EFFECTIVE ENERGY RECOVERY FROM WASTE ILLUSTRATED BY THE HAMBURG-STAPELFELD RESOURCE RECOVERY FACILITY

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There are frequent references in the literature about municipal refuse boilers being required to be shut down two to four times a year to hand clean the convection passages. Between cleanings the boiler exit gas temperature climbs, causing corresponding reductions in efficiency. The authors have tried to combat this effect by installing added heat transfer surface which can be brought into service in a compensating manner to attempt to maintain design efficiency. This has the other desirable effect of maintaining a more constant temperature to the electrostatic precipitator to help protect it from any corrosion tendencies.

With the renewed interest in energy conservation in this country, power plant engineers are taking fresh looks at co-generation. The approach described by the authors is a good example of how, with some imagination, co-generation can be applied in the refuse-to-energy field to meet a very specific need.

While the authors have described a way of compensating for a common fouling problem, the approach appears expensive. One would think a more direct solution would be to try and find ways of being able to keep the convection surfaces of incinerator boilers in a commercially clean condition without the necessity of adding compensating heat recovery equipment and requiring that they be shut down periodically for hand cleaning.

AUTHORS' REPLY

It is true that many of the older waste heat boilers for heat recovery from the incineration of solid waste have to be shut down frequently for cleaning. However, recent boiler design developments undertaken by some system vendors have successfully achieved a very high reliability and long on-stream time (up to 20,000 hr) between shut-downs for cleaning. The main characteristics of a modern waterwall boiler are:

- Totally gastight boiler in fin-pipe or pipe-web-pipe design.
- Boiler walls drawn to the combustion grate.
- Three empty radiation passes with ample volume in the first, second and third boiler flue passes, insuring sufficient residence time and low heat load per volume and per surface.
- Large cross-sections, resulting in low flue gas velocities.
- Several bends, resulting in effective, thorough blend and temperature distribution of the flue gases throughout the cross-section.
- Flue gas acceleration and bending in the transition area from the second to the third boiler pass, thereby precipitating fly ash.
- Low flue gas temperature (below melting point of fly ash) at convection heating surfaces inlet to avoid corrosion and fouling.
## BOILER DEVELOPMENT

### VOLUME

<table>
<thead>
<tr>
<th></th>
<th>160 m³</th>
<th>240 m³</th>
<th>350 m³</th>
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</thead>
<tbody>
<tr>
<td>BADEN 1968</td>
<td>CORNER TUBE BOILER</td>
<td>WERDENBERG 1971</td>
<td>CORNER TUBE BOILER WITH TAIL END CONVECTION ZONE</td>
</tr>
<tr>
<td>EMPTY PASS</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CLEANING DURING OPERATION</td>
<td>SOOT BLOWERS</td>
<td>SHOT CLEANING</td>
<td>MECHANICAL RAPPING</td>
</tr>
<tr>
<td>POSSIBLE OPERATING TIME WITHOUT BOILER CLEANING</td>
<td>3,000 hr</td>
<td>5,000 hr</td>
<td>20,000 hr</td>
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- Large cross and longitudinal spacing in proportion to the exterior pipe diameter in the convection part.
- Optimum cleaning of the heating surfaces by means of a mechanical rapping device, thereby obtaining increased boiler life span and availability (neither steam nor steel balls consumption, and no erosion related wear plates or damages, as in the case of soot blower and shot cleaning).
- Horizontally-installed convection section, causing partial precipitation of the fly ash.

The boilers in Hamburg are mainly designed according to this approach, except that a superheater is installed in the third boiler-pass.

A regulating boiler was installed for reasons of optimal heat recovery as well as to control outlet gas temperatures. Although being an expensive solution, it can pay for itself as today’s energy prices within a reasonable time.