A Review of the Leigh Creek Energy ISG Pre-commercial Demonstration Facility

Part 3: Status November 2018

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Leigh Creek ISG Pre-commercial Demonstration Status – November 2018

Introduction

Leigh Creek Energy (LCKE) initiated their ISG pre-commercial demonstration on 10th October and announced "first syngas flows" on 11th October. This was based on evidence following ignition, of heating in the bottom of the outlet well and low concentrations of combustion gases.

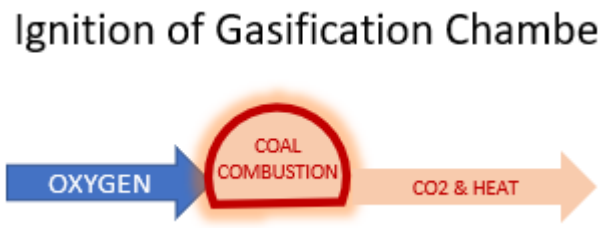
Developing a gasification chamber

Gasification is a process of partial oxidation of coal, in contrast to combustion where coal is fully oxidised producing carbon dioxide and heat. In gasification, around 10% of the coal gasified is fully oxidised to produce hot gas, and the hot gases then react with coal to produce syngas. Gasification reactions occur between 800-1600°C. An underground coal gasification chamber has to grow to a significant size, greater than 5m diameter, before the gasification process can be established in an efficient and sustainable configuration. After ignition there is a period where combustion of the coal is used to enlarge a chamber, which eventually transitions to a gasification mode, and the time taken to get to gasification depends on the UCG design method being used.

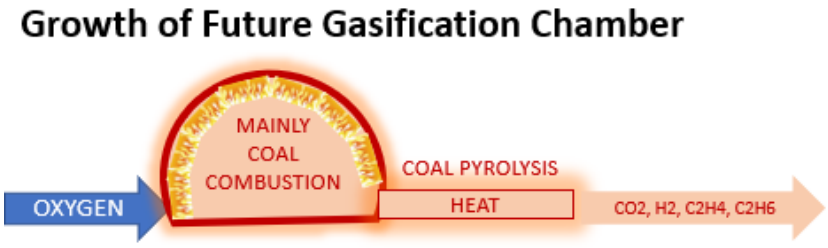
At coal temperatures above 300 °C and below 800°C coal decomposes to 'pyrolysis' products which are mainly gases, that are included to the final syngas produced in gasification, but pyrolysis is not the primary reaction in coal gasification.

Chamber development stages

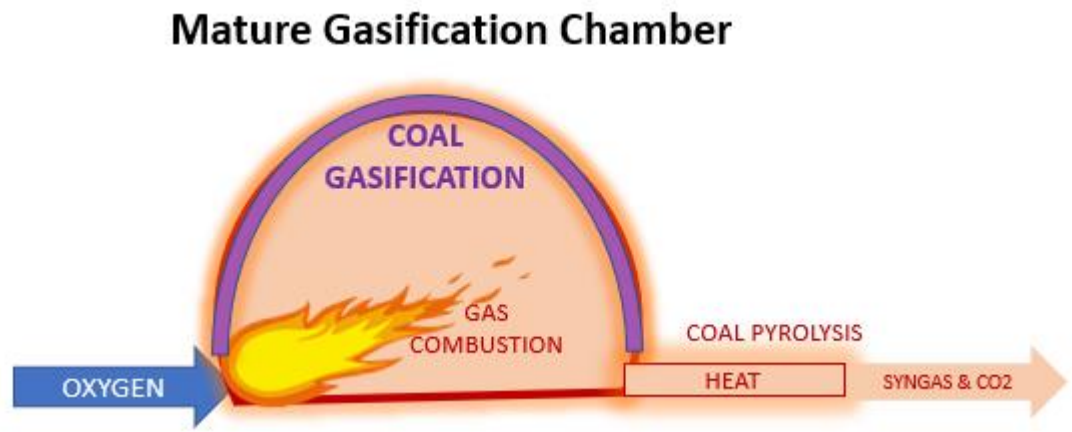
A gasification chamber in coal is developed through stages. Initially the coal is ignited and the coal combusts, starting the formation of a cavity. Hot CO2 is produced.



If efficient combustion is sustained, the cavity expands up and out. The main process is still combustion, although transition to gasification develops with growth of the chamber. The exhaust gases heat coal along the flow path, causing pyrolysis that adds gases such as H2, CO, CH4, C2H4.



As the size and temperature of the cavity increases conditions are developed for stable gasification processes. There are many chemical reactions involved between injected oxidant gases, coal and groundwater but the principal coal gasification processes result from the interaction of hot gases which are created through the burning of circulating syngas, with coal. For this to be achieved there must be an appropriate chamber shape and gas circulation pattern. A number of successful UCG chamber designs have been demonstrated, one of which is the bilaterally symmetrical expanding cavity between an inlet and outlet point used by LCKE. A consistent and stable gasification will not occur until the design chamber size, shape, and gas circulation are established. This typically takes a minimum of 1-2 weeks to develop.



Status of LCKE ISG Pre-commercial Demonstration

Having successfully ignited the coal, LCKE are now in the process of developing a gasification chamber of sufficient size to sustain efficient gasification. The rate of cavity growth varies with the design of the underground well configuration, the properties of the coal seam and the operational parameters of injected air flow rate and pressure. Demonstration of gasification cannot commence until preparation of an adequate gasification chamber has been completed.

Approval was granted to LCKE for a 90 day ISG demonstration. This was based on an expectation that development of the gasification chamber to a stage of effective coal gasification would take around 1-2 weeks. This would allow for a period of at least 60 days of testing of the performance of an operational gasification chamber.

As the gasification chamber is still being developed, LCKE successfully applied to DEM to postpone the ISG demonstration for 4-5 weeks, until it can be shown that gasification has been established. This can be proven using mass balance analyses of inlet and outlet gas composition at the intended production rates, that verify that the principal coal gasification reactions are occurring.

The key criteria is that stable gasification of coal has been established at a scale consistent with the UCG design being used by LCKE. When this is achieved, oxygen injected into the gasification chamber will have been used up in reactions and outlet gases will be composed primarily of syngas (H_2, CO, CH_4), CO_2 and H_2S, with zero or no more than a trace of oxygen.

The Department of Energy and Mining has made an appropriate response in postponing the gasification demonstration at Leigh Creek, recognising that gasification cannot commence until sufficient growth of the gasification chamber has been achieved.