Sulphur retention in CFB oxycombustion burning local Spanish fuel: CIUDEN’s experience

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- Introduction
- Fuels
- Results
  - Overall efficiency: Temperature and Ca/S ratio
  - Once-through sulphur retention/recirculation effect
- Conclusions
Introduction

Since July 2012, several testing campaigns have been carried out:

- Flexi-Burn CFB project (FP7)
- OXYCFB300 Compostilla project (EEPR)
- Macplus project (FP7)
- Internal tests

Fuels tested:

- Anthracite
- Anthracite/pet coke blends
- Anthracite/biomass blends
- Sub-bituminous coal
- Bituminous coal
## Fuels analysis:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>% Moisture (a.r.)</th>
<th>% Ash (a.r.)</th>
<th>% Volatiles (d.a.f)</th>
<th>% C (d.a.f)</th>
<th>% H (d.a.f)</th>
<th>% N (d.a.f)</th>
<th>% S (d.a.f)</th>
<th>% O (d.a.f)</th>
<th>HHV J/g (d.a.f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthracite</td>
<td>4,95</td>
<td>34,14</td>
<td>11,51</td>
<td>88,56</td>
<td>2,96</td>
<td>1,19</td>
<td>1,49</td>
<td>5,80</td>
<td>34,594</td>
</tr>
<tr>
<td>Anthracite/pet-coke</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>(70/30 % w)</td>
<td>4,50</td>
<td>25,09</td>
<td>10,69</td>
<td>88,29</td>
<td>3,21</td>
<td>1,41</td>
<td>2,97</td>
<td>4,12</td>
<td>35,032</td>
</tr>
<tr>
<td>Anthracite/pet-coke</td>
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</tr>
<tr>
<td>(50/50 % w)</td>
<td>4,49</td>
<td>18,72</td>
<td>10,70</td>
<td>88,07</td>
<td>3,38</td>
<td>1,50</td>
<td>3,84</td>
<td>3,21</td>
<td>35,174</td>
</tr>
<tr>
<td>Anthracite/pet-coke</td>
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</tr>
<tr>
<td>(20/80 % w)</td>
<td>3,70</td>
<td>9,55</td>
<td>10,61</td>
<td>88,19</td>
<td>3,57</td>
<td>1,68</td>
<td>4,97</td>
<td>1,60</td>
<td>35,325</td>
</tr>
<tr>
<td>Sub-bituminous</td>
<td>26,75</td>
<td>3,61</td>
<td>49,62</td>
<td>59,93</td>
<td>5,13</td>
<td>0,87</td>
<td>0,12</td>
<td>33,95</td>
<td>30,225</td>
</tr>
<tr>
<td>Anthracite/biomass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(80/20 % HV)</td>
<td>4,70</td>
<td>20,70</td>
<td>24,21</td>
<td>80,35</td>
<td>3,59</td>
<td>0,98</td>
<td>1,27</td>
<td>13,81</td>
<td>31,859</td>
</tr>
</tbody>
</table>
Results. Sulphur retention

Anthracite:

Ca/S ratio (mol/mol) vs % Sulphur retention

Temperature (°C) vs % Sulphur retention
Results. Sulphur retention

Anthracite/Pet coke blend (70/30 % w):

Ca/S ratio (mol/mol)

Temperature (°C)
Results. Sulphur retention

Anthracite/ Pet coke blend (50/50 % w):

Ca/S ratio (mol/mol)  Temperature (°C)
Results. Sulphur retention

Anthracite/ Pet coke blend (20/80 % w):

Ca/S ratio (mol/mol)  

Temperature (°C)
Results. Sulphur retention

Anthracite/ Biomass blend (80/20 % w):

- Ca/S ratio (mol/mol)
- Temperature (°C)
Results. Once-through sulphur retention

**Anthracite:**

![Graph showing % Per pass Sulphur retention vs Ca/S ratio for Anthracite oxy](image1)

![Graph showing % Sulphur retention vs Ca/S ratio for Anthracite oxy](image2)

**Ca/S ratio (mol/mol)**
Results. Once-through sulphur retention

Anthracite:

Temperature (°C)

Temperature (°C)
Results. Once-through sulphur retention

Anthracite:

Ca/S ratio (mol/mol)  Temperature (°C)
Anthracite/pet coke blend (70/30 % w):

Results. Once-through sulphur retention

Ca/S ratio (mol/mol)

Ca/S ratio (mol/mol)
Results. Once-through sulphur retention

Anthracite/pet coke blend (70/30 % w):

Temperature (°C)
Results. Once-through sulphur retention

**Anthracite/pet coke blend (70/30 % w):**

**Ca/S ratio (mol/mol)**

**Temperature (°C)**
Conclusions

- High sulphur capture efficiency in oxy-combustion mode, even with high sulphur fuels.
- Highly dependent on temperature and Ca/S ratio.
- Taking notice on once-through sulphur retention on the CFB boiler, an opportunity to optimization.
Acknowledgement

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