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Development of geotechnical models for verification of in situ coal conversion impacts

H. Tian (1), T. Kempka (1), R. Schlüter (2), M. Ziegler (3), and R. Azzam (1)

(1) Department of Engineering Geology and Hydrogeology, RWTH Aachen University, Aachen, Germany (tian@lih.rwth-aachen.de / +49 241 8092280), (2) Department of Geotechnical Engineering, RWTH Aachen University, Aachen, Germany (ziegler@geotechnik.rwth-aachen.de / +49 241 8022384), (3) DMT GmbH & Co. KG, Essen, Germany (ralph.schlueter@dmt.de / +49 201 1721971)

In situ coal conversion combined with geological carbon dioxide storage in converted coal seams is currently discussed on an international level having led to different preparatory studies and world-wide political activities. During the power generation process from synthesis gas produced by in situ coal conversion, carbon dioxide can be removed prior or subsequent to synthesis gas conversion in a combined cycle plant by application of advanced carbon capture technologies. Exploited fields can serve as storage deposits for carbon dioxide produced during the processes of in situ coal conversion and power generation.

Currently, different experimental studies are being carried out at the laboratories of the RWTH Aachen University and the DMT GmbH & Co. KG to investigate medium to low volatile bituminous coals and anthracites from German mining areas considering their applicability for in situ conversion and as subsequent carbon dioxide storage media. This involves the analysis of mineralogical, petrological and geotechnical properties of coals and surrounding rocks such as: CO_2/N_2 sorption experiments, permeability and porosity tests considering the roof pressure development as well as geotechnical tests (uniaxial compression tests, oedometer, shear tests, triaxial tests, etc.) with regard to in situ conversion parameters.

These experimental results are used for parameterizing numerical geotechnical models and other models. The geotechnical models are based on geological information (stratigraphy and geologic structure from borehole data and seismic, engineering geological maps, GIS, etc.). They will be influenced by the designed gasification processes simulating geomechanic response to the combined process. Further studies using these models involve:

- calculating and estimating ground subsidence resulting from in situ coal conversion;
- investigating and predicting geotechnical impacts resulting from CO_2 storage into converted coal seams;
- validating the simulation results of the models; and
- coupling geotechnical models with multiphase flow models to assess the environmental risk of geological CO_2 storage and to provide basic data support for designing and adjusting the in situ conversion process considering impacts of CO_2 injection and migration on surrounding rocks.

The adapted geotechnical models will be applied for verification of in situ coal conversion impacts on the development of ground subsidence in deep coal deposits as available in Central and Western Europe. A further development of these models will allow a site specific best-fit calculation of the conversion field dimensions aiming at maximum utilization and minimum environmental impact by ground subsidence.