DEVELOPMENT OF GOOD COMBUSTION PRACTICE FOR MUNICIPAL WASTE COMBUSTORS

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It is a pleasure to see the evolution of environmental regulations brought together into a single document. In the course of telling the tale, however, a few points were raised that warrant clarification.

The authors' point to using over-fire air to adjust local stoichiometries as GCP. This statement is true to the extent that the jets mix the hot products of combustion which ensures that enough oxygen is present in each packet of gas to ensure complete combustion. If you look at the jet mixing zone itself, however, the local mixed gas temperatures are too low for rapid reaction completion. The issue is one of penetration and coverage; it is not one of quantity. I believe that OFA is tramp air which should be minimized – consistent with using enough OFA to achieve proper mixing – in a plant that maximizes energy efficiency.

I find it interesting that the authors did not include the data presented in Fig. 4 on the production of CDD/CDF in Fig. 2. The data shows that the increase in this unit is on the order of 10,000%. Is the fact that the ESP is made out of a high copper steel of any importance? Was any of the data taken with DSI and FSI operating as normal?

I am also puzzled by the authors' statement that Fig. 4 displays high rates of formation at 300°C and intermediate rates occur at 200°C. While there is much more CDD/CDF at 300°C, Fig. 4 shows almost three orders of magnitude difference between ESP inlet and outlet concentrations at 150°C and two orders of magnitude at 300°C. An explanation is needed.

The Fig. 4 data also seem to show substantially less CDD/CDF inhibition when limestone is introduced into the furnace than when powdered hydrated lime is introduced. Assuming the stochiometric ratio was the same, is this an indication that, at least for this incinerator, the furnace temperatures are too low to calcine the limestone?

Finally, Fig. 3 would not show any trend if the single 900 ppm CO data point was absent. It is most unfortunate that there are not some replicates at this test condition so that we would know if there is a relationship or if the highest CO and CDD/CDF readings coinciding is just happenstance. Have the authors confirmed this statement using other data sets and do they find, as others have, that the relationship is only discernable above 100–150 ppm – the CDD/CDF data scatter becomes so large below this CO level that no trend is discernable?

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(a) On the affirmative side, it is encouraging to read (p. 150, bottom left), a statement by important EPA authors: "performance standards are preferable to equipment operating specifications." I agree whole-heartedly with that position; the contrary view

would freeze out improvements in equipment or operator skills.

(b) On p. 151, top right, one reads (with emphasis added) "...analyses using monitoring variables (combustion gas properties) indicated that two to four variables *best explained variations in flue gas concentrations of organics*: CO concentrations, THC concentrations, NO_x concentrations, furnace temperature, and Cl concentrations." Then, "...analyses using combustion control variables indicated that the following control variables *best explained variations in organics concentrations*: total undergrate air flow, rear wall overfire air flow, total overfire air flow, steam flow rate, and RDF moisture." Comments: *(1)* this long list is confusing, at best, and does not appear helpful; *(2)* it's puzzling to read that THC concentrations is an explanation of concentration of organics — aren't they very close to one and the same, an identity, by different names? *(3)* furnace temperature is listed as a combustion gas property, but isn't it really one of the control variables? *(4)* finally, and most important, how does this list of 8–10 variables "...provide ample evidence that flue gas concentration of CO is a good indicator of furnace destruction of organics?" In a previous paper a similar position was taken but with less conviction: "CO a sign, to a smaller extent, of dioxin emissions..."

(c) The history of MWC combustion criteria is a little hard to follow and perhaps should have been set aside as a completely different discussion, apart from the changes in recommended technology. We read (on p. 147, left) "During the initial work on the development of GCP, it became apparent that..." and then "The reformulation of the 1987 Recommendations resulted in the specification of seven GCP components:..." and then (on p. 150, left) "Early in the development of new rules for controlling air pollution emissions from MWC facilities, EPA decided to control..."

(d) This last statement of guidelines (we're not sure of the chronological order) states (p. 150) that "...CDD/CDF was selected as an indicator (surrogate) for measuring the control of MWC organics." which would be controlled "...by the use of GCP and appropriate flue gas cleaning techniques." But since "...no such technique exists for continuous monitoring total organics, it was decided to continuously monitor the furnace flue gas CO concentration." So, we are watching CO, which will indicate CDD/CDF values, which will indicate organics emissions. Seems remote or secondary and perhaps indeterminate.

(e) The paper discusses (p. 153) all types of combustors, but in stating the *promulgated* standards for CO, only the guidelines for RDF spreader stokers and rotary waterwall combustors are given.

(f) The authors put considerable emphasis on MWC fuel as a factor in emissions. On p. 147, top right, "The amount and uniformity of waste feed must be controlled..." and (p. 151 left) "...excessive variations in waste uniformity cause combustion upsets." This is generally recognized, but operators are almost powerless to excercise significant control over this variable, nor is any guidance offered. What is surprising is that, contrary to what one might assume — in the belief that RDF is a much more uniform fuel than mass burn fuel, and that fluidized beds, by their unique design will overcome fuel variations — the authors relate that tests show high CO emissions at such installations. What are the implications of this finding for the common *mass burn* unit?

(g) Figure 2 is one we have seen before and we are still puzzled by it. Relationship between temperature and CDD is reported here, but it is based on evidence from three plants operated by one company and one from another. In light of the many variables indicated above, it does not appear to be convincing to show these results and draw hard conclusions. (Further, it is tempting to extrapolate the results further to the left on this graph and perhaps discover the possibility of decreasing the CDD across the ESP by more than 100%.)

(h) Figure 3 is also not convincing. A group of data with "good operation" at or below 200 ppm CO appears to correspond to average values of CDD at about 700 ug/dscm (but with a 5:1 range), another group of poor operating values with CO data at 400 ppm corresponds to a CDD level of about 1100. Including in the analysis a single point at 900 ppm CO with a corresponding CDD of 1800 appears to stretch the test results — that last single point could be a valid data point, or it could be an "outlier," and this doubt should be considered in reporting such results, even if it spoils a tidy straight line correlation of the data that is implied in the presentation.

In conclusion, perhaps the admission should be made that after spending millions on exploratory field tests and analysis, this process is too obscure and defies rational explanation, but that to anyone familiar with the combustion process, it is obvious that a high level of organics can be surmised to be present in the flue gases if the stack analyzer indicates a high level of CO (and/or THC) and, further, that a valid relationship of these concentrations is

not presently within the grasp of the researchers. The possibility that drafters of regulations might use this data to set CO emissions guidelines in the belief that CDD (or organics in general) will thereby be controlled will constitute a setback for real scientific endeavor – not to mention the replacement of waste incineration by waste burial, which is not an EPA goal.