Thermo Chemical Simulation of a Coal Gasification Process (Applying waste captured CO_2 either from combustion or gasification)

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Effectiveness and carbon efficiency of gasification, or specifically UCG, can further be improved by applying CO_2 gasification / recycling waste captured CO_2 as gasification agent, replacing part of the oxygen and steam, and with optimal operation. The most important reaction during any gasification process is the reduction or Boudouard Reaction where $CO_2+C \rightarrow 2CO$, preferably >850°C, without combustion, with a controlled amount of oxygen and/or steam. Technical advantages may include, but not limited to:

o CO_2 reduction of at least 14 mass % from the gasification block in raw gas, together with lowering the operating temperature of the syngas production to <850°C.

o A reduction of minimum 5 mass % ton of in-situ coal mined (gasified) to produce the same amount of CO + H_2 in raw gas, based on a 20% CO_2 recycle.

o A high(er) heating value gas (if needed) and can be controlled by the operation of the CO_2 recycle cycles and feed into the reduction process.

o CO_2 capture in-situ on active mineral components in the coal seam, roof and floor, etc. Ca, Mg to form carbonates.

CO_2 Gasification, and specifically applied to an Underground Coal Gasification (UCG) process, is a practical solution to improve both carbon efficiency and lower the CO_2 footprint.

This paper will endeavour to illustrate how a thermo equilibrium approach can be applied to theoretically quantify the advantages of this concept.