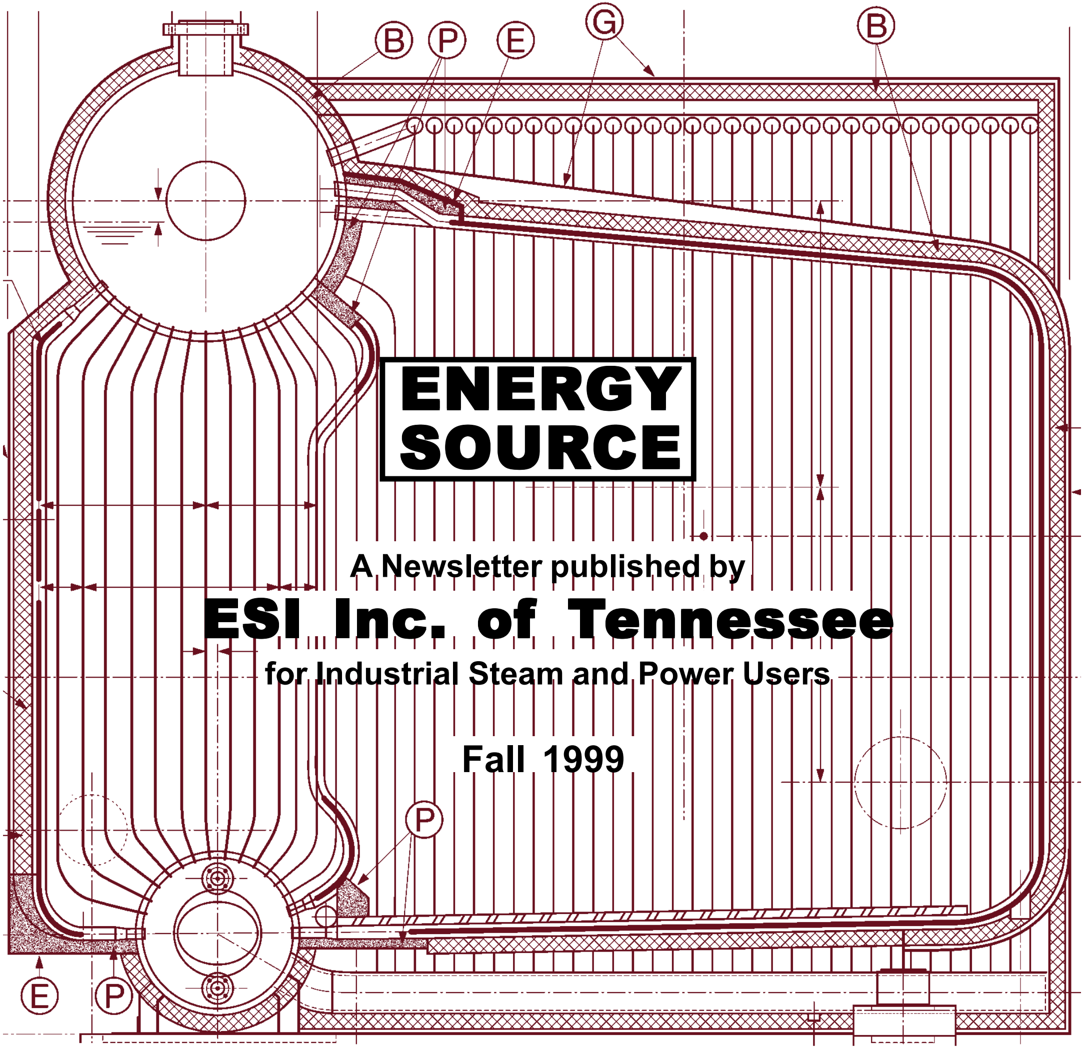

ENERGY SOURCE

A Newsletter published by

ESI Inc. of Tennessee

for Industrial Steam and Power Users

Fall 1999

CASE STUDY
CARBON BURN-OUT PLANT FOR SOUTH CAROLINA ELECTRIC & GAS

By: *Joe W. Cochran, Vice-President, Progress Materials, Inc.*
Thomas Wassel, Project Manager, ESI

In the last issue of the *Energy Source*, the development of the new carbon burn-out (CBO) technology by Progress Materials, Inc., a non-regulated subsidiary of Florida Progress Company, was discussed. Progress Materials contracted with ESI to provide the detailed design engineering, procurement, and construction management for the first commercial CBO plant to be installed at the Wateree Power Station of South Carolina Electric & Gas.

The Facility

The main component of the CBO facility is the CBO system which consists of the combustor, the product cooler, the ash separation and conveying equipment, control system, and ancillary items. Separate from this system is the product loadout area which receives the processed fly ash, and stores it, until shipped. The storage and shipping area consists of a 14,000-ton capacity dome structure for long-term storage of product, four 250-ton silos with two loadout spouts that enable trucks to be loaded continuously by an automatic system, and two additional silos which receive ash from other sources to be processed in the CBO unit. The final part of this CBO project was a remote facility at the McMeekin station which consists of a vacuum receiver and two silos which receive ash from the plant's vacuum system and load it into tanker trucks for transport to the CBO plant at the Wateree station.

The first carbon burn-out facility located at the Wateree Power Station of South Carolina Electric & Gas.

The Process

The heart of the CBO plant is the combustor. The combustor is simply a fluidized bed that utilizes specially designed nozzles, sized and placed for the proper fluidization of the ash in

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Deanna Melvin
Managing Editor

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the combustor. The nozzle velocities and air pattern were designed to provide sufficient momentum to fluidize the ash and yet maintain the appropriate carbon-to-air mixture which allows the bed to self-sustain combustion.

The combustor is fed by two ash streams. The first stream is from the feed silo which receives ash from two sources. Ash from both sources is pneumatically conveyed to the feed silo which acts as a surge vessel. The primary source is the fly ash produced at the Wateree station. This ash has a loss on ignition (LOI) of between 8% and 12%. The second source is the storage silos for ash received from other facilities including McMeekin. The feed rate of the silo is set to maintain a proper level of ash in the bed and to process the amount of carbon to be burned for a given period of time. The second fly ash stream is from the recycle silo which pulls a portion of the ash that has been processed and cooled, recycling it to the combustor to control the bed temperature. The two silos also act as surge vessels which allow the system to run smoothly with an upset condition in any one of the major components.

To initiate the combustion process, it is necessary to preheat the fluidizing air to ignite the carbon and establish self-sustaining combustion. To heat the air, a start-up burner arrangement was designed. The design had several requirements. First, the design had to provide the desired rate of temperature rise required for the combustion chamber. Second, the design required rapid load response to quickly reduce the heat input to compensate for the rapid increase in heat release when the carbon ignites and the process becomes self-sustaining.

Once the fly ash is processed through the combustor, it flows out of the bed into the flue gas stream. Before entraining the fly ash, the flue gas stream exits the top of the combustor, going through cyclones which separate the partially processed fines and drop them back into the chamber. The flue gas exits the cyclones and flows to where the pick-up of the product ash occurs. From this point, the dust-laden air flows through a heat exchanger which cools the air and product, recovering the heat and cooling the product. The most effective method to utilize the heat generated from the combustion of the carbon was an important decision in the design of the CBO plant. After reviewing several alternative methods, it was decided to use the heat to preheat the condensate from the host power plant. The process recovers as much as 60 million btu's per hour and partially bypasses two existing low pressure feedwater heaters which results in a decrease of the extraction steam taken from the turbine.

After the product cools, the ash flows to a separation cyclone where the product ash is separated from the flue gas and collected. From the cyclone, the flue gas flows through a baghouse which eliminates the dust particulate from the gas stream. The flue gas is discharged through one of the two Wateree Power Station's existing stacks. This arrangement allows the CBO process to run, burn, and add heat back to the power plant without adding an emission source to the Wateree facility.

The ash product which is collected at the cyclone and baghouse drops into a surge tank. There are four exits from the surge tank; two for product to be transported to the silo area, and two for the recycle transporters to move processed fly ash back to the recycle silo.

To convey the products around the plant, pneumatic transport systems were designed and installed. The pneumatic transport utilizes air from positive displacement blowers and provides a design transport capability 1.5 times the nominal operating tonnage rate of the combustor.

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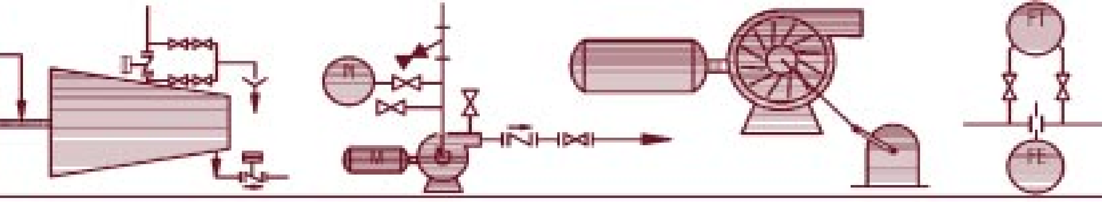


ESI is very proud to announce that the

Fox Valley Aggregate Facility

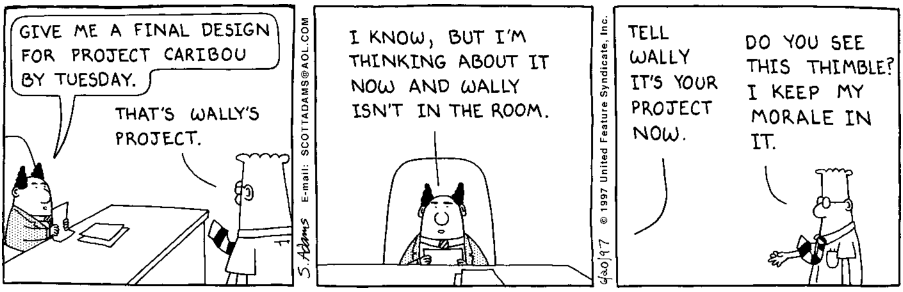
Designed & Built by ESI

received *Power* Magazine's

Each year *Power* magazine selects "diverse facilities that represent leadership in the application of advanced equipment designs and O&M practices, that optimize among competitive economics, energy efficiency, and environmental impact". The Fox Valley Glass Aggregate Facility was chosen "for putting high-volume waste streams to beneficial use in generating energy and recycling materials". This facility was designed and built by ESI Inc. of Tennessee and is owned and operated by Minergy Corporation.

The Fox Valley Glass Aggregate Facility

For additional information about this unique facility, please call Jeff White at 770-427-6200.



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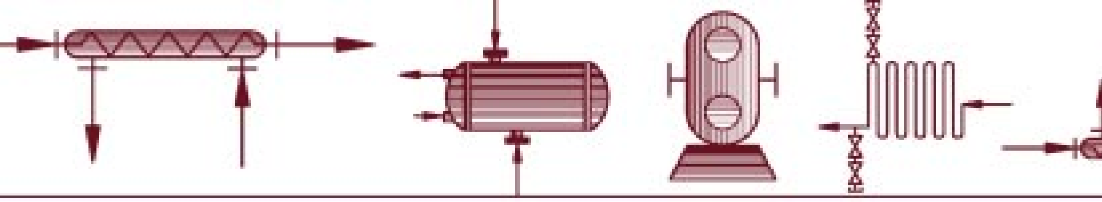

OPERATOR SAVVY

By: Jack Brown, Mechanical Engineering Manager, ESI

Quality and on schedule steam production from a boiler plant are certainly influenced by how well the plant was designed and constructed and how well the maintenance program is funded and administered. Unfortunately, these items are quite often not under the direct control of the power plant supervisor. However, another very important operation factor which is affected by the power plant staff is operator savvy. Operator savvy means not only that a good operator training program is in place, but that the operators understand and can apply the information.

Any boiler plant supervisor who wants to operate his plant at peak efficiency without excessive induced maintenance (and who wouldn't) should make the proper training of his operating personnel a top priority. Proper training not only results in better operating efficiency and less maintenance, but also provides a safer plant environment. Also, properly trained operators typically have more interest in their job and certainly have a better chance of reasoning through and resolving problems.

Quite often, plant management depends on: 1) a new operator's previous boiler plant experience, 2) an operator's ability to educate himself using manufacturers' manuals, etc., 3) existing experienced plant operators, or some combination of these techniques to train operating personnel. More desirable results are usually achieved with a formal training program, preferably conducted by someone who has had considerable experience with the design and theory of boiler plant operation, as well as having practical hands-on operating experience. The program should be tailored to the particulars of your plant. This type program is more apt to command the respect and attention of the operator since it usually has the proper content, and is presented in an interesting and digestible manner. These are all key factors in achieving the desired operator savvy.

A preliminary operator's exam can be utilized to help evaluate the competency level of the existing operators. This information can then be used to design a training program suitable for those operators. A training program should include: 1) an overall review of the entire boiler plant, including the main function of all major equipment items; 2) a thorough discussion of each individual piece of equipment along with its operating parameters; 3) a discussion of instrumentation and controls, and their interaction; and 4) start-up and shutdown procedures, including alarm conditions with responses. To insure continuity in the training program and plant operation, a written manual should be assembled and an individual copy distributed to all operators. After the operators have had a chance to review this manual, a formal presentation should be made. This presentation should consist of classroom sessions intermingled with visits to the boiler room to look at the items covered in the classroom session. The field trip provides a welcome break from the classroom and usually results in questions which the operators might not have thought of otherwise.

If the training can be conducted in small groups of 6-8 people, the atmosphere is usually more conducive to trainee participation. Plants who are interested in a more thorough training program can follow the instructional sessions up with a written operator's exam. Then, if necessary, additional training can be provided in the areas that indicate the need (via the test scores).

Many industrial and commercial facilities tend to minimize or ignore the importance of boiler plant operator training. The best boiler facility available will suffer operating difficulties if the operating staff is not trained to the point of

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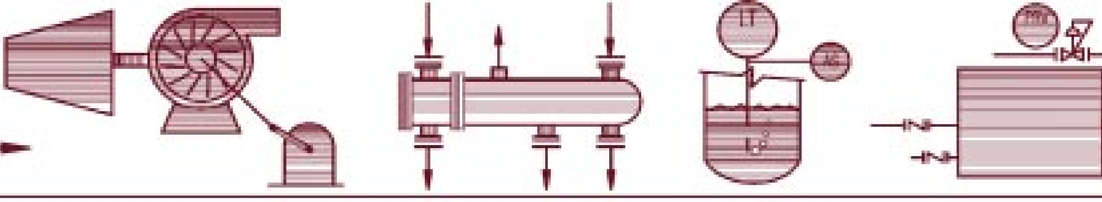


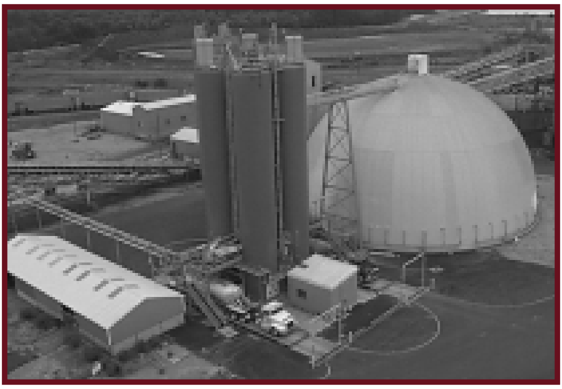
OPERATOR SAVVY... *Continued from Page 4*

good operator savvy. Although ESI does provide operator training, it should be understood that this is not just another sales pitch, but instead is an attempt to emphasize the importance of having competent operators in your boiler plant whether they are trained by ESI, in-house personnel, or another qualified outside firm.

If you are unsure about the competency level of your operators, a preliminary operator's exam could be administered. This information could then be used to determine if training was needed and if so, could assist in designing a training program suitable for your operators. If you are interested in an operator's exam, please visit our web site at www.esitenn.com and attempt our beginning, intermediate, and/or advanced test. If you would like a copy of these exams to administer to your operators, please call Deanna Melvin at 770-427-6200.

CASE STUDY... *Continued from Page 2*

Once the ash has been processed, it is pneumatically conveyed to a storage and loadout area which consists of four (4) 250-ton loadout silos and a 14,000-ton storage dome. The loadout silos have been designed to automatically transfer the product to trucks for transport to the end user. The storage dome provides the long-term storage necessary to maintain consistent product sales.



The storage loadout area consisting of the loadout silos and the storage dome.

Performance

The original plant design was to process 25 tons per hour of fly ash and produce a consistent product that contains approximately 2% carbon. The performance of the CBO plant has been extremely successful, with peak rates exceeding 40 tons per hour and producing a product with the desired 2% carbon. The plant can also be turned down to operate at significantly lower rates than the 25 tons per hour which accommodates the utilization of lower LOI material while maintaining a steady operation.

The ash capturing system at the McMeekin plant has also proved to be quite successful. The plant provides an additional source of fly ash, which allows for the full production of the CBO unit. At the present time, approximately 150 tons per day of ash is being provided to the Wateree site from the McMeekin facility.

The dome, which can store up to 14,000 tons of product fly ash, has enabled the CBO plant to operate on a continuous basis regardless of the product demand. The product ash is sold to meet the daily demands of the local concrete industry.

Conclusion

The CBO facility has been a tremendous success in converting an emerging pilot plant technology to a commercially operating facility. To date, this facility has produced approximately 100,000 tons of superior product to the industry. The challenges put forth by this facility were overcome through the collective ingenuity and engineering solutions provided by all the parties involved. The net benefit is a higher quality ash product and an overall increase in the operating efficiency of the power plant.