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Review

Underground coal gasification: From fundamentals to applications

Abdul Waheed Bhutto [a], Aqeel Ahmed Bazmi [b,c], Gholamreza Zahedi [b,*]

[a] Department of Chemical Engineering, Dawood College of Engineering & Technology, Karachi, Pakistan
[b] Process Systems Engineering Centre (PROSPECT), Chemical Engineering Department, Faculty of Chemical Engineering, Universiti Teknologi Malaysia, Skudai 81310, Johor Bahru (JB), Malaysia
[c] Biomass Conversion Research Centre (BCRC), Department of Chemical Engineering, COMSATS Institute of Information Technology, Lahore, Pakistan

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ABSTRACT

Underground coal gasification (UCG) is a promising option for the future use of un-worked coal. UCG permits coal to be gasified in situ within the coal seam, via a matrix of wells. The coal is ignited and air is injected underground to sustain a fire, which is essentially used to "mine" the coal and produce a combustible synthetic gas which can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or diesel fuel. As compared with conventional mining and surface gasification, UCG promises lower capital/operating costs and also has other advantages, such as no human labor underground. In addition, UCG has the potential to be linked with carbon capture and sequestration. The increasing demand for energy, depletion of oil, and gas resources, and threat of global climate change have lead to growing interest in UCG throughout the world. The potential for UCG to access low grade, inaccessible coal resources and convert them commercially and competitively into syngas is enormous, with potential applications in power, fuel, and chemical production. This article reviews the literature on UCG and research contributions are reported UCG with main emphasis given to the chemical and physical characteristic of feedstock, process chemistry, gasifier designs, and operating conditions. This is done to provide a general background and allow the reader to understand the influence of operating variables on UCG. Thermodynamic studies of UCG with emphasis on gasifier operation optimization based on thermodynamics, biomass gasification reaction engineering and particularly recently developed kinetic models, advantages and the technical challenges for UCG, and finally, the future prospects for UCG technology are also reviewed.

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* Corresponding author. Tel.: +60 7 553583; fax: +60 7 5566177.
E-mail addresses: grzahedi@cheme.utm.my, grzahedi@yahoo.com (G. Zahedi).

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