The abstract of the doctoral thesis

Weronika Gracz M.Sc. eng.

"**Emission of combustion gases and energy efficiency of a multi-fuel cogeneration unit in biogas plants of up to 40 kW**"

The development of micro-installations for the production of energy from renewable sources and the will to them are the reason for searching new, more effective and ecological solutions. In recent years, there have been more and more studies in co-combustion of liquid and gas fuels in self-ignition engines. Diesel engines emit harmful and greenhouse gases into the atmosphere, such as: carbon oxides (CO, CO_2), nitrogen oxides (NO_x), hydrocarbons (HC) and particulate matter (PM). However, compared to spark-ignition engines, these engines have higher efficiency, i.e. lower unit fuel consumption, moreover they are characterized by higher durability and lower CO_2 emission. In micro-installations of renewable energy sources by means of internal combustion engines with spark ignition, electricity from biogas is generated. The efficiency of these systems is limited thermodynamically, so it may be justifiable to replace the spark ignition engine with the self-ignition engine.

The use of a diesel engine in a biogas plant is an innovative activity. Therefore, the aim was to analyze the impact of a multi-fuel cogeneration unit for agricultural biogas plants with a capacity of up to 40 kW on air quality and energy efficiency of the engine.

Two liquid fuels were used for the tests: diesel (ON) and rapeseed oil methyl esters (RME) and three gas fuels: LPG, CNG and biogas. For each of the six fuel mixtures, the emission levels of such harmful gases as CO, NO, NO_2 and PM were measured as well as the determined general efficiency of the cogeneration unit. The tests were carried out on an experimental stand consisting of a diesel engine, an asynchronous motor and a control and measurement system.

On the basis of the research, the hypothesis of the positive impact adding of gaseous fuel to liquid fuel on CO and NO_2 emission has been rejected, i.e. the introduction of gaseous fuels into liquid fuels increases CO and NO_2 emissions. At the same time the hypothesis of the positive impact adding of gaseous fuel to liquid fuel on NO and PM emission has been confirmed, i.e. the introduction of gaseous fuels into liquid fuels results in the reduction of NO and PM emissions in the conditions of the experiment.

On the basis of the research, the hypothesis of the importance of the impact of co-combustion of gaseous fuels with liquid fuels on the overall efficiency of the cogeneration system has been confirmed, i.e. the introduction of gaseous fuels: LPG, CNG and biogas into liquid fuels reduces the efficiency of the cogeneration system in the conditions of the experimental study.