High pressure Oxyfuel process with staged combustion

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High pressure oxyfuel process concept

Coal gasification & dust removal

Compact steam production with staged combustion

CO2 capture & desulphurization

Pulverized coal

HP Oxygen

Gasification 90 bara

Gas cooling Dust/Soot Removal

MP steam

Hex Units with O2 supply Staged Oxidation HRSG

HP Oxygen

Preheated BFW

Water condensation & desulfurization

BFW Condensate

HP CO2 liq pump

CO2, 120 bar

HP, MP, LP steam

Conden- sate

BFW

Coal gasification & dust removal

Compact steam production with staged combustion

CO2 capture & desulphurization
Heat recovery from flue gas condensate for 1000 MW gross electricity power plant at different flue gas pressures.

→ Additional 110 MW at 80 bara for water preheating
Thermodynamic background

Increase of turbine efficiency by increased steam temperature and pressure:

- Advantages of high pressure Oxyfuel concept for higher steam temperature:
- Reduction of differential pressure between steam and flue gas by 80 bara.
- Increased heat transfer because of elevated pressure
- Reduction of heat and fouling resistance because of gas cleaning in front of heat exchanger section

Increase of HP steam temperature from 600 °C to 700 °C
Increase of HP pressure from 280 bara to 350 bara.

→ Expected increase of efficiency: 4 % points.
Key equipment for steam production

Technical reference data for LNG application:
LNG: Tube no.: 10000, Weight: 200 t, Diameter: 4.5 m, Lenght: 50 m, pressure 50 bar.
References for methanol and isothermal shift reactors.
Results of process simulation

- HP Oxyfuel shows increase of electrical efficiency of 2-6 % points to atmospheric process.
- Increased CO2 capture rate by 9 % with HP Oxyfuel.

<table>
<thead>
<tr>
<th></th>
<th>Atmospheric oxyfuel</th>
<th>IGCC &amp; CCS</th>
<th>HP Oxyfuel 600 °C</th>
<th>HP Oxyfuel 700 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net efficiency (%)</td>
<td>40</td>
<td>35</td>
<td>42</td>
<td>42+4=46</td>
</tr>
<tr>
<td>CO2 capture (%)</td>
<td>90</td>
<td>90</td>
<td>99</td>
<td>99</td>
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</tbody>
</table>
Process concept and construction
Summary

- Higher electrical efficiency by > 2-6 % points compared to atmospheric oxyfuel process.
- Strongly reduced cost reduction by unit standardisation, prefabrication and material reduction.
- Reduction of boiler size by > 80 %.
- Reduction of high temperature steel demand by 80-90 %.
- Simplified gas cleaning and CO2 capture
- Option for 700 °C steam technology possible
- Production of syngas gives opportunity for Polygeneration in times of low electricity demand.
Thank you for your attention.