***Pavlo Saik,*** *Ph.D., Associate Professor*

*Dnipro University of Technology, Dnipro, Ukraine*

*ORCID: 0000-0001-7758-1083*

***Vasyl Lozynskyi,*** *Ph.D., Associate Professor*

*Dnipro University of Technology, Dnipro, Ukraine*

*ORCID: 0000-0002-9657-0635*

***Dmytro Yankin,*** *Graduate students*

*Dnipro University of Technology, Dnipro, Ukraine*

**ON THE QUESTION OF SORPTION PROCESSES IN UNDERGROUND GASIFICATION OF COAL**

The study of sorption processes during underground coal gasification is an important area for the development of gasification technologies, which can contribute to the efficient and clean production of gas from coal. Sorption processes during coal gasification include the study of the interaction of jet flows with the plane of the fire pit of an underground gas generator [1]. Today, a number of key aspects related to sorption processes during coal gasification can be distinguished, namely: the choice of a sorbent that effectively traps pollutants (for example, sulfur, heavy metals, etc.) during gasification; establishing optimal conditions, such as temperature and pressure, to ensure maximum sorption efficiency; study of the kinetics of sorption processes to determine the optimal operating parameters of underground gas generators; development of mathematical models that reflect sorption processes during coal gasification [2]; development and implementation of sorption methods to reduce emissions of pollutants and improve the environmental safety of the gasification process [3].

When coal is heated to a temperature of 300-900°C, its organic mass intensively decomposes with the release of gases and vapors of volatile substances [4]. The temperature of coal gasification determines the composition and amount of gases that are formed during the process. Lower temperatures can lead to more methane, hydrogen, and volatile hydrocarbons being released, while higher temperatures favor the formation of more carbon dioxide and other products.

Coal gasification is a complex heterogeneous physicochemical process that occurs at high temperatures, with the main element being the interaction between the solid phase (coal) and the gas phase, achieved through blowing (air, air-oxygen, steam-air, steam-oxygen, etc.).

The course of the chemical process of underground coal gasification is influenced by the grade of coal, its moisture and ash content, the composition of the blowing agent, the thermal mode of gasification, the pressure in the gas generator, mining-geological and hydrogeological conditions, and the hardware design of the technological system.

The interaction of fuel carbon with blowing (oxygen and steam) during coal gasification can be described by several primary reactions [5]. Below are some of the key reactions that can occur during coal gasification:

C → CnHm – This reaction determines the formation of hydrocarbons from the dehydration of coal.

C + O2 → CO2 – Oxidation of coal when interacting with oxygen leads to the formation of carbon dioxide.

C + 2H2 → CH4 – Hydrogenation of coal, where hydrogen reacts with coal, forming methane.

C + CO2 → 2CO – Coal can react with carbon dioxide, forming carbon monoxide.

C + H2O → CO + H2 – The formation of hydrogen due to the interaction of coal with steam.

These reactions can depend on numerous factors such as temperature, pressure, coal moisture content, blowdown content, and other gasification conditions. Also, it is important to consider that in real conditions, a complex set of reactions can occur, and reactions can compete with each other.

It has been experimentally proven that depending on the temperature, hydrodynamic conditions, and partial pressures of individual components of the gas phase (blowing), the ratio of carbon oxides (CO and CO2) in the resulting gas varies widely. Scientific studies have established that during the gasification of high-ash coal seams with the use of water vapor as a blow, gas with a higher CO2 content is obtained than during the gasification of low-ash seams. High-ash coal may contain more mineral impurities such as silicon, aluminum, and other elements. During gasification, these mineral impurities can also interact with oxygen and water vapor, contributing to increased carbon dioxide concentrations.

The study of sorption processes during coal gasification has great potential for the development and optimization of gasification technologies. These areas of research can help improve the quality and efficiency of coal gasification, as well as reduce the negative environmental impact of this process on the environment.

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**References**

1. Blinderman, M. S., & Klimenko, A. Y. (2018). Introduction to underground coal gasification and combustion. *Underground Coal Gasification and Combustion*, 1-8. <https://doi.org/10.1016/b978-0-08-100313-8.00001-3>

2. Saik, P., & Berdnyk, M. (2022). Mathematical model and methods for solving heat-transfer problem during underground coal gasification. *Mining of Mineral Deposits*, 16(2), 87-94. <https://doi.org/10.33271/mining16.02.087>

3. Dvornikova, E. V. (2018). Environmental performance of underground coal gasification. *Underground Coal Gasification and Combustion*, 363-399. <https://doi.org/10.1016/b978-0-08-100313-8.00031-1>

4. Lozynskyi, V. (2023). Critical review of methods for intensifying the gas generation process in the reaction channel during underground coal gasification (UCG). *Mining of Mineral Deposits*, 17(3), 67-85. <https://doi.org/10.33271/mining17.03.067>

5. Huang, W., Wang, Z., Duan, T., & Xin, L. (2021). Effect of oxygen and steam on gasification and power generation in industrial tests of underground coal gasification. Fuel, 289, 119855. <https://doi.org/10.1016/j.fuel.2020.119855>

6. Some aspects of technological processes control of an in-situ gasifier during coal seam gasification. (2014). Progressive Technologies of Coal, Coalbed Methane, and Ores Mining, 121–124. <https://doi.org/10.1201/b17547-20>