Biomass Boiler Heat Balance Calculation

The Scenario

Standard biomass boilers operate in a heat efficiency range of 80~90%, depending on the size and type of heat transmission system in use. WISenvironmental was contracted to investigate the cause of a biomass boiler operating around 70% efficiency, which was causing a reduced payment of the Renewable Heat Incentive payments.

Principle

To determine the cause of the lost efficiency, WISenvironmental monitored the energy input and output flows from the system over a 4 hour test run operating at full capacity. The results were then fed into an adapted version of WISenvironmental’s in-house combustion software to investigate.

Instruments and Test Run

During the test WISenvironmental used a calibrated gas analyser (Testo 350XL) to measure and monitor boiler emissions at the stack, and the built-in energy meter was used to measure the heat produced, as well as flow rate and water temperatures. The fuel weight was measured before being fed into the auger and a representative sample was sent to a laboratory for compositional analysis.
Heat Balance Results

During the test run, the following parameters were measured: feed mass, feed moisture content (lab analysis), gas flow and composition (CO, NOₓ and O₂ concentrations), energy output, ash mass generation and composition (lab analysis).

Heat Balance Calculations

<table>
<thead>
<tr>
<th>Energy In</th>
<th>Value (KJ/h)</th>
<th>Energy Out</th>
<th>Value (KJ/h)</th>
<th>Percent. / Fuel Input (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel - Wood Chips</td>
<td>371,179</td>
<td>Hot Water</td>
<td>279,730</td>
<td>75.4</td>
</tr>
<tr>
<td>Combustion Air</td>
<td>-89</td>
<td>Combustion Gas</td>
<td>57,906</td>
<td>15.6</td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td></td>
<td>1,617</td>
<td>0.4</td>
</tr>
<tr>
<td>Losses through boiler surface</td>
<td>3,600</td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Total Energy In</td>
<td>371,090</td>
<td>Total Energy Out</td>
<td>342,853</td>
<td>92.4</td>
</tr>
</tbody>
</table>
Energy Output

The graph below shows the variations of water temperatures observed during the test and the corresponding energy output calculated.

**Client Benefits**

The client can verify whether the boiler is running according to the manufacturer’s specifications. The heat balance will also identify performance losses if there are any.

**WISenvironmental** can provide practical advice relating to fuel characteristics, combustion and air injection; all to optimise the boiler operations and ultimately improve the energy output and Renewable Heat Incentive payments.

**Further advice that WISenvironmental can provide**

- Site assessment for biomass system suitability
- Fuel storage scoping and planning
- Boiler size guidance

**CONTACT US**

For more information regarding our biomass boiler capabilities, get in touch via the details below and we will respond to your enquiry within 24 hours.

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