



Politechnika
Śląska

POLITECHNIKA ŚLĄSKA
Wydział Inżynierii Środowiska i Energetyki
Katedra Maszyn i Urządzeń Energetycznych



Badania wybranych właściwości paliw w celu wypełnienia założeń gospodarki obiegu zamkniętego

Dyscyplina
Inżynieria środowiska, górnictwo i energetyka

Praca doktorska
Mgr inż. Joanna WNOROWSKA

Promotor
Dr hab. inż. Sylwester KALISZ, prof. PŚ

Gliwice, 2022

SUMMARY

This doctoral dissertation deals with the subject of determining selected properties of solid fuels to fulfill the assumptions of the Circular Economy (CE). The first part of the work discusses the principles of CE in terms of fuel preparation and combustion by-products. Operational problems during the combustion of low-quality solid fuels have been pointed out. Possibilities of pellet production and important parameters influencing the quality of end products of the pelletization process are described. Additionally, the subject of thermogravimetric analysis of solid fuels was taken up and the corrosion processes of heating surfaces of furnace chambers were discussed. The role of a circular economy for waste from end-of-life vehicles was also focused on. Moreover, during the theoretical analysis of the above-mentioned issues, attention was paid to the role of fuel additives.

In the experimental part of the work, several tests were carried out to assess the effect of aluminosilicate fuel additives (halloysite and kaolinite) on the properties of low-quality solid fuels. First, the internal structure of pellets with additive (halloysite) and the influence of moisture content before the pelletization process on the final product was investigated. Then, the kinetic parameters of thermal decomposition of various types of biomasses were determined using thermogravimetric analysis. The influence of the heating rate and the addition of halloysite on the thermal decomposition of biomass was determined. Another topic taken up in the work was to determine the effect of aluminosilicate fuel additives (halloysite and kaolinite) on the decomposition of KCl. Sample analysis was performed in three steps. Thermogravimetric analysis, tests using a laboratory furnace, and SEM-EDS microscopic analysis of samples, as well as tests on a semi-technical scale test stand using the Pulverized Fuel-Fired Vertical Combustion Chamber (PFC) were performed. Additionally, a study was conducted to determine the effect of aluminosilicate fuel additives (halloysite and kaolinite) on the retention of heavy metals during thermal conversion of Automotive Shredder Residue (ASR). Finally, an analysis of the leachability of heavy metals from combustion by-products formed during thermal conversion of ASR was performed.

Based on the conducted research, the rightness of the use of aluminosilicate fuel additives in order to eliminate operational and environmental problems during thermal conversion of low-quality solid fuels was determined. In addition, the possibility of using low-quality fuels modified with aluminosilicate additives in order to meet the assumptions of the Circular Economy was confirmed.