

Shell Global Solutions



COAL GASIFICATION

CONVERTING COAL, PETROLEUM COKE AND BIOMASS INTO HIGH-VALUE PRODUCTS AND POWER

AT A GLANCE

CUSTOMER DRIVER: Access to coal or petcoke; lack of access to oil and gas, and high or volatile prices; sustainable operations (emissions)

SOLUTION: The SCGP, which can convert a wide range of coals, including petcoke and biomass, into syngas

VALUE DELIVERED: High-value products or power with low emissions

PROOF POINT: Twenty-four gasifiers in operation and six more due to start up in the near future



With the world's growing appetite for energy, the demand for coal is increasing, particularly in countries with indigenous reserves or access to low-cost imports. However, depletion of the highest-quality deposits and ever-more stricter legislation on emissions mean that operators will need to use lower-quality coal in more environmentally acceptable ways.

We offer Shell Coal Gasification Process (SCGP) technology in two line-ups (Figure 1) that can convert a wide range of coal to synthesis gas (syngas) for:

- integrated gasification combined-cycle (IGCC) power generation (with optional carbon dioxide capture);
- high-value chemical or synthetic hydrocarbon production; and
- hydrogen.

Shell Global Solutions provides business, operational-support and project-execution services from design and engineering through to commissioning and start-up, experience transfer, master planning and training.

WHAT DIFFERENTIATES US

- Our coal gasification experience dates back to the early 1970s; more than 30 SCGP gasification reactors have been developed or are in the planning stage.
- We continuously improve our technologies through research and development, and by incorporating lessons learned into our master designs.
- SCGP units are successfully processing a wide range of coals, from lignite to anthracite, and including petroleum coke (petcoke) and biomass blends.
- Our designs offer performance advantages by helping to minimise oxygen and fresh water consumption, and enhance syngas yield.
- Because Shell is both a gasification technology owner and an operator, it has extensive experience in gasifier start-up, operation and maintenance.

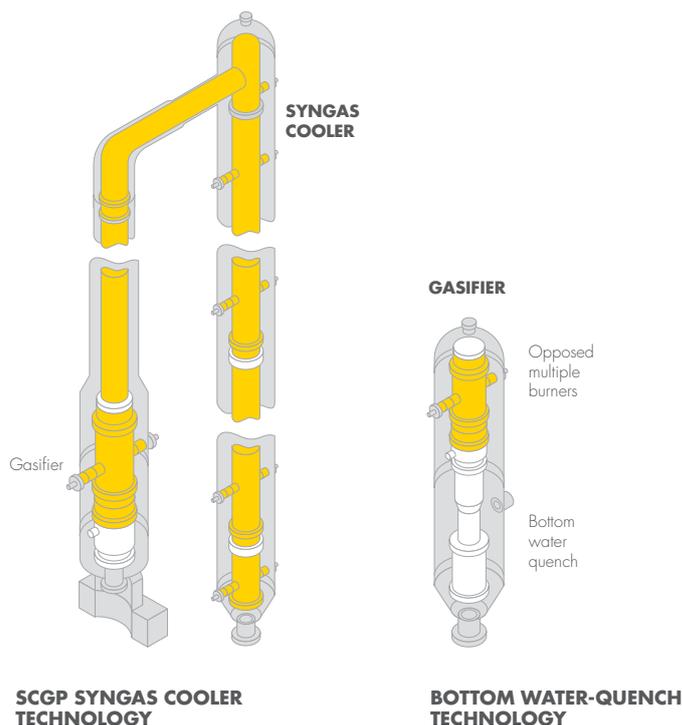


FIGURE 1: One proven technology; two line-ups.

PROCESS DESCRIPTION

Both line-ups of our proven coal gasification technology use an inert carrier gas to transport dry, pulverised coal into the gasifier, where it contacts oxygen and steam. The gasifiers consist of a membrane wall of high-pressure water/steam tubes and multiple burners designed to separate the syngas from the slag. The slag flows down into a water bath, from where it can be extracted as a solid. Multiple burners provide the potential for easy scale-up.

In the SCGP syngas cooler line-up, recycled syngas is used to quench the syngas exiting the reactor, which is then cooled further in an external cooler to generate high- and medium-pressure steam as valuable by-products. In the bottom water-quench line-up, the syngas is cooled directly in a proven water-quench system.

PERFORMANCE

Both options offer:

- low coal and oxygen consumption, 510–615 kg coal and 310–350 Nm³ oxygen per 1,000 Nm³ of effective syngas respectively; and
- high throughput and availability, and low maintenance costs by using proven reactor membrane wall and burner technology.

The **SCGP syngas cooler** line-up:

- has a higher thermal efficiency;
- produces less waste water; and
- generates high- and medium-pressure steam, which can help to reduce operating expenditure.

Our **bottom water-quench** line-up:

- requires up to 30% less capital expenditure and offers more stable operation through its simplified configuration; and
- widens coal suitability by eliminating the fouling risk in the syngas cooler.

VALUE

Our coal gasification technology can be tailored to meet different needs, including:

- providing an alternative feedstock for chemical manufacture;
- producing synthetic liquid fuels and lubricants; and
- generating power with lower emissions than from burning coal or even natural gas, with the option of easy, high-pressure carbon capture and storage.

The multiple-burner design can be easily scaled up and its high reliability removes the need for a spare gasifier. This means that you can build fewer, yet larger, units, which can help to reduce capital and operational costs as fewer operators, less maintenance and a smaller spare parts inventory are needed. Units with a dry coal intake capacity of 3,200 t/d have already been designed.

More than 100 types of coal have been processed. Gasifiers running with petcoke are among the most reliable of all units, as blending coal and petcoke can significantly improve operational stability, efficiency and syngas output, particularly for operators using high-ash coal.

CASE STUDIES

CONVERTING COAL-TO-CHEMICALS

The Yueyang Sinopec and Shell Coal Gasification Co. Ltd (Dongting) joint venture has been successfully using SCGP syngas cooler technology to supply syngas and steam to the associated Baling fertiliser plant since 2006. The facility processes 2,000 t of dry pulverised coal a day and produces syngas for urea/fertiliser and caprolactam (nylon) manufacture. In 2012, the first of two plants in Vietnam operated by Vietnam National Chemical Group began commercial operation.

GENERATING IGCC POWER

The 2,000-t/d Willem-Alexander power plant in the Netherlands (formerly owned by Nuon) operated from 1993 to 2013. It demonstrated feedstock flexibility by processing more than 20 different coal types and blends, and running successfully with up to 30%wt biomass. Its emissions were proven to be less than 30 ppm NO_x and 1.5 ppm SO_x.

Korea Western Power Co. Ltd is building South Korea's first IGCC plant. This facility will use a syngas cooler and Sulfinol[®]-M gas-treating technologies to produce 300 MW (net) of electric power from 2,670 t/d of bituminous and sub-bituminous coal.

*Sulfinol is a Shell trademark.



HAVE YOU CONSIDERED HOW YOU CAN

- produce chemicals and hydrocarbon liquids without relying on oil and gas imports?
- generate power with lower emission levels?
- adapt to lower-quality coal?

For further information, please visit our website at www.shell.com/globalsolutions

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