DULUTH CO-DISPOSAL FACILITY

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Discussion by

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The combustion of solid wastes and sludges containing substantial moisture in fluidized bed incinerators has been practiced successfully in various industrial installations in the past decade. These have been described in Volume III of State of the Art of “Disposal of Industrial Wastes by Combustion” by the ASME Research Committee on Municipal and Industrial Wastes. The use of municipal solid waste (MSW) as a fuel substitute as described for Duluth, Minnesota embodies the same principles which have been applied with successful experience.

The material additions to the furnace will be the solids contained in municipal refuse, solids in sewage sludge cake, moisture and air, resulting in output of dry gases and water vapor.

In the instance described, the ratio of wet weight of prepared refuse to wet weight of sewage sludge will be about 59 percent. Thus, only enough MSW is utilized to accomplish the combustion of the sludge. On a dry basis the ratio of MSW solids to sludge cake solids is 235 percent. The moisture content of the sludge cake represents over 85 percent of the total moisture input to the furnace. The volume ratio of the MSW to sludge cake under average conditions of shredder output could be in the neighborhood of approximately seven to one.

The heat values of both fuels per pound of dry solids in this case are not significantly different. All these relationships are well chosen based on best practice.

The authors indicate that all of the MSW generated in the geographic area generating the sludge will not be processed and no mention is made of disposition of industrial solid wastes not processible and bulky wastes. The method of disposal of the solid wastes not used as fuel would be of interest for overall economic evaluation of MSW and sewage sludge disposal for the same geographic area.

Generation of MSW in comparison to vacuum filtered sludge cake for the same geographic area would be in the ratio of about three to one on a wet weight basis and approximately twelve to one on a dry weight basis, allowing 25 percent synthesis for biological process. Thus, when the total MSW of a community is processed for resource recovery and energy recovery and co-processed with sludge, the sludge becomes a marginal weight addition and costs of sludge disposal are reduced to the level of those for MSW disposal with credits for recovered benefits. In the instance described by the authors, much benefit is derived when just enough MSW is used as a fuel substitute especially in a period of rising prices for fuel oil as well as its scarcity. A total MSW disposal installation in this case would not be compatible with the space limitations described.

In practice it may be expected that wide variations in hour to hour moisture content will occur.
in both the MSW and sludge cake. Peak moisture conditions can be expected relatively often. The addition of screenings from the treatment plant will aggravate moisture conditions. However, the fluidized bed unit is suited to this situation since the heat reservoir contained in the deep fuel bed will act to smooth out operation. Complete lack of fuel value can be tolerated for minutes without explosion.

In practice the density of shredded refuse has been found to vary considerably from hour to hour with variation of 30 percent or more. This originates from hour to hour changes in refuse components and shreddability characteristics thereof. The fluidity of the fuel bed should help mix the sewage sludge with the prepared MSW. The dimensions described for the furnace indicate due cognizance of MSW volume. The configuration of the furnace is compatible with the minimum availability of space. The secondary shredding of the prepared MSW should provide for particle size control by eliminating large objects and providing uniformly sized fuel. Variable output control for the fluidizing air fans could be of benefit since the rate at which air is blown through the bed controls the amount of fuel that can be reacted.

The authors are urged to publish operating results when these are available, particularly with respect to material and heat balance and combustion operations.

Discussion by

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The authors are to be congratulated for their participation in and description of a pioneer system for the co-disposal of refuse and sewage sludge. Several questions occurred to me upon reading this paper:

1. What is the basis for the 2½ percent annual growth rate in per capita solid waste generation used by the authors? This value seems high compared to recent data on growth in solid waste generation rates.

2. What is the effective tipping fee for solid waste disposal for this project? Does this project raise or lower net costs for solid waste disposal?

3. Since this was a multipurpose project, what percentage did USEPA fund, and how was this percentage arrived at? How important was USEPA funding to the economic feasibility of the project?

4. Several recent resource recovery facilities either have or are planning to add trommel screens ahead of the primary shredders. Was this option considered for Duluth and what are the authors thoughts on including it?

5. Explosions in primary shredders have been a repeated problem despite the inclusion of explosion suppression systems. Could the authors detail the provisions for avoiding and/or minimizing the damage from explosions at this facility, and has the facility a sufficient operating history to permit comment on the success of these measures?

6. Other refuse processing facilities have experienced problems discharging RDF from Atlas silos because of the tendency of RDF to “set” after storage. What provisions to avoid this problem were made at this facility.

The authors are urged to publish operating data on this facility at their earliest opportunity. The facility described represents an important advance in both sludge and solid waste disposal.

AUTHORS’ REPLIES

To John J. Baffa

The discussor’s comments regarding the relative weights and volumes of municipal solid waste and sewage sludge are well taken. The Duluth Co-Disposal Facility is a sludge disposal system utilizing refuse as a fuel. Reduction of the amount of refuse for disposal is a side benefit. Excess refuse is landfilled.

By utilizing extra shifts the Western Lake Superior Sanitary District could produce excess prepared fuel for sale should a market for such a fuel become available. Such an operation could improve overall process economics by spreading the refuse processing capital cost over more refuse throughput.

The discussor has accurately stated the advantages of a fluidized bed in stabilizing combustion conditions with relatively variable material input. Fluidizing air flow is controlled to accommodate various operating conditions. In early July, 1980, the reactor system demonstrated its ability to co-incinerate design capacities of sludge and RDF without creating air pollution problems. The key to achieving proper combustion conditions was to increase retention time and heat storage capacity.
in the bed by increasing bed depth so that the pressure drop across the bed increased from about 60 in. of water (15 kPa) to about 80 in. (20 kPa). This experience may prove extremely valuable to others planning fluidized bed combustion systems.

The authors thank Mr. Baffa for his interest in their paper and this project.

To Stephen C. Schwarz

The authors' replies are numbered to correspond to the discussor's numbered comments.

1. The project feasibility study was done in 1974. At that time waste generation rates were rapidly increasing and a 2½ percent annual growth rate in per capita solid waste generation was widely used. The authors agree that recent data indicate smaller increases in per capita waste generation.

2. The District took over the main Duluth landfill operation from a private organization. The disposal fee at the landfill was $2.75/ton in 1974. The current disposal fee is set at about $3.50/ton at both the landfill and the co-disposal facility. The co-disposal facility has no real impact on the refuse disposal cost. It does reduce the cost of sludge disposal.

3. This project was not funded as a multi-purpose project. USEPA funded 75 percent, the State of Minnesota funded 15 percent, and the Western Lake Superior Sanitary District funded 10 percent under the Wastewater Construction Grants Program. Economic feasibility was not dependent upon USEPA funding. The co-disposal facility was the most cost effective sludge disposal alternative. Constructing this unconventional project through conventional wastewater treatment procurement procedures has imposed heavy burdens on both the Contractor and the Engineers. The Innovative and Alternative Technologies Construction Grants Program was not available when project financing was obtained.

4. Trommel screens were not commonly used for refuse processing at the time of the design (1975). Trommel screens before shredding can reduce shredder wear and increase plant capacity. The primary reason for adding trommels in many plants, however, is to improve the quality of the fuel product. Since fluidized beds seem to be able to utilize a relatively crude fuel product, Trommel screens may be of little benefit to this plant.

5. The shredder area was isolated by blast curtains to minimize the potential danger to operating personnel. Planning is underway to add a shredder vent and roof relief structure.

6. No provisions were made to avoid the RDF solidification problem. However, the operating personnel were instructed not to leave the RDF in the Atlas bin for more than three to four days. Storage for a little over two (2) weeks has been accomplished without significant problems during plant start up.

The authors appreciate Mr. Schwarz's comments.