“Multiphase analysis of the gasification process of biomass wastes and RDF under solid catalysts based on transition metals and alkaline earth metals.”

Decreasing amount of fossil fuels, regulations introduced by the European Union, Poland's energy policy regarding the reduction of the share of energy produced from fossil fuels, reduction of CO_2 emissions and aspects related to environmental protection, have been leading to explore and search the for alternative energy sources.

The gasification process is one of the types of thermochemical processing of solid fuels into gaseous fuel. This process takes place at a high temperature (700-1300 °C), in an atmosphere of air, steam, carbon dioxide or mixtures thereof. During the gasification process, organic matter decomposes to give the following types of products: synthesis gas, liquid oils and a solid residue. In order to increase the efficiency of the gasification process, a catalyst is introduced, whose main role is to reduce the CO_2 content in the synthesis gas and the amount of liquid phase formed. Catalytic gasification leads to increased synthesis gas production. The synthesis gas obtained from solid renewable fuels (e.g. biomass wastes and RDF - solid waste fuel) allows to obtain a clean energy carrier with the simultaneous utilization of waste in accordance with the waste management hierarchy described in the EU Directive 2008/98 / EC (WFD2008).

The main goal of the project is to conduct research on the gasification process of solid renewable fuels, taking into account the impact of the following process parameters, i.e. temperature, gasification agent and the presence of catalysts. As part of the project implementation, it is planned to perform research on gasification processes for various types of biomass wastes (straw, hay, wood waste, digestate) and RDF. Biomass wastes are an easily available energy carrier, however, it is characterized by a high moisture content, volatile matter and low energy density. RDF is an alternative fuel obtained from municipal waste, which contains a relatively high content of carbon (approx. 50%) and hydrogen (approx. 7%). Therefore, biomass wastes and RDF can be an adequate substrate for the gasification process to obtain synthesis gas. During the research on the gasification process of biomass wastes and RDF, the impact of the addition of various catalysts on the formation and composition of synthesis gas will be determined. The following types of catalysts will be implemented for testing: $MgO{\cdot}CaO$, TiO_2, CuO and SrO. These are catalysts based on transition metals (TiO_2, CuO) and alkaline earth metals ($MgO{\cdot}CaO$, SrO). Based on the tests performed for various gasification temperatures, various gasifying agents and the presence of catalysts, a detailed analysis of the physical and chemical properties of the obtained gaseous, liquid and solid process products will be performed. For this purpose, tests will be performed using modern instrumental methods, i.e. thermogravimetry, scanning electron microscopy, X-ray diffraction and X-ray fluorescence spectrometry. Obtained test results will enable to assess impact of the catalyst addition on increase of hydrogen content and reduction CO_2 content in synthesis gas.

The comprehensive research planned in the project will allow expanding knowledge in the field of catalytic gasification of biomass wastes and RDF using catalysts based on transition metals and alkaline earth metals. The results will be used to develop an empirical model of the process as well as provide a source of data for carrying out numerical calculations. As part of the project, it is expected to promote knowledge in this field by preparing scientific publications and participating in international conferences.