DISCUSSION by Robert J. Schoenberger, P.E.,
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The authors have presented a paper on ash build-up when shredded solid waste is fired together with pulverized coal. The beginning portion of the paper is a good synopsis of the techniques used for ash and fuel characterization. In general, the project and paper are quite useful in trying to predict what type of problems and solid loadings one can expect if an existing boiler is retrofitted to accept solid waste material.

The respective heating values of coal and refuse as given by the authors appear to be somewhat at odds. The heating value of 26,896 J/kg appears acceptable for coal, but the 8,649 J/kg for shredded refuse appears quite low. Since the non-combustible fraction of refuse is removed one would expect the heating value to be much closer to that of pure cellulosic materials or about 15 to 16 thousand J/kg. Perhaps an investigation of this discrepancy is in order.

The accumulation rate in the bottom ash takes a dramatic step upward when even the 6 to 10% refuse is substituted for coal. What is not stated is that the particle size and rate of combustion of both the coal and refuse are determined by the physical and combustion parameters of the boiler. While the ash content of coal is considerably less than the ash content of the refuse, the percentages of accumulation of that ash are greatly reversed. Obviously the coal ash is emitted a flyash and collected downstream in an air pollution control device, whereas 60% of the ash attributable to refuse is collected as the bottom ash. Since this material is collected dominantly in the bottom ash, it is not surprising that its burning efficiency is only 90% versus 99+% for the coal. Finer grinding may alter this finding.

Provided one knows how much material is collected in the bottom ash, it is better for ash collection at this point rather than to have it collected in the air pollution control devices downstream. In terms of retrofit, it is better that the particulate loadings be taken off the air pollution control devices such as was found in this study.

The information given is very valuable in determining how refuse can be burned in existing boilers. Some additional information sampling procedures, where refuse was injected vertically, and time variation of bottom solids will improve the data quality.

The authors should be congratulated on presenting this excellent paper on the utilization of solid waste as a fuel in an existing boiler.

DISCUSSION by Robert Holloway, Resource Recovery Division, EPA, Washington, D.C.

I think the paper is a good summary describing the tests that were run and the results that were obtained. However, although it may not have been one of the purposes of the paper, I think the results should be put into the context of what they might mean in another RDF firing situation. Without further discussion and interpretation of the results, the reader does not know whether the results are only applicable to the St. Louis project, whether
they are expected to be applicable universally, or whether the authors think they have enough information to make such interpretations.

I would like to offer my interpretations of the results as follows:

1. **Size Reduction Effects.** The report states that "the data did not show a decrease in bottom ash accumulation rate when burning fine-grind refuse." Although that appears to be true, I do not think the reader should assume that a reduction in RDF particle size will not result in better burn-out and thus a lower ash and residue accumulation rate. On the contrary, better burn-out would be expected with a decrease in RDF particle size. It appears that the sampling and analysis procedures were not precise enough to measure the decrease in accumulation rate. This lack of precision appears to be evident when on the one hand the report states that "it appears that there was no discernible relationship between accumulation rate and ... percent refuse," and on the other hand it states that a seven fold increase in bottom ash accumulation can be expected when up to 10 percent of boiler output is due to RDF. It would appear that the accumulation rate would increase tremendously as the RDF firing rate increased from four to six percent up to eight to ten percent. However, there was little measurable change in the reported values (Figure 3 of the report).

As background information, the geometric mean diameter (particle size at which half the particles, by weight, are larger) of the regular grind RDF was 0.34 inches, and the mean diameter of the fine grind was 0.18 inches.

2. **90 Percent RDF Burn-Out.** The report states that the combustion efficiency for the refuse is about 90 percent. The reader should not assume from this that any other RDF could be expected to have a similar burn-out. On the contrary, because that the St. Louis RDF fraction comprised 80 to 85 percent of the incoming waste while most other projects plan to recovery only 50 to 75 percent as RDF, St. Louis RDF can be expected to be dirtier than most others—dirtier in the sense of containing more inorganic fines (glass), and dense organics (wood, plastics, leather, textiles, rubber, bones, orange peels, etc.) that do not combust in a conventional suspension fired boiler. Thus, the burn-out of the higher quality fuels can be expected to be higher than the 90 percent calculated for the St. Louis RDF.

It should be noted that a RDF with higher burn-out may not be as cost-effective as a lower quality RDF. Although the price a user is willing to pay for it may be higher, it will probably cost more to produce. The RDF product should be tailored to meet the materials handling and combustion requirements of the user steam generator, not an artificially high standard.

3. **60 Percent Bottom Ash.** The report states that 60 percent of the refuse ash goes to bottom ash, while only nine percent of coal ash goes to bottom ash. Some readers may try to jump to the conclusion that this explains why no increase in uncontrolled flyash emissions was observed with combined firing; i.e. although the RDF heat value is lower and ash content is higher than coal which means that much more ash per million Btu's are added with the RDF, much more of the RDF as falls to the bottom ash hopper rather than becoming flyash.

Although that hypothesis may be true, I don't think the data presented here supports it. This is because the ash reported as RDF bottom ash includes the ash remaining from actual RDF combustion in the boiler and ash remaining from combustion in the lab of RDF residue that did not combust in the boiler. Consequently, while the flyash is that portion of the ash that results from actual combustion in the boiler and is carried with exhaust gases, the bottom ash fraction is supplemented by the residue ash and is unfairly weighted.

Therefore, it appears that: 1) the net bottom ash (excluding residue ash) should be lower than the total bottom ash reported, thus jeopardizing the conclusion a reader might make regarding the reason for no increase in uncontrolled flyash emissions (perhaps the ratio of RDF flyash to net RDF bottom ash is the same as the ratio for coal), and 2) the higher the RDF burn-out, the higher will be the ratio of RDF flyash to net RDF bottom ash.

4. **Seven Fold Ash and Residue Increase.** The report states that ash pit accumulation rates were on the average seven times greater when firing up to 10 percent RDF. As discussed, other RDF's with better burn-out (fewer dense materials that will not combust in suspension), lower ash content, and lower moisture content can be expected to increase ash accumulation rates less than the St. Louis RDF.