BGL Gasification

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- Operating experience
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What is Gasification ?

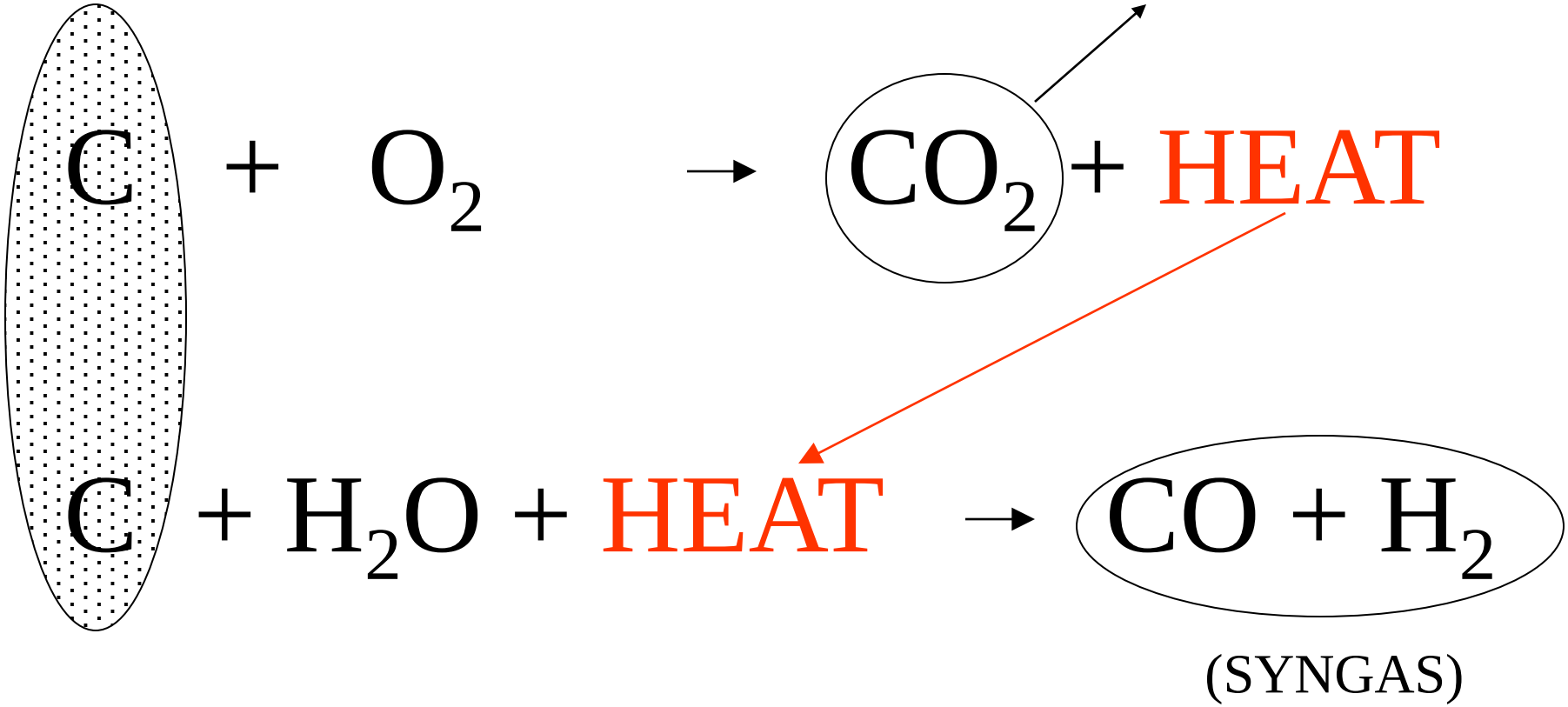
- Gasification is conversion of a feedstock, usually coal or heavy oil, to syngas
- Syngas is mostly CO and H_2
- 70%-90% of coal energy converted to syngas

What is coal?

- Carbon
- Hydrogen
  - Oxygen
  - Nitrogen
  - Sulphur
  - Other
- Moisture
- Ash

- High Ranked
  - Anthracite
  - Bituminous
  - Sub Bituminous
  - Lignite
- Low Ranked

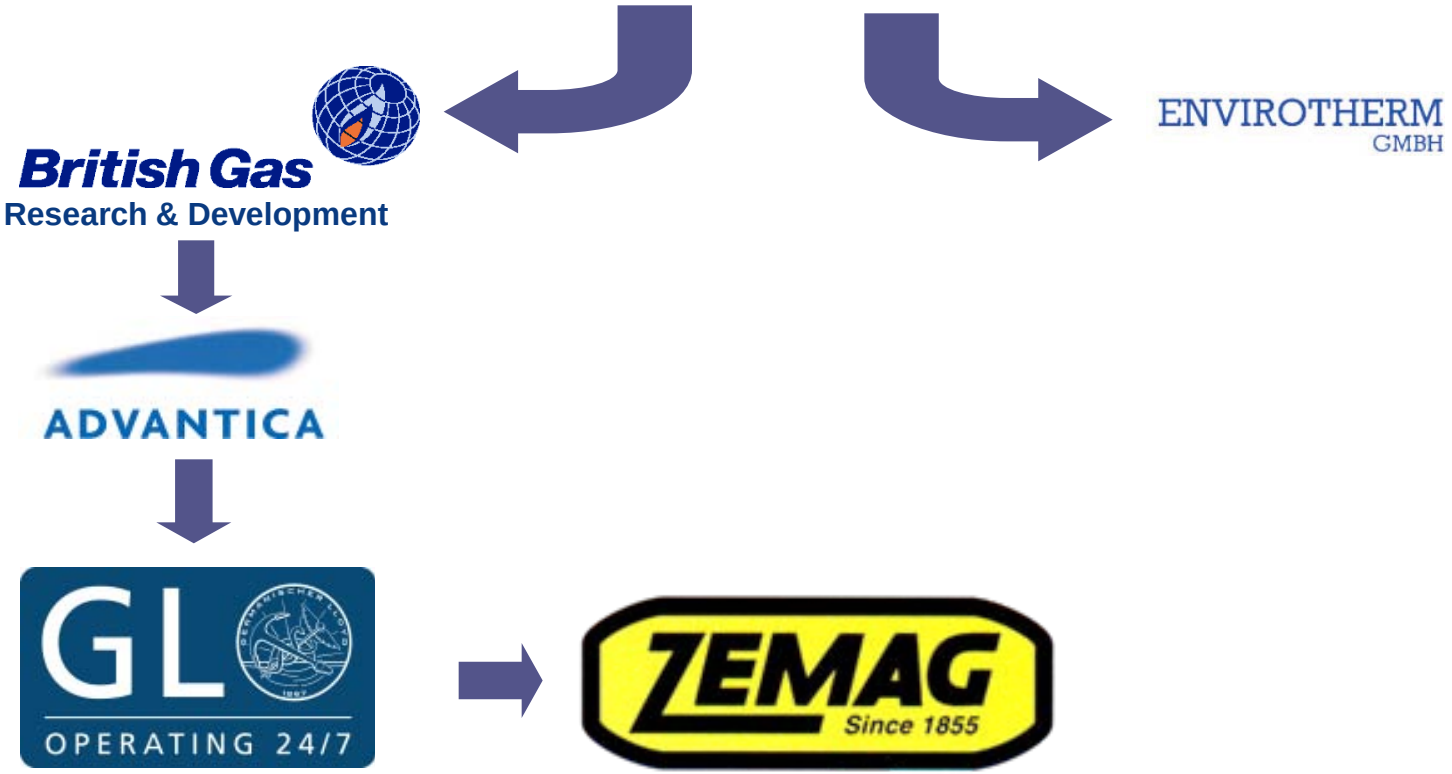
Gasification Basics



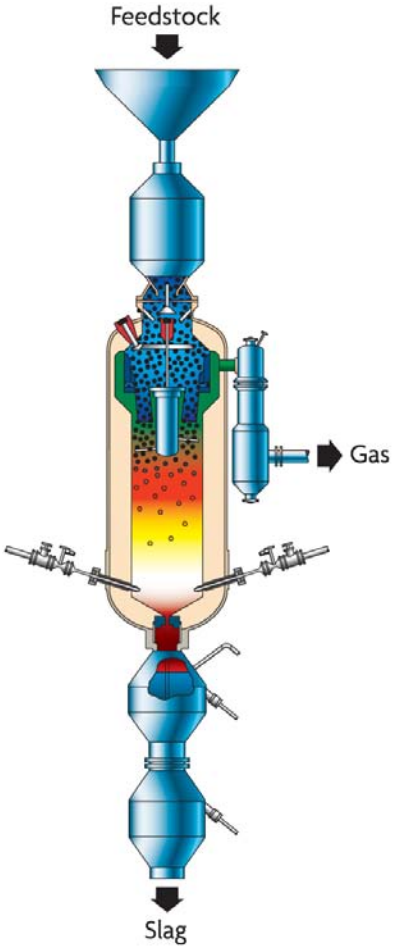
BGL Heritage

Developed by British Gas in collaboration with Lurgi for SNG production

BGL = British Gas / Lurgi



BGL Gasifier



- Fixed bed slagging gasifier
- Developed from the well proven Lurgi dry ash gasifier

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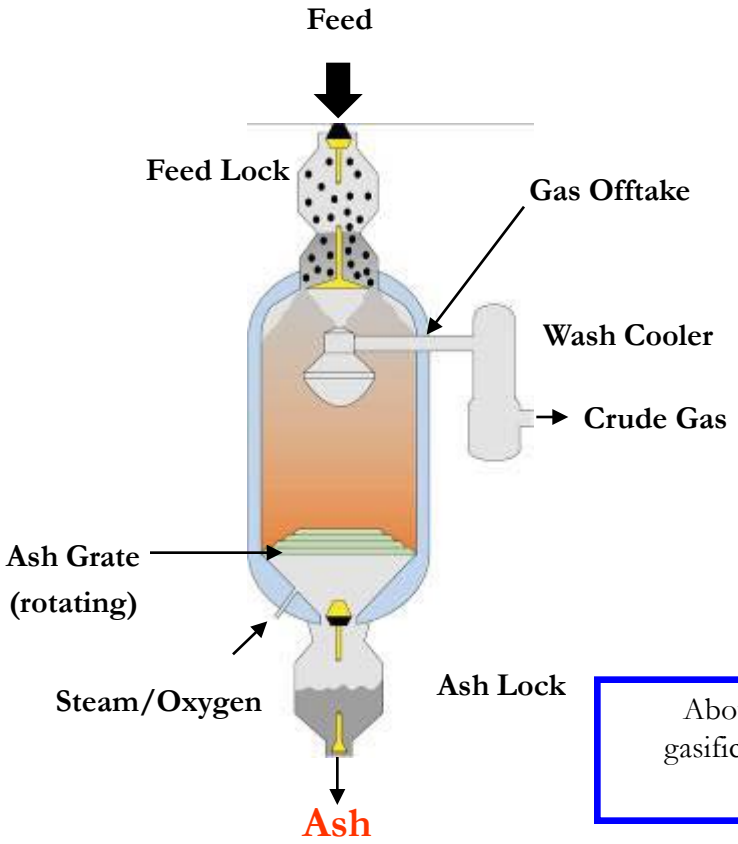
BGL Gasifier

Lurgi and BGL Comparison

Lurgi - Pressure Gasifier

(North Dakota/Sasol type)



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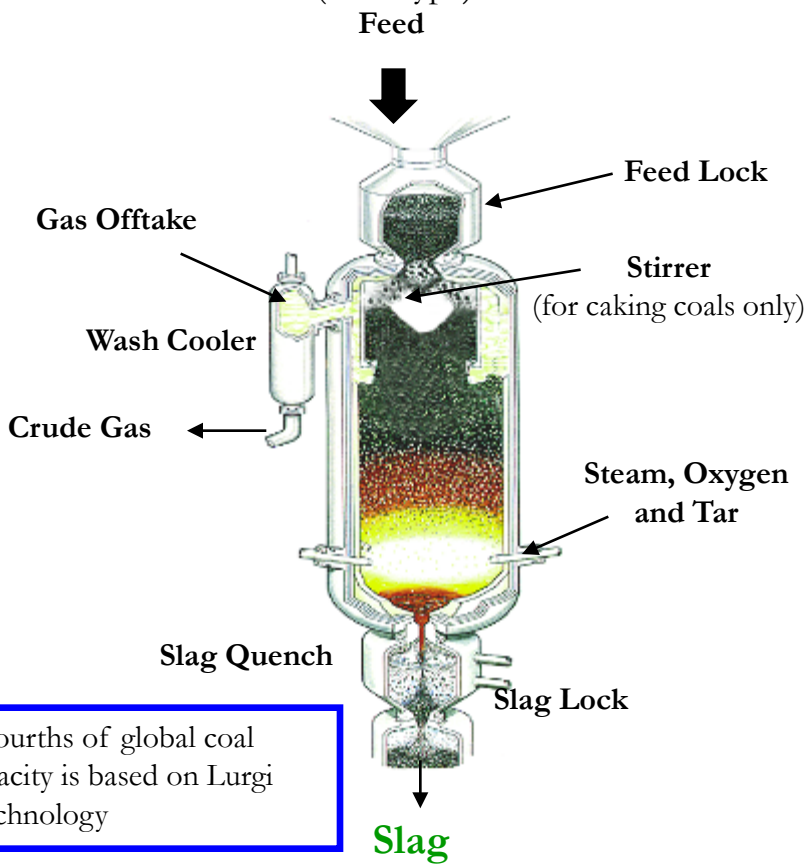
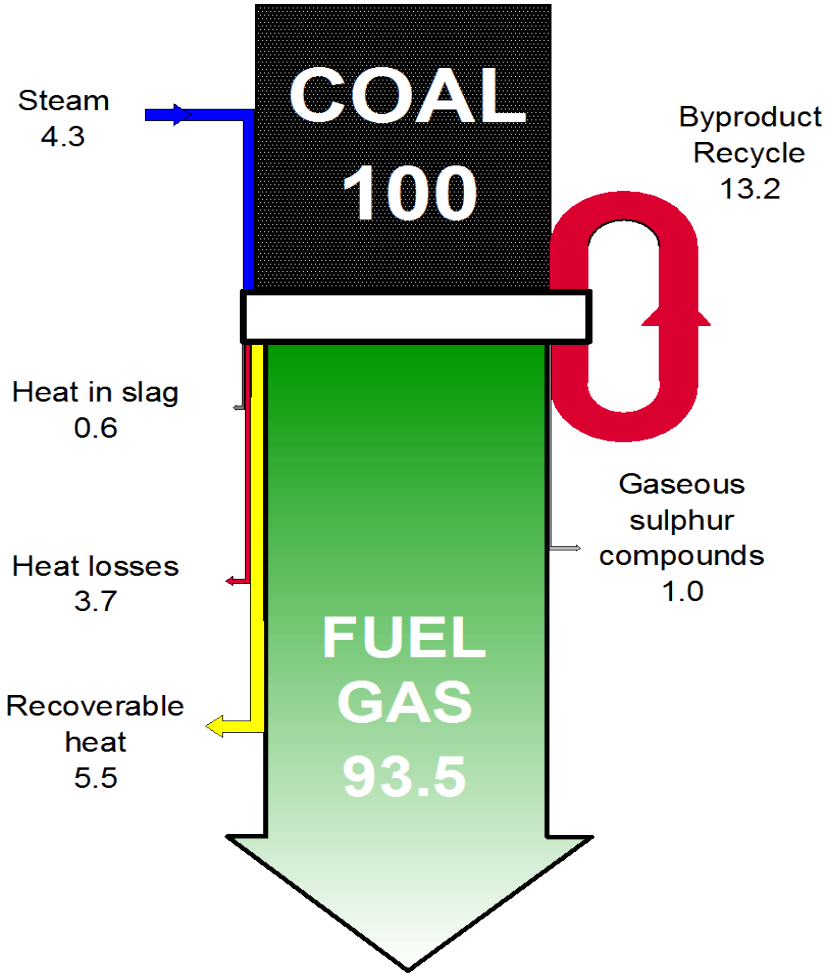
(SVZ type)



About three fourths of global coal gasification capacity is based on Lurgi technology

Fixed Bed Gasifier Advantages



- Heat recovery from product gas by contact with coal bed
- Low oxygen consumption – 50-60% of that for entrained flow gasifiers
- High cold gas efficiency
- High carbon conversion
- Low gasifier outlet temperature
- Inexpensive and well proven conventional gas cooling train
- Low CO_2 content in Syngas

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Typical clean gas composition

Component	Composition by volume %
H_2	30.8
CO	57.2
CH_4	6.2
CO_2	4.9
Other hydrocarbons	0.4
Non-combustibles	0.5

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BGL Background - Westfield

- Towns gas site with 4 Lurgi dry ash gasifiers
- Operated from 1960 to 1974
- Slagging gasifier developed in collaboration with Lurgi at Westfield using a series of demonstration scale gasifiers

Schwarze Pumpe

- Commercial production of power, methanol and heat from waste
- Commercial scale 3.6m gasifier developed from Westfield experience
- Start-up in 2000
- Successful co-gasification of coal, lignite briquettes and waste feedstocks

ENVIROTHERM GMBH

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BGL Gasifier

Lignite Briquette (binderless)

Yunnan

- Pilot scale slagging gasifier commissioned in 2006
- Raw lignite coal feed
- Most gasifier components locally sourced
- Existing gas processing train handles products

Feedstock Comparison

	SVZ 3.6m Gasifier	Westfield 1.8m Gasifier	Yunnan 2.3m Gasifier	Westfield 2.3m Gasifier	Westfield 1.8m Gasifier
Feedstock	Waste + Coal	N. Dakota Lignite	Local Lignite	Pittsburgh 8	Petroleum Coke
Moisture content (wt%)		41	30-40	6.5	4.9
Typical gas composition (mol%)					
H_2	18	32.6	26.1	27.8	30.0
CO	34	38.5	46.5	57.2	59.0
CO_2	16	18.1	12.7	4.0	0.6
CH_4	18	6.2	8.0	7.0	3.1
Carbon in slag (wt%)	-	-	<0.5	<0.5	2.2

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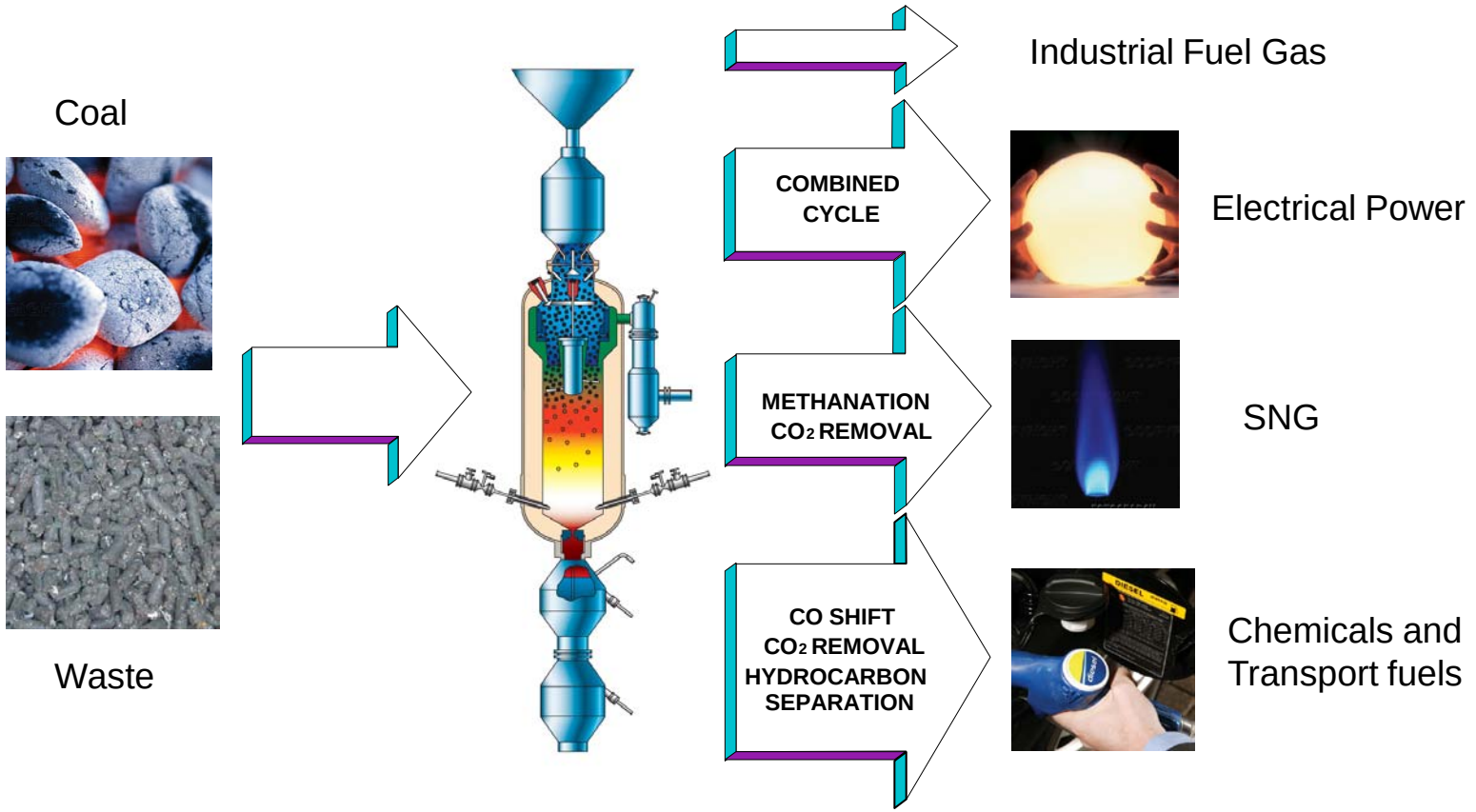
Feedstock Flexibility

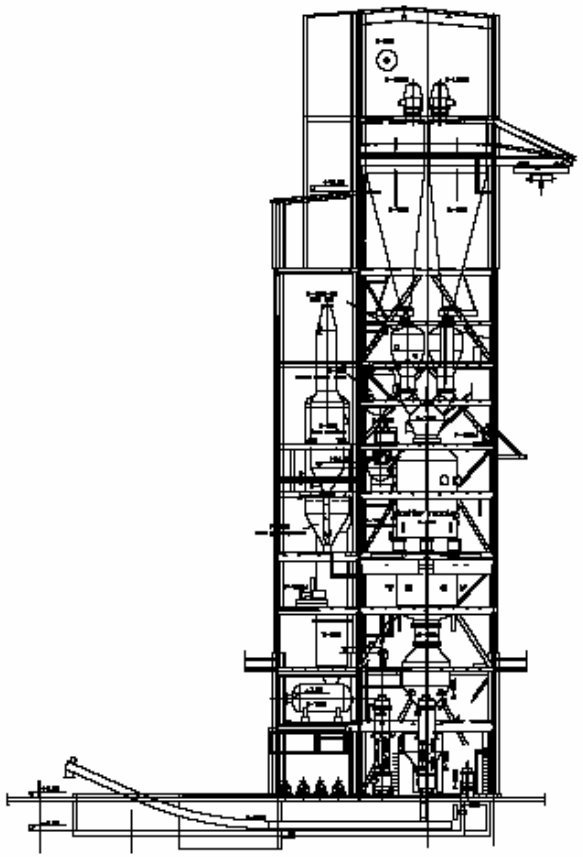
- Non-caking to strongly caking coals, UK and US
  - Ash: 0.5 - 21 wt%
  - Moisture: 3 - 28%
  - Sulphur: 0.5 - 5.6%
  - Chlorine: up to 0.6%
  - Size Range: 6 to 50 mm
- Metallurgical and Petroleum Cokes
- Briquetted coal
- Raw and briquetted lignite
- RDF and other waste fuels
- Total recycle of by-products
- Fuel can be switched whilst on line

BGL Gasifier Applications



Hulunbeier

- BGL selected by Hulunbeier New Gold Chemical Co. Ltd. in 2008 for a 500,000 t/year Ammonia plant (800,000 t/year Urea)
- Briquetted Lignite feedstock
- Process Design Package completed late 2008.
- Currently under construction
- Plant commissioning expected in 2011



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BGL Gasifier

Hulunbeier

Courtesy of Hulunbeier New Gold Chemical Co. Ltd.

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BGL Gasifier

SNG and Fuel Gas

- BGL is the best technology for SNG application owing to high efficiency and presence of CH_4 in product gas
  - See 8th European Gasification Conference paper
- Further SNG conversion efficiency realised through development of single stage shift and methanation – HICOM
- 70% coal to SNG efficiency based on Westfield demonstration – rising to 75% if based around high pressure BGL gasifier
- Process scale, high efficiency and low oxygen demand makes fuel gas application highly competitive
- South Heart Energy Development SNG project in North Dakota announced in November 2007 - planning to use 7 BGL gasifiers to produce 124 MMscfd SNG from lignite briquettes (3.33×10^6 Nm^3/day)

Power Generation

- 40-100 MWe scale of BGL makes it suitable for a range of industrial power applications
- Retrofitting to an existing GTCC is possible
- High cold gas efficiency eliminates need for integration with HRSG
- Possibilities for smaller scale units being examined

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BGL Gasifier

Summary

- Highest cold gas efficiency of commercially available gasifiers
- Ability to handle a wide range of coal feedstocks, refuse derived fuel (RDF) and sewage sludge
- Low oxygen consumption, 50-60% of entrained flow gasifiers
- Moderate outlet temperature
- Conventional materials
- Excellent load following characteristics
- No fly ash produced, only a non-leaching slag
- Proven and available for commercial exploitation