Underground Coal Gasification

On behalf of the South African Underground Coal Gasification Association (SAUCGA) i am delighted to present papers in this edition of the SAIMM *Journal*. The UCG edition showcases work by various researchers, through their respective institutions, highlighting the active and diverse research areas of importance to the SAIMM readership and to South Africa as a whole. The research work also supports the general consensus and drive towards cleaner and more sustainable mining technologies that are required for emerging countries that are endowed with coal resources. Some of the work reproduced here is the result of a number of workshops and important discussions held by SAUCGA members over the last few years. We are sincerely grateful to the SAIMM, the editorial board, and the reviewers for affording us this forum to communicate the pertinent issues relevant to UCG in the South African context.

The areas covered in this edition are loosely divided into the following categories: monitoring of UCG processes, thermodynamic modelling, and gas purification. Notably, there is a summary of the initial findings in the development of the SAUCGA roadmap. Most of the papers have multiple authors, indicating the strong collaboration propensity between industry and academia. It is hoped that this edition will encourage future discussions and collaborations and that more researchers, academics, policy-makers, funders, and UCG proponents will team up to make UCG a commercial reality.

The papers on monitoring cover groundwater monitoring as per standards laid out by existing legislation and propose fit-for-purpose monitoring standards for UCG operation, which can then be regulated and enforced. A second paper discusses the use of isotope techniques in hydrogeology to determine connections across groundwater systems and possible cross-contamination. An important result presented here is that at an existing UCG site the shallow and deep aquifers are not connected, and hence it is unlikely that the gasification zone could adversely impact shallow aquifers. Follow-on work is covered by another study, at a site that has completed a UCG trial, that looks at the geochemistry and leaching probability of products into groundwater. Acid-base accounting techniques have been used to predict the acid-producing capacity of a gasification zone in unburnt coal samples. This work is also supplemented by a stratification assessment towards a better understanding of diffusion effects within an underground cavity.

Thermo-equilibrium simulations have been studied to determine the mineral transformations in residual ash. The paper reports on the mineral transformations of potassium, aluminum, and titanium and the conditions for slag formation are identified. Another paper determines the thermodynamic limits of gasification processes using a ternary phase diagram based on the inherent chemical properties of the coal. Also covered is the possibility of using carbon dioxide as a reactant to produce synthesis gas, a topic that is also echoed by other authors. It is shown that carbon dioxide gasification is a practical solution to improve carbon efficiency and lowering the overall CO_2 footprint of a UCG process. Finally, a paper outlines a novel integration of known technologies using vortex tubes to develop an efficient process and equipment to purify syngas from UCG.

The SAUCGA hopes this edition provides a taste of future work that may emerge from research and practical efforts in the field of UCG in South Africa. It would indeed require the collaboration of many people to fully contextualize this multidisciplinary technology and to become the obvious choice for future clean coal industries.

S. Kauchali