

SUMMARY

Wood pellets are classified as solid biomass. They are one of the most popular fuels in Europe for green heating, especially in the small heating sector, they are burned in low-power domestic boilers. The popularity of pellets and automatic heating devices enabling the combustion of this fuel has increased due to the growing problem of atmospheric air pollution (smog). Compressed wood biomass in the form of pellets or briquettes eliminates the adverse effects of weather conditions associated with improper storage of biomass. For the production of pellets, hardwood and coniferous wood is used, with coniferous wood usually representing 70% of the raw material used.

Increasing attention is being paid when choosing heating technology in construction for the share of RES energy in total primary energy consumption and the impact of building on climate change (reducing greenhouse gas emissions), giving up fossil fuels (coal, natural gas, petroleum products) to renewable energy sources: solar, biomass, geothermal and aerothermal energy. This is the direction currently being taken in the European Union by the so-called European Green Deal, withdrawing from fossil fuels at a faster rate than expected, which will help reduce greenhouse gas emissions and air pollution. The vast majority of EU countries have a problem replacing natural gas and heating oil in households and the service sector with climate-neutral technology. Climate neutrality in the non-system (individual) district heating sector currently only provides boilers for biogenic fuels in the form of solid biomass, heat pumps provided that they are supplied with electricity from RES and auxiliary solar collectors mainly for the production of domestic hot water. In the future, probably after 2040, as evidenced by forecasts of global development trends, the energy carrier used to heat buildings in highly developed countries will mainly be electricity and hydrogen (Fuel Cells and Hydrogen Joint Undertaking, 2019; Renewable Energy Agency, 2018).

The purpose of this dissertation is to design the composition of the mixture for the production of wood pellets used in modern low-power boilers up to 500 kW with low-carbon fuel characteristics, which will be used in the non-system heating sector, mainly single- and multi-family households. A work-based analysis of the results of the raw material composition studies of substances contained in individual woody biomass mixtures for the production of wood granules will be helpful in decision-making processes in the selection of additives acceptable by the standard. Particular emphasis was placed on the analysis of the quality of the

wood pellet mixtures tested, in which the permitted admixtures determined the quality parameters such as calorific value, mechanical strength and elemental composition of the ash.

The reduction of gaseous pollutant emissions in fixed biogenic fuel equipment and the improvement of the energy efficiency of these appliances have long led to central heating boilers up to 500 kW being recognised as environmentally friendly resin appliances in the European Union and many other countries such as the USA, Canada, Australia and New Zealand and Japan (Bioenergy Australia). , 2020; Dutch & Gordon, 2019; EHS, 2019; Japan WPA, 2020). EU and EU climate Polish sets the course for the development of RES, while at the same time reducing greenhouse gas emissions (mainly CO₂) also in the agricultural and household sectors. The fuel that can replace coal in Poland in the non-system heating sector, i.e. local heating plants and individual central heating installations in houses, is wood pellets. It is important to maintain high quality parameters of such fuel.

The results of analyses carried out during the implementation doctorate at the Faculty of Natural Sciences of the University of Silesia under the direction of Dr. Iwona Jelonek have shown that the correct selection of ingredients for the preparation of the mixture and its granulation allows to obtain a high-energy fuel, the combustion of which in a class 5 boiler with ecodesign will effectively reduce the emission of air pollutants from dust, sulphur oxides, nitrogen, coal and PVA. The guidelines for designing an energy-efficient mixture of wood pellets have been obtained through industrial research carried out as part of this dissertation. The test bench located in zamech's Solid Fuel Combustion Laboratory allowed for long-term testing of the combustion of variable composition wood pellet mixtures with the possibility of measuring exhaust emissions, dust, ash collection in accordance with the guidelines of standard PN-EN 303-5:2012.

The research was carried out on selected samples of pellets obtained on the market and prepared to order in the Laboratory of Biofuel Production and Quality Assessment technology at the University of Agriculture in Krakow. The designed pellet mixtures are made of coniferous sawdust and a one-component additive in the form of flour or bran. The aim was to prove that clean fuel without unnecessary ballast allows for better efficiency and is a source of the lowest possible pollution. For this purpose, a series of tests were carried out on designed samples of coniferous sawdust with the addition of flour, followed by wheat bran, thereby forming samples for laboratory tests and subsequent industrial testing. The addition of flour and bran used in the production of pellets is intended to reduce friction during the granulation process. This has a significant impact on energy consumption costs during pellet production. The content of these

components affects the quality of the fuel, primarily the ash content and the reduction of mechanical strength.

Keywords:

combustion, biomass, renewable energy sources, 5th class boilers, ecodesign certified.