The influence of aluminosilicate additives on high-temperature corrosion and ash properties of animal-origin biomass

Animal-origin biomass as a renewable energy source is gaining more and more interest among its potential users in the world. This is mainly solid waste such as manure and bedding, which is produced in large amounts during the animals' breeding. The safe and effective management of animal-origin waste becomes a problem in the modern world. One of the prospective methods is thermal conversion, such as combustion and co-combustion. However, the fuel properties of animal biomass differ significantly from conventional fuels or even plant-origin biomass, which makes it unattractive to potential recipients. The main factors determining its usefulness in the power sector are combustion-related issues, such as chlorine corrosion, slagging and ash deposition. These problems are directly related to the chemical composition of the ash. The most important are the ash fusion temperatures (AFT), chlorine content and the presence of alkaline compounds, mainly sodium and potassium.

Preventing these problems is a key issue for the use of animal-origin biomass in the power sector. The use of aluminosilicate fuel additives such as kaolin, halloysite and bentonite seems to be an efficient and cost-effective solution. They are naturally occurring sedimental rocks with excellent sorption properties. Finely ground, they have the ability to adsorb contaminants in their micropores. They are used for water and wastewater purification, chemical spills neutralization, and in the medical and food industries.

The addition of aluminosilicates increases the ash fusion temperatures by bonding sodium and potassium mainly in the form of chlorides with higher melting points. In practical terms, the aluminosilicates reduce the amount of KCl and NaCl present in the ash deposits, hence the rate of high-temperature corrosion is expected to decrease. Moreover, those additives are expected to reduce ash deposition, slagging and fouling of boiler heating surfaces as well as deteriorate the agglomeration processes in fluidized beds.
Due to the extensive specific surface area, they also have the ability to adsorb alkali metals on their surface. Their effectiveness has been confirmed in many studies with plant-origin biomass and coal.

The scientific aim of presented project is to evaluate the influence of aluminosilicate additives on the ash properties and corrosion process for two types of animal biomass: poultry litter and cow dung. Scanning electron microscopy (SEM) with an EDS spectrometer will be used to determine the composition of corrosion products and their distribution on the surface of the tested samples. Long-term corrosion tests will be performed to determine the corrosion kinetics. Factors such as temperature, biomass type, steel grade and the influence of aluminosilicate additives will be investigated. Moreover, ash properties such as particle size distribution, metals and metalloids concentration and heavy metals leachability will be under investigation.

Majority of the studies on the corrosion process and aluminosilicate additives concern plant-origin biomass. A very limited data concerning animal-origin biomass can be found. Therefore an innovative research topic is presented in this project. The results will allow a better understanding of the corrosion process and recognition of the influence of aluminosilicates on animal-origin thermal conversion. Progress in this area may contribute to increasing the share of biomass in the Polish energy sector.