OPERATING EXPERIENCE AND DATA ON REVOLVING TYPE FLUIDIZED BED INCINERATION PLANS

JUNJI NAKAYAMA
Ebara Corporation
Tokyo, Japan

Discussion by
Greg Ford
HDR Engineering, Inc.

The installations discussed in this paper present some very interesting concepts and experience with regard to combustion of solid wastes. The use of fluidized bed combustion for burning various solid wastes should be applicable to the needs of many municipalities and industrial concerns in this country and around the world. This general concept of internally circulating bubbling bed design has been worked on by a number of different suppliers during the last decade.

FUELS AND COMBUSTOR DESIGN

The primary fuel discussed is Municipal Solid Waste or MSW, which is burned without "fine preshredding". An indication of the approximate sizing characteristics of the MSW necessary for feeding. The fuel feed point is indicated to be above the bed and the exhaust gas temperature indicates a significant amount of combustion is taking place above the bed. Have there been any problems with controlling both bed and above bed temperatures with variation in the quality of the MSW? Have the units experienced any problems with materials normally found in MSW such as wire or stringy fabrics?

AIR EMISSIONS

The particulate emission data indicates outlet values which would potentially meet proposed U.S. standards of 0.015 gr/DSCF for municipal waste combustors. An improved particulate emission can be obtained through additional backend equipment unrelated to the fluid bed.

Nitrogen oxide emissions appear to be very good compared to fluid bed data I have seen and would probably meet the limits of the proposed New Source Performance Standards for Municipal Waste Combustors. The operating bed temperature of 800°C (approximately 1400°F) is somewhat lower than most facilities in the U.S. This is due to the need to maximize sulfur capture which requires higher bed temperature (1450–1650°F).

The emissions of HCl appear to be higher than normally achieved in testing on MSW combustors in the U.S. with similar removal systems. The proposed New Source Performance Standards would require either 80–95% removal or 25 ppmdv depending on unit size. Percent removal of HCl is not identified, so direct comparison cannot be done.

The sulfur emissions of 30–40 ppm with over 50% capture come very close to meeting the proposed New Source Performance Standards for small units (less than 250 tons per day). Addition of limestone directly in the bed would likely improve the emissions data.
ASH

Elutriation of heavy metals from ash is a major concern for all types of municipal waste combustors. Standards for ground water limits are in the formative stage in a number of states. The nondetectable results for most of the metals tested are an indication of good results. However, the Chromium measurement of 0.16 mg/L, while below the regulation limit listed, appears to be approximately five times higher than a draft proposed limit for the State of Minnesota of 30 μg/L.

The pH of the ash ranging from 10 to 12 is also of concern. Many states may consider this pH level to be adequate to classify the ash as a special waste which would require higher grade landfill disposal criteria. This is an issue which is in limbo and waiting for direction through Federal guidelines yet to be developed.

AUTHOR'S REPLY

As pointed out in the discussion, this is a very interesting concept, but more than that, it is a patented technology, that has been successfully applied by Ebara in more than 50 operating plants.

FUELS AND COMBUSTOR DESIGN

This technology has been applied in Japan to the combustion of MSW without the use of a shredder, and with only the rough tearing of the twin screw feed mechanism. The technology is not generally expected to handle whole bicycles, but bagged domestic refuse of the order of 50 cm diameter.

A fuel feed point above the bed eliminates the pressure feeding problems of direct bed input, while the lapping motion of revolving sand helps engulf the fed refuse. Bed and freeboard temperatures are controlled by water injection and air level control, and no problems have been experienced in controlling temperatures. Waste water from the refuse pit is used for bed temperature control, but if the calorific value of the fuel is at a level which requires high water input, it may be appropriate to consider the use of the new Internally Circulating Fluidized Bed Boiler (ICFB) which includes an effective bed heat recovery mechanism.

Wire or stringy fabrics do not normally pose any problems for the combustor. Quantities of whole steel radial tires have been burned and the only remaining residue—balls of fragile steel wire—extracted by the discharge mechanism without any obstruction of fluidization or other problems. In the early days of development, stringy fabrics posed problems to the feed mechanism by winding round the screws, but this was overcome by cantilevering the shafts.

AIR EMISSIONS

In our experience, the sulfur content of refuse is normally low and is effectively handled well within the proposed NSPS limits by some form of dry sorbent injection. The operating bed temperature is normally in the range of 600 ~ 800°C for MSW and at this level is already working to reduce SOx formation. (It should be realized also that a bed temperature in this range represents a freeboard temperature in the range of 900 ~ 1000°C.)

If HCl emission levels are higher than other plants with similar removal systems, it can be assumed that the plastic content of the refuse is higher.

Probably comparisons ignore the fact that Japanese fluidized bed systems have generally only included dolomite input to the furnace and the use of an electrostatic precipitator for both HCl and SOx control.

Percentage reduction figures for these emissions can be difficult to establish on a comparable basis because of the effective activation of calcium in the refuse by the fluidized bed itself.

It will be easier to meet NSPS guidelines with a fluidized bed than with any other type of furnace, and an 80% reduction of HCl can be achieved with only slaked lime injection and a good fabric filter.

ASH

The more effectively metals are removed from the flue gas the more they appear in the ash. A Chromium level of 0.16 mg/L is a comparatively high level and the majority of measurements are lower. Nevertheless, all combustion processes are somewhat similarly at the mercy of input levels, and that is why the EPA is working to reduce heavy metals input. Cement pelletization of ash is the typical method of bringing ash within regulated levels and facilitating handling. Other more thorough but costly processes are appearing on the market.

At the same time, it must be highlighted that the fly ash of these fluidized bed systems has a lower level of unburnt combustible material, and they have none of the problems of a dirty, water-quenched, putrescible bottom ash inherent in conventional technologies.

The high pH of fly ash is not a peculiarity of fluidized bed systems, but is inevitable with any sorbent-injecting flue gas treatment system operating at a level that ensures effective control of acid gases. This has never been
perceived as a landfill shortcoming as most landfills suffer from a substantial residual acidity, increasing leachate levels. Federal guidelines have generally accepted conventional MSW ash as not being a special waste, so we anticipate the far superior residues of fluidized bed systems being welcomed.