Traditionally, crude-oil residues have been sold as marine bunker fuel or used on-site as furnace fuel. However, with changing legislation, refineries are under pressure to reduce both their emissions and the sulphur content of their products; in addition, the market for fuel oil is shrinking.

The Shell gasification process can be combined with other upgrading and treating technologies to convert a wide range of low-value heavy residues and asphaltenes into synthesis gas (syngas). After treating, this gas can be used as clean fuel for high-efficiency combined-cycle power generation (with optional carbon dioxide capture); as a hydrogen source for hydrocrackers (combined with the water–gas shift reaction); or it can be converted into high-value products such as synthetic hydrocarbons.

By drawing on its experience, 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.

**ABOUT THE TECHNOLOGY**

The Shell Group’s (“Shell”) experience in gasification dates back to the 1950s, and more than 100 Shell gasification units have been developed or are at the planning stage.

**PROCESS DESCRIPTION**

The non-catalytic partial oxidation of hydrocarbons takes place in a refractory-lined reactor. The syngas is cooled in the syngas effluent cooler, which is directly connected to the reactor, and high-pressure saturated or superheated
Steam is produced. The low level of soot in the syngas is removed when it passes through a quench, a separator and a scrubber. The process has an automated heat-up, start-up and shutdown system, which provides reliable plant operation.

**PERFORMANCE DATA**

The Shell gasification process offers several technical advantages. It helps provide a high syngas yield, which is provided by special burner and reactor designs that enable operation at low oxygen consumption and low soot formation. Key features include:

- **feed**: high ash, sulphur content and viscosity;
- **typically >2,600 Nm³ (CO + H2)/t feedstock**; and
- **<1 mg soot/Nm³** in raw syngas. It also helps enhance thermal efficiency through the syngas cooling process. Typically \[ \frac{Q_{\text{steam}} + Q_{\text{H2}+\text{H2O}}}{H_{\text{H2}+\text{H2O}}} > 89.5\% \]

**BUSINESS VALUE**

The gasification process provides an intermediate product and does not operate in isolation; it is integrated into an existing (refinery) complex. Therefore, Shell’s gasification technology is highly flexible and can be tuned to a variety of configurations, depending on customers’ needs. The use of gasification can help in:

- improving product quality while simultaneously reducing plant emissions;
- producing sufficient hydrogen for producing today’s clean fuels;
- adapting processing facilities as demand for fuel oil diminishes;
- reducing demand for natural gas; and
- converting low-value products into high-value products.

**SHELL’S GASIFICATION TECHNOLOGY IS HIGHLY FLEXIBLE AND CAN BE TUNED TO A VARIETY OF CONFIGURATIONS, DEPENDING ON CUSTOMERS’ NEEDS.**

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**PROOF POINTS**

**Shell Pernis refinery**

In the late 1980s, Pernis refinery was faced with tight environmental requirements and stringent product-quality specifications. The gasification unit was integrated with a new hydrocracking unit and a cogeneration plant. A thermal cracker was revamped into a deep thermal cracker, which now produces 1,650 t/d of heavy residue as feed for the gasification process. The syngas produced is used in making 285 t/d of pure hydrogen for the hydrocracker and as a clean fuel for power generation in a 117-MWe integrated gasification combined-cycle plant.

This project demonstrates the benefits of integrating a polygeneration plant into a refinery where power, steam and hydrogen are all required for upgrading light products.

**OPTI Canada Inc.**

and Nexen Inc. The Long Lake project in Alberta, Canada, is a joint venture between energy company Nexen and OPTI Canada, a developer of integrated bitumen and heavy oil projects.

The project involves extracting 72,000 bbl/d of bitumen from the Athabasca oil sands. OPTI’s OrCrude™ primary upgrading process converts the raw bitumen into a partially upgraded product and a heavy asphaltene by-product. A distillate-hydrocracking unit upgrades the product further into a premium-quality synthetic crude. The heavy asphaltene by-product feeds a 3,600-t/d Shell gasification unit, which generates hydrogen for the hydrocracker and process steam. Excess syngas is used to generate steam and power for bitumen extraction.