Geophysical Research Abstracts,
Vol. 11, EGU2009-4628-4, 2009
EGU General Assembly 2009

Geochemical Proxies for Enhanced Process Control of Underground Coal Gasification

A. Kronimus, M. Koenen, P. David, H. Veld, A. van Dijk, and F. van Bergen

Netherlands Organisation for Applied Scientific Research (TNO), P.O. Box 80015, 3508 TA Utrecht, The Netherlands
(alexander.kronimus@tno.nl/+31 30 256 46 05)

Underground coal gasification (UCG) represents a strategy targeting at syngas production for fuel or power generation from *in-situ* coal seams. It is a promising technique for exploiting coal deposits as an energy source at locations not allowing conventional mining under economic conditions. Although the underlying concept has already been suggested in 1868 and has been later on implemented in a number of field trials and even at a commercial scale, UCG is still facing technological barriers, impeding its widespread application. Field UCG operations rely on injection wells enabling the ignition of the target seam and the supply with oxidants (air, O_2) inducing combustion (oxidative conditions). The combustion process delivers the enthalpy required for endothermic hydrogen production under reduction prone conditions in some distance to the injection point. The produced hydrogen - usually accompanied by organic and inorganic carbon species, e.g. CH_4, CO, and CO_2 - can then be retrieved through a production well. In contrast to gasification of mined coal in furnaces, it is difficult to measure the combustion temperature directly during UCG operations. It is already known that geochemical parameters such as the relative production gas composition as well as its stable isotope signature are related to the combustion temperature and, consequently, can be used as temperature proxies. However, so far the general applicability of such relations has not been proven. In order to get corresponding insights with respect to coals of significantly different rank and origin, four powdered coal samples covering maturities ranging from R_o= 0.43% (lignite) to R_o= 3.39% (anthracite) have been gasified in laboratory experiments. The combustion temperature has been varied between 350 and 900 ˚C, respectively. During gasification, the generated gas has been captured in a cryo-trap, dried and the carbon containing gas components have been catalytically oxidized to CO_2. Thereafter, the generated CO_2 has been analyzed with respect to its stable carbon isotope composition by mass spectrometry. All samples exhibited a similar trend: The $\delta^{13}C$ signatures of initially produced CO_2 revealed to be relatively light and linearly increasing with temperature until approaching the bulk stable carbon isotope composition of the coal at a certain temperature, where the isotope signature kept virtually constant during further temperature increase. The temperature introducing the range of constant isotope compositions of the produced gas increased with coal rank. Additionally, all coal samples were treated by Rock Eval pyrolysis up to 550 ˚C in order to investigate temperature dependent generation of CO and CO_2. The results exhibited a linear decrease of the CO_2/CO ratio at increasing temperature. Both experimental approaches demonstrated dependencies between the qualitative and the isotope composition of the generated syngas on the one hand and the applied combustion temperature on the other hand and, consequently, the principal applicability of the considered geochemical parameters as temperature proxies for coals of significantly different rank and origin. Although the investigated samples revealed similar trends, the absolute characteristics of the correlation functions (e.g. linear gradients) between geochemical parameters and combustion temperatures differed on an individual sample base, implying a significant additional dependence of the considered geochemical parameters on the coal composition. As a consequence, corresponding experimental approaches are currently continued and refined by involving multi component compound specific isotope analysis, high temperature Rock Eval pyrolysis as well as an enforced consideration of initial coal and oxidant compositions.