gravity, and water is added with the feed which impinges against an inclined plate. Coarse solids are rejected over the inclined plate while fines flow over the top of the classification section. Two middling products can also be obtained by adjusting the location of middling ports. Control of the classification size is adjusted by controlling the amount of water added with the feed. Extensive test results showed that with a very coarse pond ash, the hydraulic classifier provided an excellent separation of fine material. There was essentially no misplaced material in the coarse or fine products. The relatively large proportion of middlings product in this particular test can be significantly reduced by optimizing the operating conditions. These results show that efficient, controllable classification at 100 to 325 mesh (150 x 45 mm) can be achieved with the hydraulic classifier. This capability allows for control of the fineness of the low LOI product produced by flotation.

Beneficiation

Continuous pilot-scale froth flotation testing has been completed on samples of ponded ash from several sources with throughputs of 125 to 200 lbs/hr. Results showed that the LOI could be reduced to 0.5 to 2.5% C with reasonable reagent costs with a yield of low LOI product of 75 to 80%. The remaining 20 to 25% of material recovered in the froth product contained 35 to 40% carbon (5000 to 5800 Btu/lb) which is suitable for reburning or further upgrading as a value-added product. Classification followed by froth flotation provided sufficient control to ensure that fineness specifications were also met.

The objective of ash beneficiation is not simply to remove carbon, but to produce a quality pozzolan. Low LOI is only one aspect of a quality pozzolan. Another important criteria, as specified in ASTM C-618 is fineness, which requires that no more than 34% of the material may be retained on a 325 mesh screen (45 mm). Even more important is strength index. This criteria requires that specimens made with a standard mix of cement and pozzolan, must be within 75% of strength of a non pozzolan control, in either 7 or 28 days. Meeting the ASTM fineness criteria helps assure the proper development of strength.

Properties of Processed Ash

Strength index for two samples as produced from the pilot runs of APT=s technology were also run. Strength index values for these samples increased from an average of 85% at 7 days (range 81-86%) to 91% at 28 days (range 89-93%) and 99% at 56 days (range 96-103%). Fineness values were all less than 10% retained on a 325 mesh screen. These data clearly demonstrate both the importance and benefit of classification of the ponded material.