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Self-sustaining Carbamide production using the UCG-CC-Urea process

Natalie Nakaten (1), Thomas Kempka (1), Ralph Schlüter (2), Jörg Hamann (3), and Rafig Azzam (4)

(1) Helmholtz Centre Potsdam, German Research Centre for Geosciences – GFZ, Germany (natalie@gfz-potsdam.de, kempka@gfz-potsdam.de), (2) DMT GmbH & Co. KG, Essen, Germany (ralph.schlueter@dmt.de), (3) EPC Industrial Engineering GmbH, Alzenau, Germany (joerg.hamann@epc-online.de), (4) RWTH Aachen University, Department of Engineering Geology and Hydrogeology, Germany (azzam@lih.rwth-aachen.de)

World-wide coal reserves have an energy supply potential of several hundred years. Deep lying seams as well as structural problems of the coal-bearing layers can strongly restrict the mining exploitation of these coal seams. Taking these circumstances into account, underground coal gasification (UCG) offers an economic and sustainable approach to coal conversion and utilization as syngas. The high caloric synthesis gas, composed mainly of methane, hydrogen and carbon dioxide, can be used for electricity generation in a Combined Cycle Power Plant (CC) or for feedstock production making use of its various chemical components. In this context, the Urea process can be applied to produce the nitrogen based fertilizer Carbamide (CH_4N_2O). Raw materials required for the production of Carbamide fertilizer can be supplied by the syngas produced in the UCG process.

The aim of the present study is to develop an integrated carbon utilization concept on the basis of a combined UCG-CC-Urea process. A significant amount of carbon dioxide from the UCG syngas is consumed during the Carbamide production process, whereas excessive CO_2 can be injected into the gasified coal seams. Gasified coal seams have high porosity and enhanced adsorption capacity toward CO_2. Thus, a new approach to utilize carbon dioxide resulting from coal combustion was developed. Based on a self-sufficient power supply, the coupled technology offers the integration of geological storage of excessive carbon dioxide.

A theoretical feasibility study, taking into account economics and potentials of UCG as well as the storage of carbon dioxide in the gasified layers, was performed for a selected study area in Northern Bangladesh. The results of the calculations show that the combined UCG-CC-Urea-CCS technology offers high competitiveness on international feedstock markets.