THE ACHIEVEMENT OF "GOOD COMBUSTION" BY IMPROVEMENT OF SECONDARY AIR INJECTION AT THE MONTGOMERY COUNTY WASTE TO ENERGY FACILITY

M. BETTE, W. SCHÄFERS, AND H. KIRSCHNER
L&C Steinmüller GmbH
Gummersbach, Germany

W. G. SCHUETZENDUEBEL
Birwelco-Montenay, Inc.
Miami, Florida

Discussion by

Floyd Hasselriis
Consulting Engineer
Forest Hills, New York

Publication of this paper indicates an unfortunately unusual willingness of a WTE system vendor to carry out fundamental research and publish the results so that all can benefit from it. It is timely because it emphasizes the importance of optimizing primary measures to obtain "good combustion practice," as opposed to imposing the burden of removing the products of incomplete combustion, only to increase the organic materials in the collected flyash.

The principles which must be employed to achieve the "well-stirred reactor," which achieves low CO, are clearly illustrated by the flow-model diagrams. The extremely powerful tendency for a plume of flame to streak up the furnace has been destroyed by forcing the crossing of streams. One stream contains products of incomplete combustion due to sub-stoiciometric primary air supply, which controls the rate of combustion. The other stream, containing excess oxygen needed to assure burnout of carbon in the bed, must be mixed with the deficient stream to complete burnout, together with the secondary air, and reduce the gas temperatures to achieve the desired retention time above 1800°F.

In the past, overfire air nozzles have been placed at fixed angles. Would the authors like to have the nozzles designed with a swivelling arrangement? This would make it possible to adjust them actively so that the air placement could be adjusted to suit changes in waste composition.

As the waste varies in moisture, the quantity of total combustion air and the split to underfire and overfire air must be adjusted in order to maintain the furnace temperature. When reducing the flow through the overfire nozzles, the jet energy which causes mixing is reduced. One way to maintain full penetration while reducing the quantity of air is to have two headers, one of which is modulated to reduce total flow. Has this been considered or used anywhere?

AUTHORS' REPLY

The desire to improve combustion on a conventional MSW grate by direct influence upon the flame pattern is not innovative.

This primary effect, however, becomes more and more important as a decrease in organic gas emissions and an improvement in the ash quality can only be achieved by use of very expensive technologies, such as oxidation catalysts, activated carbon filters, and ash vitrification.

A primary effect is still the optimization of the combustion air supply. Here, secondary air injection plays a role, even though not the major role. For instance, a bad fire on the grate cannot be corrected necessarily by secondary air injection.

Tests have proven that the positive effect of secondary air injection can only be obtained if the mixing impulse is sufficiently high to cover the total flow area of the combustion chamber cross section. Locating the secondary air nozzles at the smallest cross section and at a negative injection angle provide for optimum mixing conditions.

This nozzle angle was found to be at its optimum in the range of –20° to –10° for the normal operating range of the boiler.

The proposed (by the commentator) variable nozzle arrangement therefore would bring little improvement in this relatively small range for the actual nozzle angle of −15°. A variable angle nozzle system would require a very complicated measuring system in the first pass of the boiler to permit the operator to evaluate the effects of nozzle angle changes.

We agree with the commentator's statement that the main problem stems from a reduced mixing impulse due to changes in the primary/secondary air ratio as affected by the boiler control system. This, however, can be remedied by two different methods.

(a) One more row of air injection ports above the secondary air nozzles which will inject approximately 10% recirculated flue gas from a point downstream of the air pollution control equipment. This system should only be used if the gas can be recirculated at about 400°F, which is not achievable with a spray drier system.

(b) Use of plug-valve type nozzles where the annular flow area can be changed by the movement of a control cone, thereby changing the injection velocity. This method, again, requires expensive control apparata and adds complexity to the operation.

In closing, the authors would like to emphasize that the success of any of these methods is very dependent on the flue gas flow pattern in the furnace. The flow, however, can only be optimized by the proper technical design of the combustion grate and furnace geometry.