CONVERTING A MUNICIPAL INCINERATOR PLANT TO AN ENERGY RECOVERY FACILITY

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Discussion by

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The title of this paper suggests a presentation or discussion on the design and construction aspects of converting an existing incinerator into an energy recovery facility. However, the authors, Curro and Miller, have presented the background, rationale, and economics associated with several alternatives of this conversion. This information and logic may be beneficial or interesting to planners or consultants in the field. As a designer, I encourage the authors to deliver a follow-up paper describing the engineering aspects of the conversion with supporting logic.

Discussion by

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In today’s energy conscious world, the concept of converting a existing municipal refuse incinerator plant to an energy recovery facility will gain much attention and therefore this paper will receive a great deal of exposure.

In reviewing this paper, the following points should be addressed and/or clarified by the authors.

(1) For an energy recovery facility, a three-day pit storage should be maintained. No mention of this face was made in the paper or its impact on the project cost.

(2) A 95% availability for the proposed plant appears excessive even with the use of a redundant furnace. The author should elaborate on how this value was determined.

(3) The selection of air-cooled condensers in lieu of cooling towers because of the elimination of a steam plume seems incongruous as the plant description mentioned wet scrubbers as the pollution control device.

(4) In Fig. 7 the total gas flow from an incinerator furnace rated at 300 TPD is listed as 408,861 ACFM at 1358°F. This flow value is in error and the corresponding flow to the scrubber is therefore in error. The author should review this calculation and specify the heating value of the refuse and excess air percentage in computing these values.

(5) The optimum energy output of 4.0 MW is given in the paper but there is no mention of the total in-plant use and the resulting amount utilized to compute kW sales.

(6) The authors have indicated they use insulated stainless steel breeching between the proposed boiler outlet and scrubber inlet. What is the rational for such a selection.

(7) The authors have indicated the use of 450 psig steam to the turbine. Certainly the use of a higher steam pressure would be more effective in a cogeneration energy recovery facility.

(8) The installation of a boiler in the existing gas stream would certainly increase the system resistance of the system, yet no mention of this fact and its impact on the existing induced draft fan has been mentioned.

(9) With regards to the financial aspects of the paper, the authors would do well to better elucidate the meaning of “The Present Value Net Costs To The City” and how it was compiled. Lastly, it would be better if all values were presented in 1984 dollars.
Discussion by

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The paper presented by the authors is a well-documented description of the efforts of the City of Fall River, Massachusetts to consider the feasibility of retrofitting their municipal incinerator to an energy recovery facility.

The authors of this discussion wish to comment on this paper since we are jointly involved in similar studies in the State of New York, examining the technical and economic requirements for rehabilitating twelve incinerators, including both operating and non-operating installations.

The analysis of the Fall River investigation can be divided into several components, which are discussed by the paper’s authors:

1. Design capacity of facility
2. Available solid waste quantities
3. Energy output
4. Design considerations
5. Installed capital cost
6. Economic analysis

FACILITY DESIGN CAPACITY

The authors describe the existing 600 TPD design capacity of the facility (consisting of two furnaces each having a 300 TPD capacity) operating on a 4 day per week combustion schedule with only one furnace on line at any given time. It is interesting to note that this 100% redundancy in furnace design is indicative of the design philosophy of refractory-lined furnaces designed and constructed in the period from 1950 to the early 1970’s when refuse disposal was the dominant objective.

When energy recovery and the consequent revenues from sale of power are considered, however, refuse throughput and furnace utilization become important factors, and design capacity of the facility should be considered as the potential facility throughput. Although the authors do recognize the need to expand throughput by increasing operating days as well as the simultaneous operation of both furnaces, they have limited their analysis of the total potential applicability of the energy recovery option to the analysis of one 300 TPD furnace train. While this may be appropriate to this specific facility, it limits the perspective of the overall study. In other words, including a two-line facility in the analysis would have shown a substantial reduction in the tipping fee, which might attract refuse from a broader region.

SOLID WASTE QUANTITIES AVAILABLE

The authors, recognizing the need for increasing the throughput of the facility have inventoried the available solid waste disposal quantities in the surrounding communities. This requirement for increasing throughput is a direct result of the over-redundant design philosophies which result in unused excess capacity.

Although sufficient quantities of solid waste are available in surrounding communities, this waste will not be attracted to the facility unless it can offer tipping fees which are competitive with the tipping fees which are presently or will in the future be imposed on these communities. The scope of work of the study apparently did not include addressing the future solid waste disposal needs of the surrounding communities, nor project the probable increase in the tipping fees to levels which might make the Fall River project attractive.

ENERGY OUTPUT

The authors present a proposed energy balance for the facility, defining waste gas flows and temperatures through to the rated megawatt output. This analysis is a critical part of any resource recovery analysis since the resultant available energy is directly proportional to projected revenues from the sale of this energy.

In reviewing their Fig. 7 showing the mass/energy balance, we find an obvious error in the stated air flows. The gas flow which would result from combustion of 300 TPD of normal municipal refuse would be closer to 204,000 lb/hr, or 150,000 ACFM at 1358°F, not 408,861 ACFM as shown. Likewise, the volume leaving the waste heat boiler would be 78,000 ACFM at 450°F, not 204,497 ACFM.

These flows would generate 56,000 lb/hr steam for power production at 450 psig and 550°F, which can generate the 4.0 MW which the authors have shown in Fig. 7, limited by the air cooled condenser. An evaporative condenser might also have been considered. This would improve power output and would also permit control of the plume.

DESIGN CONSIDERATIONS

The authors present a well-planned layout of boiler and turbine locations within the Fall River facility. In the determination of the boiler location it is important to
ensure that sufficient volume is available for complete combustion of the gases prior to their entry into the convection bank, and that overfire air is properly introduced so as not to quench the flame yet assure temperatures at the boiler entry that keep fouling to manageable levels. Suitable ash hoppers are needed prior to and integral with the boiler.

In the retrofit of refractory incinerators, the infiltration which was permitted if not encouraged to help cool the brick setting must be minimized when the objective is to recover energy, and to attain the furnace temperatures necessary to assure complete combustion of organics (1500°F or higher).

INSTALLED CAPITAL COST

The capital cost of $5,257,000 for the proposed single train energy recovery system in 1982 dollars for the proposed single train energy recovery system is in the range of costs projected by the reviewers for similarly sized power train installations, taking into account the existing emission controls (which can only handle one train).

ECONOMIC ANALYSIS

The authors present several alternative operating schemes with and without energy recovery, highlighting both the first year tipping fee and the total present value of the net costs to the city. They conclude from these analyses, and particularly the net present worth analysis, that energy recovery is a viable alternative.

The authors do not include a discussion of the factors which make up their economic analyses such as electricity rates, projected electricity rate escalations, operating and maintenance escalations, bond interest rates and facility life. All of these factors, and particularly electric rates and escalation are independent variables whose fluctuations can result in substantial changes in the economic analysis of such a project.

In the analysis of energy recovery as a viable option in an existing operating municipal incinerator, first year tipping fee is only a partial indicator of plant viability and is highly dependent upon financing alternatives and schemes. It does not account for net life cycle costs which enhance energy recovery alternatives by accounting for the fixed debt service of the capital investment and the increasing benefits of increasing energy prices.

Although net present worth cost analysis better reflect life cycle costs for an existing operating installation, it is not an adequate factor for analyzing the economic merits of this proposed project. The investment in new energy recovery equipment should be looked upon as a capital investment venture. This is particularly true in the Fall River situation, where the project does not by itself increase solid waste disposal capacity of the City.

For example, a question which the City of Fall River should be asking is, given an investment of $6-7 million, what is the projected rate of return? If it is 5-10%, then the City would do better by keeping its money in the bank, and continue to burn its refuse as is. If its return is 20-30%, then the City may be dealing with an attractive project.

The authors point out that at present the City is subsidizing waste disposal for private haulers and outside disposers. This situation often results in rejection of resource recovery proposals which are truly economical when realistic evaluations are made. Recent rapid increases in landfill disposal costs resulting from demands that such disposal be properly handled are bringing to the attention of the public the true disposal costs, and thus making it politically possible to talk about the true costs of disposal which make resource recovery a more and more favorable alternative.