Abstract for general public

Poland belongs to a group of countries with good accessibility to agricultural biomass which every year leads to an overproduction of straw. That is why this kind of biomass waste could be used in the energy sector. The conversion of biomass to energy is recommended according to the EU's energy and climate policy. It should be emphasised that biomass can bring significant benefits for sustainable development and energy security. Unfortunately, biomass requires the use of advanced technological methods for conversion. Biomass is characterised by its chemical diversity, a high amount of moisture and volatile matter, and it is also biodegradable. Municipal solid waste (MSW) has a similar energy potential to biomass. However, the greatest part of MSW is stored in landfill areas. This is a major problem from an environmental point of view. According to this situation it is necessary to investigate methods into reducing MSW simultaneously taking into account its energy potential. These actions fit with the "Circular Economy - waste minimization and maximum utilisation" agreement which prioritises recycling and thermal conversion of waste, e.g. the process of pyrolysis.

The role of researchers is to focus on an investigation concerning development of efficiency and safety methods leading to a reduction in waste. Pyrolysis belongs to the most perspective thermal method of biomass and MSW conversion processes. Three kinds of products are obtained during the pyrolysis: solid (char), liquid (bio-oil) and gas. They are characterised by their enhanced energy properties compared to raw materials.

The main aim of this project is to broaden knowledge of the co-pyrolysis of biomass and municipal solid waste. The aim is to conduct experiments in fast co-pyrolysis by using a drop tube furnace (DTF). Fast pyrolysis leads to a high content of bio-oil (Fig. 1). The following parameters will be studied: blending ratio of biomass to MSW and process atmosphere. Significant investigation will include a detailed analysis of the physical and chemical parameters of all obtained products. Also, the addition of chlorine as an influence will be examined to detect its amount in products. Moreover, the project will assume the use of catalysts to purify the bio-oil. Ni/CO and ZSM 5-zeolite catalysts, which are dedicated to this process, will be involved.

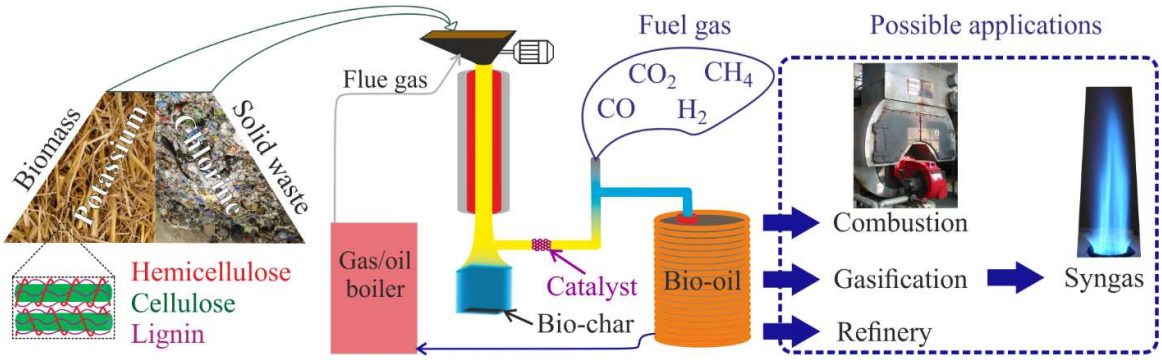

Fig. 1. Concept of the project.

The numerical and thermodynamic calculations will represent the crucial part of the project. It is expected to obtain detailed characteristics of condensed and gaseous products using thermodynamic computation. Numerical calculation will be completed based on the obtained experimental data. The kinetic parameters will be determined and then implemented for numerical modelling development using the Euler – Euler multi-phase model. Multiparameter analysis will be used to indicate chlorine mass fraction in pyrolysis products.

The results of the project based on experimental and numerical investigation will bring new knowledge to the field of renewable solid fuels. In the future, these results could help to develop new technologies involving co-pyrolysis of various types of waste with energy potential. This project will be realized at AGH University of Science and Technology in Cracow. The multidisciplinary research team consists of researchers working in the following areas: chemistry, material science, power engineering and fuel engineering.