Hard coal, known as a source energy considered in the energetic and ecological policy of the EU is at the same time one of the most widespread sorbent on the Earth. Potential possibilities of placing CO_2 in the off-balance coal seams with simultaneous recovery of CH_4 is one of the methods whose realisation allows for temporary solution of the problem of the CO_2 emission into the atmosphere and fits in the assumptions of the climate and energy package. In spite of the fact that the utilitarian concept appeared many years ago, the amount of research concerning the analysis of the physics of CO_2/CH_4 exchange sorption in coal under confining pressure (corresponding with natural conditions) is sparse.

The phenomenon of the CO_2/CH_4 competitive sorption in coal in a free state in the context of mutual relations between its sorption capacities toward the analysed gases has been identified and described. There are papers concerning the analysis of the sorption properties of coal under confining pressure taking into the account the effects of sorption swelling. Considerably fewer papers discusses exchange sorption in coal material in a geometry allowing for simultaneous analysis of the process both in time and space. What is lacking though is papers describing exchange or competitive sorption under confining pressure. In the light of the current state of knowledge of this area, the proposition to analyse the mechanism of exchange sorption under confining pressure taking into account the time and space factor is extremely interesting and undoubtedly unique. Considering the above needs and gaps in the research, the proposed unique analysis are the objective of the project of the authors of the application.

The project will involve the analysis of intertwining phenomena of sorption and transportation of gas molecules simultaneously with the investigation of the influence of confining pressure, sorption swelling and CH_4 displacement by CO_2 on them. The sorption preference of coal towards CO_2 is much higher than towards CH_4. The sorption processes are accompanied by swelling and desorption processes are accompanied by shrinking. Confining pressure affects the pore structure. It limits it and at the same time prevents swelling. During the CO_2/CH_4 exchange sorption in coal under confining pressure the affinity of coal towards CO_2 results in sorption swelling of coal. Swelling is prevented by confining pressure. In addition, the process of CO_2/CH_4 exchange sorption can lead to structural changes of the pore space of coal resulting from the penetration by CO_2. Due to the large number of mutually competitive physical phenomena, the relation: exchange sorption, sorption swelling of coal, confining pressure, the effects of the proposed research are extremely interesting and are the reason why the authors undertook this research subject.

The main research goal is quantitative and qualitative assessment of the influence of confining pressure on the parameters of the coal-gas system. The analysis of the course of the exchange sorption processes, sweep efficiency, the kinetics of the movement of the exchange zone under conditions of confining pressure particularly pose a challenge from the analytical point of view. An additional, extremely interesting phenomenon is swelling caused by sorption processed in coal. Moreover, the observation of the topography of the surfaces of the coal samples will make it possible to determine the course of changes within its structure which took place as a result of CO_2 sorption and confining pressure.

The analyses of the CO_2/CH_4 exchange sorption in coal under confining pressure proposed in the project will be carried out on original equipment, built for that purpose within the project. The device will provide isobaric and isothermal conditions during the measurements of exchange sorption and a possibility to record all the parameters necessary for the analysis of the results. The sample will be a cylindrical coal briquette of considerable length. Before and after the analyses of exchange sorption, the coal material will be subjected to petrographic and structural analyses in order to specify the parameters which may have changed during the sorption measurements under confining pressure. The petrographic analyses will be made by the use of scanning electron microscopy, and the structural analyses by the mercury porosimetry, low-pressure gas adsorption and helium pycnometry.

The mutual influence of particular phenomena observed during the studies of the mechanism of the exchange sorption of the coal material under confining pressure that take into account the time and space factor is an extremely interesting research area. The results of the project will be a very interesting study of the phenomenon and they will also be a missing link in the comprehensive identification of the coal gas system.