Discussion by

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I wish to thank the authors for bringing to our attention the efforts and accomplishments of Hampton, Virginia and of NASA in implementing a 200 ton/day (180 t/d) MSW-fired waterwall steam generator. Being the smallest such system in the country, it should attract substantial attention, and I’m pleased to note that the authors intend to report on operations in the future.

The paper provides an overview of process objectives, project selection, design logic and plant arrangements. Discussion of some additional details is warranted at this time; the following is meant to elicit that discussion:

1. Project Economics. Major categories of construction cost and overall project cost should be presented. Annual cost of operation, including labor and maintenance, residue disposal, and utilities should be shown. Calculation of the tipping fee and the steam revenues would be valuable.

2. Project Financing. How was the project financed, and at what cost? What is the ownership structure?

3. Energy Recovery. At design conditions [200 TPD MSW disposed 66,000 lb/hr (29,900 kg/h) steam produced], about 4 (1.8 kg) of steam are produced from each pound of refuse. What is the average or expected condition? Is a pattern of variation over a day expected in either production or purchase?

4. Project Size. Given the scaled down equipment size and the source sizing methods, what provisions are included for moving oversized inorganics through the furnace and onto the ash discharge system? Also, how much acreage is required by the project?

AUTHORS’ REPLY

The authors wish to thank Mr. Von Stein for his helpful discussion. The paper obviously lacks economic and financial information which is of great interest to most of us involved in this field. Whereas some economic data could have been included in the original draft, we felt that a partial presentation would be confusing and promote false speculation about the details. (Remember final drafts were due in December 1979 for a paper to be presented in May 1980.) We decided to complement the paper by presenting project economics at the conference, and we are pleased to reiterate this information here following Mr. Von Stein’s numbering system:

1 & 2. Project Economics and Financing

A. Major Categories of Construction

- Design $ 400,000
- Boiler Trains (boilers, stokers, combustion fans) 2,500,000

20
- Cranes 525,000
- Precipitators 400,000
- Stacks 135,000
- Ash Removal 450,000
- Steam Distribution 465,000
- Structural 2,500,000
- Electrical 500,000
- Mechanical and miscellaneous equipment 2,060,000
- Civil 450,000

Total Project $10,385,000

B. Project Financing
- City of Hampton, VA
  General Obligation Bonds
  (5.94% - 20 years) $7,000,000
- NASA (FY77) 2,485,000
- USAF (FY76) 900,000

$10,385,000

Formulas have been developed by the interested parties to define the various charges as follows:

\[(A + B + C) - (D + E) = F\]

\[F = \text{Savings (+) or Additional Cost (-)}\]
\[G = 67.17\% \text{ of } F\]
\[H = 32.83\% \text{ of } F\]
\[T_f/T = (A - G) + 90,000 \text{ (if "F" is savings)}\]
\[SC/k# = \frac{(D + E) - [(A - G + (10,000 \times T_f)]}{300,000}\]
\[T_f/T = \frac{(D + E) - (B)}{100,000} \text{ (if "F" is additional cost)}\]
\[SC/k# = \frac{B}{300,000} \text{ (if "F" is additional cost)}\]

Where:

A. Cost to City to dispose of 90,000 tons (81,600 t)
B. Cost to Government to generate 300,000,000 lb (136,000,000 kg)
C. Cost to Government to dispose of 10,000 tons (9,000 t)
D. Cost of facility operation and bond amortization
E. Cost to dispose of residue and trash
F. Savings or additional cost
G. City savings or additional cost
H. Government savings or additional cost

\[T_f/T - \text{Tipping fee per ton}\]
\[SC/k# - \text{Steam charge per 1,000 lb}\]

Pertinent data for the first year of operation are:

- Operation and maintenance by City of Hampton

Estimated operating cost for first year including amortization of bonds $2,032,974

- Refuse Input – 200 TPD (182 t/d) unprepared MSW
  City of Hampton 175 TPD (159 t/d)
  Federal Government 25 TPD (23 t/d)

- Energy Customer – NASA (Approx. 50,000 pph @ 70% Utility)

- Plant Revenues
  Initial tipping charge (7/80) $4.70 per ton
  Initial steam charge (7/80) $5.21 per thousand

3. Energy Recovery
In designing the process, it was assumed that the heating value of the refuse will vary between 4500 – 6500 Btu/lb.
In performing the design calculations, sometimes the higher figure represents the worst case, or design condition, and other times the lower value is used. A steaming rate of 66,000 pph is the maximum which could occur if both units were operated at rated capacity on 6500 Btu/lb refuse. Thus, the water steam side of the process is designed for 66,000 pph. It is unlikely that this condition would occur for any prolonged period, and a steaming rate of about 50,000 pph is a more realistic figure for the rated 200 TPD operation. As indicated above, a steaming rate of 50,000 pph with 70 percent utility is the assumed energy output in determining project economics.

4. It is hoped that oversized objects will for the most part be screened out by the source sizing method; however, when an oversized object does enter the fuel stream, it may be dealt with in the following ways:

   a. The crane operator may spot it and remove it from the pit.
   b. If it is large enough, it will become lodged in the charging hopper and subsequently removed by the crane operator or manually.
   c. A large object small enough to pass through the charging hopper should pass through the chute and stoker and come to rest on the sizing grid at the top of the ash discharge chute. From there it can be manually removed through the rear access door.

The project site is about five acres and it includes an extensive, tree filled, "buffer zone" to shield the facility from the highway.