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Recovery and Utilization of Pond Ash

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Abstract

With increased inventories of ash not meeting Ready Mix Concrete C-618 specifications, Utilities are constantly looking for new opportunities to utilize high LOI ash or recover the carbon. In 1994, Santee Cooper, a state owned electric utility located in South Carolina, recognized the need to look for ways to increase utilization of coal combustion products and/or recover the carbon through one of the various carbon removal processes. The fly ash markets in concrete and cement are traditionally what utilities and ash marketers would prefer because of the volume and revenue associated with it. Realizing that a strong commitment to ash marketing was necessary, management decided to dedicate someone to oversee the ash utilization program. Prior to 1994, utilization of these coal combustion products accounted for only 5% of the total ash produced corporate wide. With a more concentrated effort, fly ash utilization increased to 85% in 1998. Since the inception of the new ash utilization strategy at Winyah Generating Station in 1994 a total of 408,477 tons were shipped from the ash ponds. This increase in utilization prolonged the life of the existing ponds by 3.5 years. One of the factors, which dramatically affects storage, is the amount of unburned carbon carried out to the ponds due to the low NOx burners. These new Low NOx burners resulted in an increase in loss on ignition and a further reduction in valuable pond storage space. The reduction in space is due in part to the carbon fraction being in the –50 to 100 mesh size. The large amount of unburned carbon in the ponds was a major factor in the decision to form alternate utilization plans. A consultant was hired to determine what markets might be available in the immediate area surrounding the Winyah Generating Station, located in Georgetown, South Carolina for the recovery of these combustion products. In 1995 at the International Ash Utilization Symposium in Lexington, Ky., Santee Cooper learned of the Froth Flotation Process being improved at the University of Kentucky, Center for Applied Energy Research (CAER). This process afforded us the

opportunity the take part in a pilot plant study to examine the possibility of recovering the carbon, fly ash and bottom ash from Winyah ponds. Although several other recovery processes were examined, we found that spirals and flotation cells would better fit the Winyah Generating Station due to the volume of ash in the ponds. While most carbon removal processes operate on dry fly ash, Froth Flotation can operate independent of plant operation, making it the best choice for the Winyah Station.

Introduction

Figure 1

After several months of comparing the variety of ash betterment systems on the market, Santee Cooper decided to focus on the recovery of wet ash from Winyah storage ponds and possible use of the Froth Flotation System. In March 1996, Santee Cooper and the University of Kentucky, Center for Applied Energy Research entered into an agreement to study the ash ponds at Santee Cooper's Winyah Generating Station (Figure 1 shows aerial photo of Winyah ash ponds). The Winyah Station had accumulated approximately 5 million tons of ash since it began operations in 1975. These units produced fly ash with LOI's varying from 5% to 23% carbon content. The necessity of looking at this particular station was in part due to limited pond storage space, the abundance of material and the need to construct new storage ponds in the near future.

Implementation

Figure 2

In order to develop a recovery strategy, the first objective was to obtain core samples of the ponds to determine the quality and quantity of material present in the various locations within the ponds. The coring was necessary because the ash lines were moved over several areas of the pond over time. This proved to be difficult in three of the existing ash ponds because they were still active and had not been de-watered. The A-Pond is the oldest and largest of the four ponds encompassing 82 acres at a depth of 15 feet (Figure 2 De-watering canal). The pond had been decanted to the B pond and was the easiest to core. A drilling rig was utilized to core the pond but even with a fairly stabilized surface, vibration of the equipment caused the trapped water between the layers of ash to pump up to the surface. The west pond and south ponds provided a tremendous challenge when attempting to obtain samples.

Although changes in the recovery location had to be made on occasion, the core sampling results pinpointed the location of the highest concentrations of bottom ash and the fly ash. From the coring we were able to develop an ash-recovery plan. Samples were collected according to recommended sampling guidelines and shipped to the University of Kentucky, CAER facility to perform spiral and flotation work to separate the carbon from the ash. The results indicated that a good pozzolan ash and carbon product could be efficiently removed using spirals and froth flotation.

Several techniques were attempted, such ash: posthole diggers, hand augers, split spoon sampler and the use of an airboat with PVC pipe. Walking with a hand auger did not prove safe or successful mainly due to the instability of the material and the fact that the hole caved in before the individual layers could be obtained. The attempt, however, was made using large pieces of plywood as a work surface. The suction created on the auger and the inability get a core that was in a complete column prevented this from being a reliable sample. The airboat method using 8-10 ft lengths of PVC pipe and plugging the end prior to extraction proved to provide the best core, although a small portion of sample was lost from the bottom. The sample cores were cut into two feet lengths, labeled and shipped to the University for analysis. The data was used to begin the recovery operation.

Recovery

Figure 3

To provide maximum access to the ash pond, a series of relief canals were dug around the perimeter. Collection cells were created to reduce the handling and screening of the fly ash and bottom ash. These separate accumulation points increased bottom ash production by reducing the amount of co-mingled ash being processed. Recovery consisted of digging the material with track hoe or dragline then transporting the materials to a feed stockpile. Screening involved using a front-end loader, which obtained material from the feed stockpile, and sending it across the double deck screen (Figure 3), classifying and de-watering the material. Santee Cooper purchased the first phase equipment of the flotation process to begin recovering bottom ash for the block industry. A small trailer mounted prototype of the wet classification system developed by Lewis Minerals Corporation was used and proved to be very efficient at providing material that met the fineness modulus required by the block industry. Santee Cooper had previously set up the dry screening operation utilizing a double deck diesel engine dry screen to remove vegetative matter from the pond ash and, to provide raw feed material to the cement industry. We originally started screening with a wire screen deck but soon experienced wear holes where the wire broke. This created a great deal of misplaced material and caused plugging problems. This deck was replaced with a stainless steel turbine screen that has been replaced once in 3 years. A diesel powered wet screw washer was added later to recover the large volume +3/8 inch material to sell as driveway and drain field stone or to be crushed back as a block sand later. The dry screen and wet screw were incorporated into the Econosizer process and tied to the slurry tank (Figure 4).

Figure 4

There were many lessons learned as the recovery operation progressed. Some included: lining the Econosizer hopper bottom with ceramic, utilizing different valves, and placing a solid plate at the point of material discharge on the de-watering screen. All of these problems were due to the unexpected abrasion from the ash. Experience and time in the recovery operation taught us how to minimize the amount of rolling stock, which in turn decreased the number of personnel required. Utilizing electric motors instead of diesel reduced maintenance and diesel engine replacements, which were damaged by fine ash. Dust control was another major problem that has hampered the operation. Initial clearing and leveling of the pond surface should have been done on a smaller scale. Clearing and grading of the pond surface created major dust problems; especially being along the coastal area of South Carolina which is subject to ocean breezes. Sprinkler systems were installed along the access roads in the pond; this was a less expensive alternative to running a water truck. Although there are still dusting problems, the sprinkler system has proved to be a valuable tool.

As time progressed the plant operators were under pressure to produce material to meet demand which caused them to try and over feed the Econosizer which resulted in misplaced fines being carried out with the coarse material and washed over the top with the fines. With the increase of fines, the material failed the fineness modulus guideline established by the block industry. The carryover actually caused production to go down because the coarse material was carried back to the pond. The demand for the material has proved that the Econosizer needed to be much larger than we had planned and thus we are able to supply only one of four block companies in the area. The actual process scalps off materials 1.75 in. and larger with the trash. Material –1.75 to +3/8 inch are carried to a screw washer to remove fines. The fine material –3/8 inch are conveyed into a slurry feed tank that feeds the Lewis Econosizer. The Econosizer then makes the appropriate cut to meet the block industry specifications. Materials from the Econosizer are then placed on a series of spiral runs to remove carbon. We experienced tremendous problems with the spirals due to fact that the light weight carbon also carried with it ultra light aggregates (floaters) 3/8 inch and smaller, which plugged the spiral races and minimized carbon recovery. Later research indicated that a wet screen with a lower end cut of 1/8 inch would prevent the plugging problem but not totally reject the ultra-light aggregates. Due to the additional cost of switching to a wet screening operation, the spirals were abandoned and some of the materials are returned to the pond. The block aggregate materials from the Econosizer discharges are placed on a de-watering screen and stacked out for shipment via radial stacker.

Summary

With careful planning and implementation, the recovery and utilization of pond ash can be a cost effective means of reducing the need for additional pond volume and create a revenue stream for the utility. Santee Cooper has been able to successfully obtain markets in cement raw feed for the fly ash portion of the pond. Additional markets have been established in the concrete block industry, which utilizes 100% of the stations annual production of bottom ash. Further market development can only be achieved through the expansion of existing equipment. In order to obtain additional material for the market and further enhance to variety of materials needed in the market place, the system will need to be changed to a dredge and wet screen operation. No matter which recovery and utilization system is used, the process has help to put off the construction of new ash ponds well into the future.

With deregulation approaching, the control of combustion products will provide an economic advantage to the utility. The delay or elimination of the need for additional ash ponds will help to reduce costs associated with by-product storage, and reduce Operation & Maintenance costs. Creating a positive revenue stream requires careful attention to both the method of operation, to maximize equipment, and placing emphasis on material quality control.

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