World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:18, No:07, 2024

Underground Coal Gasification Technology in Türkiye: A Techno-Economic Assessment

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Abstract : Increasing worldwide population and technological requirements lead to an increase in energy demand every year. The demand has been mainly supplied from fossil fuels such as coal and petroleum due to insufficient natural gas resources. In recent years, the amount of coal reserves has reached almost 21 billion tons in Türkiye. These are mostly lignite (%92,7), that contains high levels of moisture and sulfur components. Underground coal gasification technology is one of the most suitable methods in comparison with direct combustion techniques for the evaluation of such coal types. In this study, the applicability of the underground coal gasification process is investigated in the Eskişehir-Alpu lignite reserve as a pilot region, both technologically and economically. It is assumed that the electricity is produced from the obtained synthesis gas in an integrated gasification combined cycle (IGCC). Firstly, an equilibrium model has been developed by using the thermodynamic properties of the gasification reactions. The effect of the type of oxidizing gas, the sulfur content of coal, the rate of water vapor/air, and the pressure of the system have been investigated to find optimum process conditions. Secondly, the parallel and linear controlled recreation and injection point (CRIP) models were implemented as drilling methods, and costs were calculated under the different oxidizing agents (air and high-purity O2). In Parallel CRIP (P-CRIP), drilling cost is found to be lower than the linear CRIP (L-CRIP) since two coal beds simultaneously are gasified. It is seen that CO2 Capture and Storage (CCS) technology was the most effective unit on the total cost in both models. The cost of the synthesis gas produced varies between 0,02 $/Mcal and 0,09 $/Mcal. This is the promising result when considering the selling price of Türkiye natural gas for Q1-2023 (0.103 $ /Mcal).

Keywords : energy, lignite reserve, techno-economic analysis, underground coal gasification.
Conference Title : ICETCR 2024 : International Conference on Energy Technologies and Coal Reserves
Conference Location : London, United Kingdom
Conference Dates : July 29-30, 2024