ADVANCES IN THE TECHNOLOGY OF LIQUID SYN FUEL PRODUCTION FROM COAL

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1. Introduction

The production of synfuels from coal consists of three major process steps:
(i) The gasification of coal to produce syngas, a mixture of hydrogen and carbon monoxide;
(ii) The conversion of the syngas to a syncrude by means of the Fischer-Tropsch process;
(iii) The hydrotreating and work up of the syncrude to final products.

Since commissioning its first liquid synfuel from coal plant in the early 1950's, Sasol has become a world leader in the development and commercial application of coal gasification and Fischer-Tropsch technology. This has been achieved by significant advances in the design and operation of its coal gasifiers as well as in the reactor and catalyst technology being used for the Fischer-Tropsch processes.

Currently Sasol is operating three synfuel production plants in South Africa with a combined capacity of approximately 150,000 bbl/d of fuel equivalent. Sasol's Circulating Fluidised Bed Fischer-Tropsch technology is used under license by Mossgas in South Africa to produce about 21,000 bbl/d of synfuels from natural gas. Sasol is also investigating a number of business opportunities in the Middle East, West Africa, South and North America, Norway, the former Soviet Union and the Far East for the application of its Slurry Phase Distillate Process to convert natural gas to naphtha and clean-burning diesel.

2. Coal Gasification

Fig. 1 is a schematic diagram of the Lurgi non-slagging moving bed coal gasifier. In such a gasifier coal, steam and oxygen are converted primarily to CO, CH₄, H₂, CO₂ and coal tar liquids. Other byproducts, like H₂S and nitrogen containing compounds, are also formed. After removal of these byproducts and the CO₂, the syngas will typically have a composition of 56 H₂, 32% CO and 11% CH₄.
At the Sasol's synfuel plants in Sasolburg and Secunda, the following Lurgi gasifiers are in operation:

(i) 13 Mark I to III gasifiers: Syngas capacity of 14,000 m₃/h each.
(ii) 83 Mark IV gasifiers: Syngas capacity of 41,000 m₃/h each.
(iii) 1 Mark V gasifier: Syngas capacity of 66,000 m₃/h.

During the past ten years the syngas production of the 97 gasifiers used by Sasol has increased by 15% to about 3.5 million m₃/h. The factors that contributed to the increased production are [1]:

(i) 60% due to increased gasifier throughput;
(ii) 20% due to the reduction of CO₂ produced during gasification;
(iii) 10% due to the recovery of coal lock off gas;
(iv) 10% due to increased gasifier availability.

The 13% increase in the maximum throughput per gasifier is the combined effect of minimising the fluctuations in the feed coal size distribution, modifications to the gasifier internals and the automation of the coal and ash lock controls. Although no beneficiation processes are used to decrease the ash content of the coal, the mining...