DEMOnstration of the Shell-Wison Bottom Quench Coal Gasification Process

Gasification Technologies
Council Conference
October 26-29, 2014
Washington DC

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Resources: Our use of the term “resources” in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Resources plays: our use of the term ‘resources plays’ refers to tight, shale and coal bed methane oil and gas acreage.

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SCGP line-up with SGC offers high efficiency, but has a comparatively high capex, and suffers from fouling with certain coals.
First step in CAPEX reduction and further widening feedstock flexibility by replacing the syngas cooler with a mature, ‘industry-standard’ water quench technology, yet keeping the SCGP benefits of high throughput with multiple burners, high availability and low maintenance costs.

A further simplification of the SCGP design: no gas quench, less steel, so even lower CAPEX, yet keeping successful membrane wall, dry feed & multiple burners.
A simple and robust, low-cost design, with a wide feedstock range
A side-fired, membrane wall, bottom flow water quench

- Side-fired multiple burners, dry feed proven in SCGP operation
- Membrane wall (long lifetime) Proven in SCGP operation
- Bottom water quench Eliminate fouling risks in SCGP, wider coal suitability
- Slag handling system Proven in SCGP operation
Extensive research to come to a bottom water quench design...
Project progress: Shell-Wison Bottom Quench demo project

- **Gasifier/quench in the Dongfang workshop**
  - October 2012

- **Hoisting of the gasifier and quench**
  - December 2012

- **Wison site overview (Nanjing)**
  - June 2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2011</td>
<td>Mar: BDP/BDEP start</td>
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<tr>
<td>2011</td>
<td>Aug: Gasifier contract</td>
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<tr>
<td>2012</td>
<td>Jan: Construction kick-off</td>
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<tr>
<td>2012</td>
<td>Oct: Gasifier delivery</td>
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<tr>
<td>2012</td>
<td>Oct: Detailed Design completed</td>
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<tr>
<td>2013</td>
<td>May: MCI</td>
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<tr>
<td>2013</td>
<td>Oct: Start-up</td>
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The bottom quench gasifier was successfully started up on October 28, 2013.
Feedstock
Four coals tested: ash contents between 8 and 25% (with and without flux)

Syngas composition
CO+H₂ % up to 90% on a dry basis depending on load (50-85%)

Carbon conversion
>99% carbon conversion, carbon <0.5% in slag and <5% in filter cake, high (>90%) slagging efficiency

Gasifier and quench
Good slag coverage overall inside gasifier with very effective water quench performance

Primary water treatment
Good settling with black water via proper flocculant to recycle gray water: TSS < 50 ppm, COD <100 ppm

Good results of the Nanjing Bottom Quench gasifier are completely in line with expectations
Project progress: Shell-Wison Bottom Quench demo project
Conclusions

Shell-Wison Bottom Water Quench has been demonstrated successfully offering a lower CAPEX and wide feedstock flexibility.

Demonstration phase is currently on-going:

- Application of different feedstocks, such as high-ash and high-FT coals, coal-petcoke mixtures, lignite etc.
- Process optimization to increase efficiency and reduce water consumption
- Assess further cost reduction potential

Shell-Wison Bottom Quench gasification process is ready for commercial application providing customers with an additional option in Shell’s gasification portfolio.
Q & A