FIRST YEAR OF OPERATION AT THE SEMASS wTe FACILITY

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The authors' paper was easily read and well organized, but in general, it lacked technical information that would have been beneficial to the informed technical community. The comments prepared in this discussion follow the format of the paper.

The inspection procedures at SEMASS are quite extensive; as each truckload is discharged onto the tipping floor, the load is scanned with hand-held hydrocarbon and radiation detectors. It would have been interesting to learn from the authors whether this procedure has resulted in rejection of any potentially hazardous or explosive loads. A modification was made to the drive systems for the apron pans feeding the shredders. This modification resulted in a significantly higher speed, allowing the burden depth to be reduced and nonprocessable objects could be identified and removed. It would also be interesting to learn if this modification has increased the maintenance requirements of this conveyor. The nonprocessable waste pulled out at this final inspection stage can be routed to a shear shredder for volume reduction and eventual refeed to the process stream. The authors did not mention this Shearpack shredder or any problems associated with utilization of this system.

During the shredding process, one of the three 100% capacity Jeffries hammermills, which each have 4 pins and 34 hammers, are utilized. Each shredder is provided with a hydraulic pin puller, which reduces the number of personnel and change-out time required. Do the authors have any experience with the amount of time saved by providing this type of auxiliary system? Also of interest would be the hammer life expressed in tons of shredded material and the hammer composition.

The dual pickup Eriez belt magnets experienced early problems with the failure of the drop belt material. This material was changed to an exotic ultra-high molecular weight conveyor. What has been the operational impact of this change?

The Combustion/Steam Generation System section of the paper would have been of more interest had more technical information been provided regarding the Riley boilers and stokers. Information such as the overfire air arrangement, the overfire air-to-total-air ratio, the actual excess air supplied during combustion, the waterwall loading in Btu/hr/SF, and gas temperatures and velocities in and out of the convection zones should have been provided. Also, a discussion of the ultrasonic testing program for the boiler tubes would have been of interest, as would comments on whether SEMASS has experienced any significant wastage or slagging problems in the units. No mention was made of the auxiliary fuel (No. 2 oil) capability. The units have
100% oil capability; however, they are limited by permit to a 10% annual heat input.

The flue gas cleanup system, as noted, is a dry system in which bottom and fly ash are handled separately. Of interest would be whether SEMASS has experienced significant dust problems. If so, is the dust heavy in lead content? Additionally, it would be interesting to know how much lime the Joy scrubbers use. Screw augers are used to remove fly ash from the precipitators. Have these augers provided problems and, if so, are any modifications planned to reduce the maintenance required on this system?

The zero water discharge aspect of the SEMASS facility is commendable. There are three holding ponds on site. Are these ponds lined and what is their approximate holding capacity?

Of interest is the low plant noise level, as mentioned in the paper. The air condenser configuration and fan data would have been of interest. The A-frame condenser has twelve fans, as noted, with a 80 rpm design speed, there are eight blades per fan, 24 ft diameter. Was the 80 rpm reduced to 40 rpm or is the 80 rpm the current speed?

The rail delivery at the SEMASS facility is indeed unique: Each rail car must be handled individually before dumping, which can increase the overall unloading time to more than 15 min per car.

The Operations and Maintenance section of the paper indicated full-time personnel loading; however, no mention of contract services was made. SEMASS utilizes contract services for loader maintenance, major boiler maintenance items, minor custodial services, etc. Has this philosophy proven economical? Additionally, since the ash is being conditioned by an independent contractor, do the SEMASS personnel get involved with any ash handling requirements?

The Waste Throughput section indicated that the operator’s learning curve is the major reason for improving throughput. No mention was made of the modification programs which resulted in a more reliable facility such as the bottom ash system modifications, plugged feed conveyor detectors and others which, combined with the learning curve, increased facility throughput.

The Material Recovery section discussed process recovery and the post-combustion material recovery. There was no discussion of the current pilot program for the City of Rochester. Do the authors have any data on this pilot program in terms of recovered materials or implementation cost? There was no discussion of the emission test requirements for plant acceptance, such as noncriteria pollutants, dioxins, heavy metals, etc.

The air-cooled condenser data were interesting. However, freeze protection procedures were not discussed. Is freezing of the air condenser a problem, and is there a freeze protection system in use at SEMASS?

We would have liked to see a discussion about the facility’s capital and operating/maintenance costs on a dollar-per-ton basis, as well as a brief discussion of the business arrangement with the communities, such as tipping fees and spot waste acceptance.

Another point not presented was the GE turbine’s process steam capability for serving future customers. Also overlooked was the current facility’s provision for a fourth shredder line and a third flue in the stack, which will assist in the expansion effort. What is the current political atmosphere surrounding the expansion?

The SEMASS facility is indeed unique, especially in regards to the fly ash stabilization and bottom ash processing components of the project. Various walls inside the facility have been constructed with the Boiler Aggregate material. The nonferrous material recovered from the bottom ash has proved marketable and the stabilized fly ash, if approved for cover material, would be a higher contribution to the industry. All personnel involved with SEMASS should be commended for their successful contribution to waste-to-energy and material recovery technology.

Discussion by

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The overview of the design and first year of operation presented by the authors is clear and concise. For anyone who has not been to the SEMASS facility, this paper provides the basic description of the process and first year of operation.

The facility does have several design features which makes it somewhat unique when compared to other prepared fuel facilities. Those features are as follows:

(a) No significant intermediate storage of prepared fuel. Most prepared fuel plants have significant intermediate storage areas. The intermediate storage allows the front-end to operate on 5–6 day/week shifts for 8–16 hr/day. As discussed in the paper, SEMASS operates the front-end on a continuous basis to match the boiler fuel requirements.

(b) Use of an electrostatic precipitator (ESP) instead of a baghouse. Most designers are combining dry scrubbers with baghouses instead of ESPs. The advan-
tages of baghouses seem to be better emission control of fine particulates and lower acid gas emissions due to the beneficial effect of lime carryover into the baghouse.

(c) No glass and/or aluminum removal prior to combustion. Many prepared fuel plants remove the grit/glass fraction from the fuel with either a trommel or disk screen prior to combustion. In addition, several facilities try to remove aluminum prior to combustion.

The paper should discuss the rationale for the above three decisions regarding the design of the plant. In addition the paper should comment on if results of the first year of operation supports that rationale.

In addition to the above design features, I would have liked to seen more discussion and detailed data on issues which are common to most prepared fuel facilities such as the rate of boiler tube corrosion, problems experienced with fuel feed systems and grates, ash characteristics, design of the combustion air system and performance of the air pollution control equipment.

Discussion by

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ABSTRACT

The SEMASS waste-to-energy facility has employed the straightforward "Shred Burn" approach to Refuse Derived Fuel (RDF) production. The relatively trouble-free start-up seems to indicate that the designers have incorporated the industry learning experience of the past 10 years. In this discussion, questions are raised relative to local press reports of noise and odor problems, and industry rumors of problems in the fuel feed/distribution system. The desirability of providing capital cost, operating cost, and revenue data to facilitate comparisons with other RDF technologies also is noted.

DISCUSSION

The SEMASS waste-to-energy facility is the latest of the "Shred Burn" Refuse Derived Fuel (RDF) dedicated boiler facilities. It is interesting to note that the first RDF dedicated boiler facility was placed on line in Akron, Ohio, in 1979. As built, the Akron facility employed unproven fuel preparation technology which, even after numerous modifications, could not be made to work in a reliable manner. In 1982, the City's second private operator made numerous changes to the facility at a cost of $11.4 million, but the most significant of these changes was to simplify the operations to the "Shred Burn" concept. Although the modifications performed reasonably well, the facility was beset by several serious explosions. The City assumed control of the facility in October, 1985, and in a public/private "partnership" with wTe Corporation, the City has implemented over $1.1 million of safety improvements. These changes, combined with operational improvements, have made the Akron facility a reliable energy producer for the past 4 years.

In contrast, the SEMASS project was designed from the outset as a "Shred Burn" facility, and the designers have incorporated much of the knowledge gained by the RDF industry over the past 10 years. The result is evident in the minimal number of start-up problems experienced.

However, two start-up/operational problems that have received significant local press coverage, and apparently have been a factor in the delayed permitting of the planned facility expansion to 2800 TPD (29.4 kg/s), are plant noise and odor complaints from local residents. These problems are not unique to the SEMASS facility; they have been experienced at other facilities which are located in relatively close proximity to residential areas. As noted by the authors, special precautions were taken in the design and construction of the facility to reduce the noise levels to 50 dBA at the plant boundary. Therefore, to assist others in avoiding these potential problems, it would be informative for the industry to learn the specifics related to the noise and odor problems experienced at SEMASS, and the steps taken to resolve them.

The authors have explained the various steps in the simplified RDF fuel preparation process employed at the SEMASS facility. In any facility which utilizes shredding as the first mechanical processing step, it is very desirable to carefully inspect the incoming waste for hazardous or unprocessable materials. Hazardous materials are those which can affect the health and safety of employees, or can result in damage to the equipment or the facility. At some facilities, such as Akron, wastes are dumped into a receiving pit, so there is only a limited opportunity to inspect the wastes as they are dumped. Akron does employ a dedicated operator and knuckle boom grapple to remove obvious hazardous or unprocessable materials prior to shredding. In contrast, the SEMASS facility employs three inspection stages; this should minimize the frequency and severity of equipment damage, explosions, and accidental processing of other hazardous materials.
Although not specifically noted by the authors, other important steps in the overall pre-inspection process are related to the training and motivation of inspection personnel. Clearly, personnel must be adequately trained so they can identify suspect materials, and they must be motivated to carefully inspect all of the incoming wastes. Some inspection procedures can be relatively mundane, so there is a tendency for the inspectors to become more lax as their shift time elapses. Therefore, it is beneficial to rotate inspectors in certain positions every few hours.

The degree of pre-inspection employed at the SEMASS plant and at other similar facilities raises another issue regarding the processing methodologies employed at RDF facilities. Several facilities employ the same “Shred Burn” concept as SEMASS, while others, such as Hartford, Connecticut, utilize flail mills followed by trommel screens or disk screens and reshedding of only the oversize material. Some facilities employ shredding and air classification, such as at the Delaware Reclamation Plant, and still others utilize multiple trommels and shredding of only the oversize material, such as at SPSA’s Portsmouth, Virginia, facility. While each of the RDF technologies has its own proponents and opponents, from an industry perspective, the key factors are safety, on-line availability, costs (both capital and operating costs), and project revenues. While the authors have addressed, in a general manner, the first two areas, the cost and revenue issues are noticeably absent. We certainly hope that such information will be made available in future presentations.

The design of the SEMASS facility incorporates short-term (5 min) storage of RDF in 10 vibrating feed bins located prior to the boilers. These bins serve primarily as a means of normalizing the variations in RDF flow to the boilers. In addition, the authors note that a 4–8 hr supply of RDF (recycled from the vibrating feed bins) is maintained on the tipping floor, and this supply can be re-fed directly to the feed bins. This design configuration necessitates operation of the shredding and magnetic separation equipment on an essentially full-time basis. Our own evaluations in similar plants have shown that it can be cost beneficial to provide 1–3 days of interim RDF storage as a means of reducing shredding operations to 2 shifts per day, for 7 days or even 5 days per week. It would be interesting to learn whether or not similar evaluations have been made for the SEMASS facility.

The replacement of the drag chain conveyor with the “spring fingers” conveyor for distributing RDF to the five feed bins per boiler appears to be a unique solution to an age old materials handling problem. However, with only 60–70% removal of ferrous metals from the RDF feed stream, do the metals tend to be missed by the “fingers” until an area of concentrated metals develops? If so, is there a tendency for this slug to feed into the first bin? As often times happens in this industry, the correction of one problem can create others, although they may not be serious enough on their own to warrant further corrective action.

RDF production and boiler feeding have been the bane of many RDF dedicated boiler facilities. Rumors have persisted in some segments of this industry that significant problems exist (or existed) in the boiler feed/distribution system at SEMASS. The authors have not identified the precise nature of the feed/distribution system in their paper, nor have they suggested that any significant problems were experienced, other than those associated with the drag chain conveyor. If problems were experienced, it would be helpful to learn what they were and how they were resolved. If there were none, then it would be desirable to put such rumors to rest.

The technology associated with the combustion of RDF in dedicated boilers has evolved over the years to the extent that relatively few problems should be experienced. Of course, time will tell if corrosion/erosion will become an issue, but nothing presented points to this problem.

The gross power generation rate of 632 kWh/ton of RDF combusted, which is an average over 12 months, appears to be better than the gross generation rates attained at the few other “Shred Burn” facilities where data is available. The authors indicated that the boiler design was based on an RDF heating value of 5000 Btu/lb (11.6 ms/kg), although the actual values experienced were not reported. It could be that the heating value of the incoming MSW and the RDF produced therefrom are actually higher than expected. This phenomenon, which has been experienced at other facilities, could have resulted in a gross power generation rate which is higher than one might expect.

The paper indicates that the total weight of ash products from the facility was roughly 19% of the incoming waste, although the moisture content was not specified. By comparison, the ash from the Akron, Ohio, “Shred Burn” facility, which has excellent burnout, averages approximately 25%, at about a 25% moisture content. Since SEMASS employs lime slurry injection (Akron does not), it would appear that the 19% must be on a dry weight basis. Even so, the results are excellent.

The processing of ash from the SEMASS facility, although not unique, is certainly more comprehensive than employed at most other waste-to-energy facilities. The uses for the Boiler Aggregate® have not been iden-
tified. Of course, a key issue in this regard relates to obtaining appropriate regulatory agency approvals. The existence of such approvals was not indicated in the text.

The air pollution control system employed at the SEMASS facility appears to be performing well, especially with respect to particulate removal. The use of spray dryer absorbers in combination with electrostatic precipitators, even oversized units such as these, appears to be contrary to the trend toward baghouses, and the alleged additional reaction that occurs in the filter cake. The paper indicates that the water consumption in the spray dryer was approximately 15% higher than anticipated. It would be interesting to learn whether or not the chemical additions were correspondingly higher and, if so, were they required to meet the emission limits.

The overall throughput at the SEMASS facility has improved steadily during 1989, as shown on the bar chart presented in Fig. 3. In August and November, facility throughput appeared to reach levels which correspond approximately 85% of its 1900 TPD (19.95 kg/s) design capacity. If these levels can be sustained, then this project should have a good chance at success. Of course, it is not possible to substantiate such an assessment unless cost data and revenue details, such as tipping fees, waste availability, including contract and spot market arrangements, and power sales are made available.

**CONCLUSIONS**

The SEMASS facility appears to have incorporated most of the RDF “learning experience” of the past 10 years and, as a result, apparently enjoyed a relatively trouble-free start-up. This appears to be carrying forward into the operations phase as well. The authors have presented a reasonable amount of design-related information, but only a limited amount of actual performance data has been presented, and no cost or revenue information was included. We certainly hope that such information can be made available in the future to assist the industry in its assessment of RDF technologies. Such assessments hopefully will lead to further technology refinements which will benefit the overall industry.

**AUTHORS’ REPLY**

The authors of the SEMASS paper wish to thank the various reviewers for their efforts in developing comments, suggestions and questions concerning this paper. In an attempt to efficiently respond to the various points raised by the viewers, our comments will be combined into a single discussion organized in similar fashion to the process flow at the plant.

**MSW Processing**

As suggested by the reviewers, the MSW inspection at SEMASS is quite extensive. The use of hand-held hydrocarbon detectors has been very helpful in discovering containers of gasoline, or waste soaked with lacquer thinners, and various other organic solvents. On occasion, entire truckloads have been rejected based on high hydrocarbon vapor levels. Approximately 2000 tons are rejected annually (approximately 0.3% of the total waste) based on safety inspections.

Increasing the speed of the infeed conveyors to aid in waste inspection has not lead to an increase in maintenance on the conveyors.

Operation of the Shred Pax shredder (bulky wastes) has been relatively problem free. The problems associated with the bulky wastes processing have been conveying the material to the shredder. Moving bulky wastes on the “walking floor” feed conveyor has been somewhat troublesome.

In response to questions on the hydraulic pin puller for the shredders, it is our observation that most horizontal shaft hammermills at WTE facilities utilize hydraulic pin pullers. The hydraulic pressure used to pull the pins at SEMASS is 3000 psi. If personnel were used to manually pull the pins, it would be an extremely time consuming task. With the aid of the hydraulic puller, rotating the “bow tie” hammers takes approximately 3-4 hr. Typical hammer life with three rotations is 18,000–20,000 tons.

The impact of changing the magnetic separator transfer conveyor to a high molecular weight synthetic material has dramatically increased the operating life of the belt.

**BOILER OPERATION**

In regards to boiler erosion and corrosion effects, SEMASS has a Non Destructive Examination program for the boiler tubes. After 1½ years of operation, significant metal wastage was measured via hand held ultrasonic metering, in the lower section of the water wall tubes. To arrest this trend, the first 20 ft of the back and side wall water tubes were clad with 0.070 in. of Inconel overlay.

Tube wastage in other sections of the boiler has not been as severe as in the water wall membrane. However,
ash and slag buildup in the evaporator section of the boiler has necessitated periodic high pressure washing in addition to normal soot blowing.

Oil firing of the boiler has been both for startup of the units and for short term temperature maintenance (1 hr or less) during fuel interruptions. On average, input from oil averages between 1% and 2% of the total heat input to the boilers.

ASH HANDLING

Utilizing a dry ash handling system has resulted in some dust problems. To combat these problems, the bottom ash area was enclosed and a negative air pressure is maintained through the use of a slip stream to the suction side of the distributor air fan. Operators who enter the area are required to wear half-face respirators.

Conveying of the ash is accomplished through a combination of drag conveyors, vibrating pans and belt conveyors. Screw conveyors are no longer utilized for any ash conveying service.

AIR CONDENSER

The “quiet design” air condenser fans are run at two speeds. High speed is 80 rpm with low speed set at 40 rpm.

Freezing temperatures can cause problems with the air condenser. To combat this effect, the center section fans in the unit automatically reverse direction to draw warm air down through the condenser upon reaching a preset ambient temperature.

ZERO WASTE DISCHARGE

The site ponds at the plant are independent from the plant water system. They contain rain run off only and thus are not lined.

EMISSIONS TESTING REQUIREMENTS

A full description of the multitude of emissions testing programs both at facility acceptance and ongoing is deserving of a paper all by itself. But to briefly describe the program, full compliance testing for dioxins, heavy metals, acid gases and particulate loading is performed every 9 months of operation.

CAPITAL AND OPERATION AND MAINTENANCE COSTS

SEMASS is a privately owned and operated WTe facility and thus financial information is not available for public consumption.