

## About Syngas

### Introduction

Coal may be used to produce liquid fuels, suitable for transportation fuel applications, by the removal of carbon or addition of hydrogen, either directly or indirectly.

One approach is known as liquefaction, the second approach is called carbonisation, pyrolysis or gasification.

Direct Liquefaction yields are in excess of 70% by weight of the dry, ash-free (daf) coal feed. Although many different direct processes exist, common features are the dissolution of a high proportion of the coal in a solvent at elevated temperature and pressure, followed by catalysed hydrocracking of the dissolved coal with hydrogen gas.

Although no commercial liquefaction plants currently exist, Shenhua Group's first facility is under construction in China using direct liquefaction technology.

Indirect liquefaction or gasification however is a commercially proven process. It relies on the gasification of coal to produce synthesis gas (a mixture of hydrogen and carbon monoxide) known as Syngas that can then be reacted over a catalyst at temperature and pressure to produce the desired liquid products. Overall energy efficiency is typically >40% for gasification. It is this indirect process, using the well-established Fischer-Tropsch process that has been commercialised by Sasol in South Africa. In 2005 over 390 indirect liquefaction plants had been constructed or were planned for construction worldwide 20% fed or to be fed by lignite. In addition to Sasol, Lurgi, Siemens, Shell and GE Energy also licence gasification technology.

The process of coal gasification has been available for over 100 years in commercial use for more than 60 years.

### The Syngas Project in South Australia

The Syngas project by GulfX limited in South Australia is a long term, coal to premium diesel (C.T.L) gasification project.

The project

- known/previously drilled and delineated lignite deposits (estimated/published as 1.4 billion tonnes (non JORC); as feed material
- will use commercially proven, licensed gasification technology
- is located close to growing markets for diesel, power and native sulphur(all products); and
- Will capitalise on favourable long term oil price outlooks (premium diesel recently traded at record highs of US\$105 a barrel).

The project's target in production of 30,000 bbl/d of premium diesel, installation of 500 MW of power and production of 120, 000 tpa of native sulphur at a break even cost of close to US\$40 per barrel/power/sulphur unit.

## Gasification of Lignite Relevant to GulfX

The gasification process as it applies to the Syngas project involves converting carbon-containing material into a synthesis gas composed primarily of hydrogen and carbon monoxide. Typically the raw material used in gasification is coal, however it can include petroleum based materials (crude oil, sulphur fuel oil, petroleum based materials, gases, or materials that would otherwise be disposed of as waste). The feedstock is prepared and fed into the gasifier in either a dry or slurried form. The feedstock reacts in the gasifier with the addition of steam and oxygen at high temperature and pressure in a reducing (oxygen starved) atmosphere to produce syngas.

The high temperature in the gasifier converts the inorganic materials in the feed material into a vitrified material resembling coarse sand which is inert and has a variety of uses in construction and building industries.

Further gas treatment then takes place to refine the raw syngas. Trace elements and other impurities in particulate form are removed from the syngas and are either recirculated to the gasifier for further processing or recovered. Sulphur is removed during gasification and sold as a by product.

**SYNGAS** (from synthesis gas) is the name given to a gas mixture that contains varying amounts of hydrogen ( $H_2$ ) and carbon monoxide ( $CO$ ) generated through the gasification process. Syngas has a heating value/calorific value.

The following basic steps are involved in gasification steps:



b) Combustion with oxygen



c) Gasification with carbon dioxide ([Boudouard reaction](#))



d) Gasification with steam (water gas reaction)



e) Gasification with hydrogen (hydrogasification reaction)



Synthesis gas can then either be used as a fuel to generate electricity in gas-fired power plants (or generate steam for drying and other industrial uses) or it can also be used as the basic chemical building block for the production of a number of products in the petrochemical industry through refining premium diesel which is the focus for GulfX.

## **Environmental Benefits**

With the latest developments in large, efficient gas turbines and large scale moisture removal from feedstocks, the gasification of coal has the potential to generate power more efficiently than many modern conventional coal-fired power plants, with lower carbon and greenhouse gas emissions as well as reduced particulates.

Gasification technologies offer the following benefits:

- More efficient, lower emission generation of transportation fuel and power from coal than many currently operating facilities;
- Environmentally-benign disposal of solid and liquid wastes;
- Potential utilisation/supplementation of feed with geo-fluids and biomass (renewable energy sources for power production).