ENERGY RECOVERY AND THERMAL DISPOSAL
OF WASTES UTILIZING FLUIDIZED BED
REACTOR SYSTEMS

WILLIAM TRETHAWAY
Copeland Systems Inc.
Oak Brook, Illinois

DISCUSSION by Yen-Hsiung Kiang, Trane Thermal Company, Conshohocken, Pa.

1. You refer to operating temperature of 1200° to 1900°F. Experience indicates that at operating temperature lower than 1300°F, CO emission is considerable. What is your experience with CO emission? How do you control it?

2. When burning wastes that generate a mixture of salts, say a mixture of NaCl and Na₂CO₃, it is possible to have a melting point depression. What is your experience on this? Besides lower operating temperature (which will eventually generate considerable CO and unburned hydrocarbon), is there any other way to insure complete combustion without causing bed collapse?

DISCUSSION by William T. Clark, P.E., Day and Zimmerman, Inc.

This paper outlines the favorable results of fluidized bed operation and demonstrates that this mode of incineration may become a strong contender in the race for viable methods of solid waste disposal.

It appears to this observer that the unit may be able to compete with conventional modes of incineration particularly if the cost of preparation of feed material can be eliminated from the process. It therefore is highly adaptable to pre-separation resource recovery facilities where all or a portion of the expense of feed preparation would be recovered by sale of separated materials.

Preseparation of the waste could reduce some of the bed problems which are briefly touched upon in the paper. The removal of bulky metal objects, glass, etc., would reduce the design and maintenance problems associated with bed removal and cleaning conveyors. A reduction in noncombustible material introduced into the unit should significantly reduce operating and maintenance costs. An example of pre-separation can be found in the EPA demonstration project at Franklin, Ohio, where wet pulp from municipal refuse is incinerated in a fluid bed unit.

This writer is interested in the fluid bed operating temperature. It is known that the bed temperature can be controlled within very narrow limits by control of feed material and auxiliary fuel. Temperature excursions from a narrow predetermined band may result in bed agglomeration. The softening temperatures of clay fillers used in paper manufacturing and the softening points of glass are examples of materials that may agglomerate within the range of possible operating temperatures. Agglomeration of such materials can destroy the fluidity of the bed and require shutdown for cleaning.

Operation of the bed at the low (760°C - 1400°F) temperature reported in the paper reflects a relatively high excess air condition. High air flows are necessary to maintain the fluidized bed condition, however this will be reflected in a significant reduction in steam generation due to the effect of mass flow on stack heat loss. It is therefore desirable, from the standpoint of heat recovery to operate at as high a bed temperature as possible.
DISCUSSION by Charles O. Velzy

I looked forward to receiving useful information from this paper. This tool for the thermal destruction of solid wastes (as opposed to sludges and liquid combustible wastes) has been discussed for some time now but there is little definitive operating data or experience available.

Several comments in the paper (i.e. use of auxiliary fuel “with other methods of incineration”, and spraying of incoming feed into the combustion zone and evaporation of water) indicate the primary frame of reference of the paper is disposal of sludges from treatment of various types of wastewater. It would have been helpful if the author had more clearly defined when he was discussing disposal of sludges versus disposal of solid wastes.

I feel the treatment of the air pollution control aspects of this type of facility was handled much too simplistically. No data is presented on results in this very important area of concern. Also, Figure 1 creates the impression that cyclone collectors are used on this equipment for air pollution control when, of course, the air pollution control equipment would be downstream of the cyclones. No mention is made, in the text, of the function of the cyclone collectors.

An “optimum” size of 30 cm (12 inches) is cited for shredded solid waste based on “energy requirements, capital cost, and maintenance costs.” The studies upon which this optimization is based would be of interest to the profession. It is too bad they were not presented in this paper.

In the section on “Thermal Efficiency,” the author apparently is discussing disposal of sludges but has not clearly indicated this in the text. It also would be helpful, instead of discussing an “average sized fluidized bed reactor,” to use as a frame of reference the ratio of weight of bed material to rated capacity of a unit, or some similar comparison. I also find it difficult to understand how the “thermal efficiency” of these systems can be “further improved” by use of an auxiliary fuel to preheat combustion air.

Finally, in the Summary, the author refers to European experience in the use of fluidized beds for “combustion of municipal solid waste and generating steam for use in heating buildings.” However, no specific installations or experience is cited, and no apparent or obvious reference is cited. In short, this paper implies experience in burning solid wastes (as opposed to sludges) and extracting energy from the exhaust gases but, disappointingly, it lacks specifics for proper evaluation of this as a technique to consider in the thermal destruction of solid wastes.

AUTHOR’S REPLY

In Answer to Mr. Yen-Hsiung Kiang, Trane Thermal Company

1) CO emissions below 1300°F. can amount to 2% by volume of exhaust gases depending upon organics in waste streams. Injection of waste streams beneath the fluidized bed often reduces CO formation since longer combustion time at temperature can be achieved. The only positive correction of excessive CO emissions is to operate an afterburner in the exhaust gases following particulate removal.

2) Mixtures of salts, as say NaCl and Na₂CO₃ does depress the melting point of the ash below that for either salt individually. Depending upon the salt mixture, NaCl content has to be controlled below 0.7-1.0% by weight. The only other method for preventing bed collapse other than lowering temperature, is to add a high melting point compound to the bed, such as gypsum, to serve as a diluent.

Rebuttal to: Mr. Charles O. Velzy

Unfortunately, I was unable to report on definitive operating experience and results from commercial application of this technology since no installations have yet been completed.

Primarily I was discussing the combustion of prepared solid waste and sludge simultaneously as opposed to combustion of each separately. The use of prepared solid waste as fuel to burn sludge rather than oil or gas makes economic sense.

The technical paper by Mr. Kleinau cited in the bibliography is a complete discussion of the air pollution control subject and discusses specific operating data from sludge and industrial waste installations.

Shredding of solid waste and the economics associated with size reduction optimization was addressed by Mr. Peter Franconeri at some length.

The thermal efficiency improvement discussed involved preheating the combustion air with exhaust gases by indirect heat exchangers and not auxiliary fuel.