NEW JERSEY'S FIRST RESOURCE RECOVERY FACILITY
(The Warren County Energy Resource Facility)

WOLFRAM G. SCHUETZENDUEBEL AND WILLIAM C. NOBLES
Blount Energy Resource Corp.
Montgomery, Alabama

Discussion

by

Joe Smisko
Los Angeles County Sanitation Districts
Los Angeles, California

The authors did an excellent job in presenting detailed information about the facility in an organized manner. The important design features which normally cause the most operating problems were given adequate coverage. Of particular interest was the discussion of the plant modification which helps designers as well as operators.

Areas which could have had better coverage included:
(a) Need more description of closure plates (history and success).
(b) Size and quantity of OFA nozzles.
(c) Waterwall corrosion experience and tube thickness chosen.
(d) Type of refractory and studs.
(e) Acid gas permit requirements measured over what time period.
(f) Capacity of lime tank and feed tank should be shown.
(g) How is final dilution done, is there calcium carbonate buildup, and how fast of a response time is needed in slurry concentration changes?
(h) What type of slurry pumps are used and maintenance history?
(i) Mechanism for temperature control and operating problems.
(j) Is the residue mixer used and operating problems?
(k) Results of ash testing.
(l) Controls discussion too general; provide details of logic and PID set points.

I enjoyed the discussion of using rappers instead of sootblowers. I think an entire paper could be written on the operating success.

Discussion by

David Traeger
HDR Engineering, Inc.
Omaha, Nebraska

GENERAL

The paper generally provided an adequate description of the plant design parameters for Warren County and the operational shakedown modifications made to the original design. The paper provided some insights into the plant design philosophy and was cleanly written and well organized. As with any technical paper, the presentation often suggests to the reader additional areas of interest which, if added, could provide particu-
larly helpful insights. The following comments and questions come to mind in the course of reading this technical paper.

**COMMENTS AND QUESTIONS**

(a) The facility description focused on the design parameters, but only briefly mentioned in general terms the results of the performance tests. It would have been particularly interesting to have more information on the emission test data, the ash testing data, and the energy performance results.

(b) Solid waste management regulations are currently undergoing a considerable amount of review on the federal legislative and regulatory fronts. Although the legislative packages are subject to considerable changes, the EPA New Source Performance Standards (NSPS) are fairly well defined at this time. What additional improvements, if any, are currently expected in order for the Warren County facility to meet NSPS requirements for existing facilities?

(c) Reference was made in the paper to NJDEP requirement during the permitting process regarding removal of SO₂, HCl, and HF, but the measurement period is not specified. In addition, is the Warren County Facility required to have continuous emission monitoring equipment and telemetry capability for submittal of this data to the NJDEP in accordance with requirements now being imposed on newer facilities?

(d) No economic data was presented on the facility. In light of the impacts economic considerations have on engineering decisions, it would seem the basic data on the capital cost, facility operating cost, and residue disposal costs might be presented to demonstrate the economic impacts of design parameters and decisions. (e.g., the external economizers, semi-dry scrubbing system modification, and the semi-dry ash removal system impacts on ash disposal costs.)

(e) The figures were helpful in visualizing the facility, but the reduced construction drawings were difficult to read in terms of lettering and component details.

(f) In light of the high sulfur content indicated in the fuel analysis, it would have been interesting to read more about the special design philosophy taken to protect the boiler system from corrosion and erosion including gas flow velocities, and corrosion allowances actually used on the boiler tubes.

**Discussion by**

Joseph W. Schilli
Irvine, California

The paper stated its purpose is to describe the Warren County Energy Resource Facility and to relate certain design philosophies. These comments will focus upon the approach utilized to describe the facility.

The paper could have usefully enlightened the readers relative to the contractual details by explaining the provisions related to the design heating value of 5300 Btu/lb and the reference fuel heating value of 4500 Btu/lb and the difference between these two terms. Again, the paper could have further provided the readers with useful contractual details by explaining what waste is defined as unprocessable.

The discussion of the design parameters and philosophy addressed the facility from chute to stack. Additional in-depth discussions in the following areas would be useful to readers, especially since these types of facilities are facing tough scrutiny relative to environmental impacts.

(a) The air emissions specifically impacted by designing turbulence into the furnace.

(b) The air emissions specifically impacted by increasing the residence time in the furnace.

(c) The time frame over which air emissions are measured to determine compliance with regulatory requirements.

(d) The type of landfill utilized to manage the bottom and fly ash.

(e) The operating time between major boiler cleanings actually planned at the Facility.

(f) The reasoning for sizing each of the feedwater pumps at 65% of capacity instead of 100%.

Further discussion of the following two points would be useful to readers trying to avoid pitfalls in the implementation of a waste-to-energy facility.

(a) The shortage of solid waste experienced during the shakedown mentioned in the Summary section.

(b) The initial equipment shakedown difficulties mentioned in the Summary section.

**AUTHORS' REPLY**

To Joe Smisko

(a) The closure plates consist of lower and upper plates as shown in Figs. 7 and 10 and as described in the test. During the March, April 1990 outage, 30 plates on unit 1 and 33 plates on unit 2 were replaced in the first two firing zones. Some of the plates were considered reusable after reconditioning. However, others were discarded due to warping, cracking or wear. It is believed that some of the plate damage could have been caused by a failure of the tertiary cooling air fans several months prior to the outage.

(b) Ten 2½ in. I.D. OFA nozzles are installed on both the front and rear furnace walls.
(c) Accelerated tube metal wastage was experienced on boiler #2 requiring replacement of a 3 ft × 3.5 ft tube wall section and in situ weld metal overlay of Inconel 625. The accelerated corrosion occurred in the area of the furnace just above the refractory. A technical paper entitled “Accelerated Tube Metal Wastage In Municipal Solid Waste Fired Furnaces” was prepared by Schuetzenduebel, et al. and will be presented at the National Association of Corrosion Engineers’ “Corrosion 91” conference to be held March 11-15, 1991 in Cincinnati. This paper deals with the tube failure in detail. The furnace water wall tubes are 2.5 in. diameter × 0.150 in. minimum wall.

(d) VGT Dyko silicon carbide refractory was installed on the furnace walls. Nelson studs, type NBL, \( \frac{3}{4} \) in. diameter × \( \frac{1}{4} \) in. long were used to anchor the refractory to the tube walls.

(e) See our reply to Mr. Shillis’ comments for acid gas permit requirement.

(f) Lime tank: 2850 gal; feed tank: 400 gal.

(g) Typically the spray dryer has been operated with 10% solids in the lime slurry. Once set, this concentration is not normally changed. SO2 spikes can be attenuated by decreasing the spray dryer exit temperatures. Final dilution occurs in the feed tank. Build-up can and occasionally does occur in the lime slurry lines. When this occurs chemical cleaning is required. At Warren the build-up did not become a problem until after the first year of operation when the lime slurry concentration was increased.

(h) Slurry pumps are relatively inexpensive items (about $2500 each). They required replacement or rebuild within the first 2 years of operation.

(i) Mechanism for temperature control is covered in the text. No particular operating problems with temperature control have been noted.

(j) The residue mixer has been a source of problems with the residue tending to adhere to the drum. Chains were installed to keep the material cleaned off the interior of the drum, but this did not significantly improve the operation. Subsequently, a stationary cable was installed lengthwise through the drum. The cable effectively keeps the residue build-up under control, but the cable requires replacement every 1–2 weeks. The facility is considering replacement of the drum with a vibrating conveyor.

(k) Results of ash testing were provided under our response to Mr. Traeger’s questions.

(l) Details of logic and PID set points are outside the scope of the paper.

To David Traeger

(a) Results of the plant acceptance test are contained in a technical paper presented at the 52nd annual meeting of the American Power Conference (April 23–25, 1990). The paper, entitled “Warren County, New Jersey, Resource Recovery Facility Plant Acceptance Test-Methods and Results,” by W. C. Nobles, C. W. Clemons and W. G. Schuetzenduebel, will be published in the conference proceedings. The paper does not cover results of the environmental compliance test.

The plant tested below all limits during the environmental compliance testing of 1988. Subsequent tests in 1989 indicated one test run for mercury was above the allowable limit.

The ash testing data spans more than 2 years of operation and consists of 99 batches of EP Toxicity analyses. A batch is roughly equivalent to seven operating days of ash. For the first 9 months of operation (June 1988 through February 1989), the ash exhibited lead or cadmium concentrations above the statutory limit in approximately 52% of the batches tested. Sufficient waste deliveries became more reliable toward the end of the first 9 months of operation. In the next 9 months of operation (March through November 1989), the failure rate decreased to approximately 15%. Since November 20, 1989, all the ash generated by the facility has been characterized as nonhazardous.

It is noteworthy that the weighted average of the test results from all 99 batches of ash was below the statutory limit for both lead and cadmium.

(b) The facility as designed and permitted is already in compliance with the emission limits proposed in the new Source Performance Standards. A battery separation program has been implemented by the Pollution Control Financing Authority of Warren County.

(c) The averaging periods for SO2, HCl and HF are 3 hr, 1 hr and 1 hr, respectively. The facility is equipped with continuous emission monitors for SO2 at the scrubber inlet and stack in addition to NOx, CO, O2, opacity and temperature. The information is telemetered to the DEP offices in Trenton via a dedicated phone line. This system has been in operation since August, 1989.

(d) The capital cost of the facility was about $58 million. Annual O&M cost is approximately $4.5 million. Residue disposal is the responsibility of the County.

(e) Drawing details lost through the reduction and reproduction process were not needed for the level of detail dealt with in the paper.

(f) Standard design practices were followed as these standards allow for a broad range in fuel analyses.

To Joe Schillis

The technical paper mentioned above in our reply (a) to Mr. Traeger contains information relative to how
the contract guarantees varied as a function of fuel heating value.

Increased turbulence and gas residence time improves overall combustion and reduces CO while minimizing emission of toxic substances. Early theories of minimizing dioxin and its precursors focused on reaching sufficient time and temperature for destruction of potential precursors.

Emission limits for the Warren Facility are as follows:

SO₂: 50 ppmv (dry) corrected to 7% O₂, 3 hr average, or 80% removal, also 3 hr average, whichever is less stringent.

HCl: 50 ppmv (dry) corrected to 7% O₂, 1 hr average, or 90% removal, also 1 hr average, whichever is less stringent.

PM: 0.015 gr/dscf corrected to 7% O₂ as measured for 1 hr per EPA Method 5.

CO: 400 ppmv (dry) corrected to 7% O₂, 1 hr average and 100 ppmv (dry) corrected to 7% O₂, 4 day moving average.

NO₂: 300 ppmv (dry) corrected to 7% O₂, 3 hr average.

Non-methane hydrocarbons: 70 ppmv (dry) corrected to 7% O₂, 1 hr average.

H₂SO₄ and SO₃: 0.23 lb/hr.

The combined fly ash and bottom ash stream is characterized according to the Extraction Procedure (EP) Toxicity test prior to disposal. Ash which is characterized as nonhazardous is currently being disposed at the Warren County District Landfill. The WCDL is a state-of-the-art ash monofill with a synthetic and clay liner, leachate collection system and groundwater monitoring. Separate cells are maintained for bulky and bypassed waste. Prior to September 1990 ash which was characterized as nonhazardous was disposed at Grand Central Sanitary Landfill in Pennsylvania. This landfill has a single liner and ash is codisposed with municipal solid waste.

Ash that is characterized as hazardous according to the EP toxicity test is disposed at Chemical Waste Management in Model City, New York.

Operating experience at Warren indicates major boiler cleanings will be required at least annually, with additional periodic cleaning of some slagged areas.

The feedwater pumps were sized for 65% of total plant capacity, or in excess of 100% of each unit’s capacity. The intent was for each pump to serve one boiler at its maximum efficiency operating point. However, if one pump is down, both boilers may operate at reduced load by making use of the turbine driven boiler feed pump, which normally is on hot standby. It’s capacity (65% of full plant flow) is sufficient to safely shut down both boilers in case of loss of power.

The facility experienced an insufficient waste supply from start up until around February of 1989. Several actions were taken to insure a proper waste flow to the facility. First, the Pollution Control Financing Authority determined that some of the waste was illegally transported to Pennsylvania and corrected this by increasing enforcement activity. Consultants for the Authority also concluded that the full effect of recycling had not been considered in estimating the capacity of the facility. To ensure a consistent, excess supply of garbage the Authority has arrangements with two bordering counties for waste deliveries. The two counties, Hunterdon and Somerset, send a portion of their waste stream to the facility and use recycling, landfilling and composting to deal with the remainder of the waste stream.

The waste was processed basically as it was received, requiring several startups and shutdowns per month. The off-line time lengthened the time to optimize major equipment operation such as the air pollution control system.

The major shakedown difficulties and the required modifications were covered in the paper. Other shakedown difficulties included refractory rework, a small generator oil leak, ash conditioner maladjustment (wet/dry ash), and inoperable demineralizer system (vendor control system problems). As is typically the case, a certain amount of rewiring, tuning and debugging were also required.