CO₂ - ENHANCED COAL GASIFICATION IN CIRCULATING FLUIDISED BED REACTOR

*G. Tomaszewicz, M. Sciazko, A. Czaplicki, M. Tomaszewicz

Institute for Chemical Processing of Coal, 41-803 Zabrze, 1 Zamkowa Str, Poland

Abstract:
Currently, concerns about the role of CO₂ in the greenhouse gas effect have led to several international agreements aimed at controlling carbon dioxide emissions. Substantial improvements in the processing of solid fuels are considered to be essential for achieving emission targets. Gasification is the primary conversion process used to produce hydrogen and carbon monoxide from carbonaceous materials.

The effective use of CO₂ as a carbon and oxygen carrier in a gasification process requires several primary conditions to be met. A process temperature higher than 650°C shifts the equilibrium of the Boudouard (carbon-CO₂) reaction to the formation of CO. To ensure that the Boudouard reaction will proceed, the following conditions are essential: obviously, the availability of a char, a suitable time due to the kinetic constraints, and an intensive contact between the gaseous, and solid phases (i.e., CO₂ and char). The application of a circulating fluidized bed reactor, ensuring favorable conditions for heat, and mass exchange, and an efficient route for the process, is an important element of the concept of coal gasification technology involving the use of CO₂. In a circulating fluidized bed CFB gasifier, the recirculation of partly converted reactive char removed from the gas creates conditions involving high concentrations of the solid phase (char) that are well mixed with the gas. A reactive char with a high carbon content is present in the reactor. On the surface of this char, the CO₂ introduced to the reactor is converted to the basic component of the syngas—carbon monoxide.

The work presented herein discusses the results of experiments performed at 1.5 MW circulating fluidized bed gasification reactor. For the studies three coals, lignite (Belchatow), sub-bituminous (Janina) and sub-bituminous (Wieczorek), were selected. The samples were obtained from Polish mines, and prior to the experiments were dried, ground and sieved to particle sizes ranging from 0 to 3 mm.

The obtained results indicate that the more carbon dioxide is introduced the higher is the carbon monoxide content in the product gas. Taking into account product gas yield and quality, it is more favourable to gasify the lignite coal in spite to other coals.

Keywords: coal, gasification, fluidised bed

Acknowledgement: The research results presented herein were obtained during the course of the project “Development of coal gasification technology for high-efficiency production of fuels and energy", Task No. 3 of the Strategic Program for Research and Development: "Advanced energy generation technologies" funded by the Polish National Center for Research and Development.

* Corresponding author:
e-mail: tomaszewicz@ichpw.zabrze.pl Tel: +48 32 271 0041 int. 255, fax. +48 32 271 0809