A COMPACT GRANULAR BED PARTICLE FILTER FOR HIGH TEMPERATURE SYNTHESIS GASES

4th International Conference on Clean Coal Technologies

Kavitha Pathmanathan

19.05.2009
Content

• Objective
• Introduction
  - Working Principle of Panel Bed Filter
  - The ”Filter Tray” design
  - Filtration Parameters
  - In situ investigation – high temperature
• Experimental Setup
• Results and Discussion
  - Laboratory investigation – room temperature
• Conclusion
• Future work
Objective

- Investigation of new panel bed design
- Develop a granular bed filter for high temperature
- Compact filter design
- Increase filtration velocity
Introduction - Working principle of PBF
Introduction – Filter Tray Design

L10-56

Squires Patent 2006

Modified
Introduction
Introduction – Filtration Theory

- Residual pressure drop
- Filtration cycles
## Results- In-situ investigation

Two high temperature filters were tested on producer gas from the biomass gasification plant in Güssing Austria.


<table>
<thead>
<tr>
<th>Filter type</th>
<th>Concentration [g/m³]</th>
<th>Velocity [cm/s]</th>
<th>Temperature [°C]</th>
<th>Collection efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small filter</td>
<td>2 - 3</td>
<td>1.8 - 8.5</td>
<td>550</td>
<td>&gt; 99.99</td>
</tr>
<tr>
<td>Upscaled filter</td>
<td>7 - 11</td>
<td>3.4 - 5.5</td>
<td>550</td>
<td>&gt; 99.98</td>
</tr>
</tbody>
</table>
Results- In-situ investigation

* Small scale filter (1 m³/h)

Up scaled filter (8.5 m³/h)
Experimental Setup
Results - Summary of laboratory investigations

<table>
<thead>
<tr>
<th>TEST #</th>
<th>PUFF [PA]</th>
<th>FILTRATION VELOCITY [cm/s]</th>
<th>CONCENTRATION IN [g/m³]</th>
<th>CONCENTRATION OUT [g/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1200</td>
<td>6.97</td>
<td>6.63</td>
<td>0.003</td>
</tr>
<tr>
<td>#2</td>
<td>1200</td>
<td>15.15</td>
<td>4.17</td>
<td>0.003</td>
</tr>
<tr>
<td>#3</td>
<td>1200</td>
<td>20.18</td>
<td>5.86</td>
<td>0.007</td>
</tr>
<tr>
<td>#4</td>
<td>1400</td>
<td>25.22</td>
<td>4.05</td>
<td>-</td>
</tr>
<tr>
<td>#5</td>
<td>1400</td>
<td>30.17</td>
<td>6.65</td>
<td>0.006</td>
</tr>
<tr>
<td>#6</td>
<td>1200</td>
<td>13.85</td>
<td>8.43</td>
<td>0.007</td>
</tr>
<tr>
<td>#7</td>
<td>1400</td>
<td>15.46</td>
<td>10.39</td>
<td>0.006</td>
</tr>
</tbody>
</table>
Results- Laboratory investigation

- Δp [Pa]
- Filtration velocity [cm/s]

- time [min]
Results - Laboratory investigation

Residual Pressure drop from 30 cm/s

\[ \Delta p \text{ [Pa]} \]

\[ \text{time [min]} \]

0 50 100 150 200 250

0 40 80 120 160 200 240 280 320 360
Conclusion

- Granular bed filter has been operated at 550°C
- The filtration velocity has been increased from 9 cm/s to 30 cm/s
- The new filter in addition:
  - Lower residual pressure drop
  - Longer filtration cycles
  - Lower dust concentration out
Future investigations

- Improve design and filter size – even more compact filter
- The new filter shall be tested at elevated temperature
- More detail experiments at 30 cm/s
- Maintain stable and low residual pressure drop
THANK YOU FOR YOUR ATTENTION 😊