

## **Description for the general public**

As one of the alternative fuels to coal, biomass has almost zero CO<sub>2</sub> emission balance. At present in Europe, the share of biomass in renewable energy sources is significant (approx. 50%), although recently in some countries the burning of biomass is also the subject to environmental restrictions. Recent studies have shown that combustion of biomass emits significant amounts of dust and organic compounds into the air. In Poland, biomass is mostly burned in low-power boilers used to heat single-family houses or in small boiler houses without any dust removal devices. Its share is significant, especially out of the normal heating season, especially in tourist and holiday areas, where the wood is much more easily available than coal. Together with fly ash emitted to the atmosphere during the combustion of coal, many harmful chemical substances are released into the environment. One of them are potentially toxic metals and metalloids, which are transported mostly by technogenic magnetic particles (TMPs - mainly iron oxides) formed during combustion. Due to the magnetic properties of TMPs, their presence in the environment can be easily detected by simple measurements of magnetic parameters. In coal, iron occurs in mineral forms (mainly sulfides) with paramagnetic properties, and during combustion Fe is transformed into oxide forms, mainly with ferrimagnetic properties, therefore the ash after coal combustion is "magnetically enriched" in relation to the initial fuel. Biomass consists mainly of organic matter with diamagnetic properties, and iron contained in plants is mainly in the form of organic compounds (e.g. metal-organic complexes, phytoferritin, chelates) and the expected iron oxide content in the ash should be much lower. However, preliminary measurements of the magnetic susceptibility of the fly ash after the combustion of several types of biomass have shown, that the magnetic properties of the ash were surprisingly high and very differentiated, depending on the type of biomass burned. There is a high probability that also other magnetic parameters will be varied and therefore they will be characteristic for individual types of biomass and can be used as indicators of the type of biomass burned, determined in ash samples. The second aspect of the research will be to determine to what extent the biomass growth environment, (i.e. geological background, soil type and the level of soil pollution, level of atmospheric deposition during plant growth), will affect the content of trace elements and magnetic particles in bottom and fly ash after biomass burning. This is particularly important as in many places biomass is obtained from areas excluded from food production due to high level of soil contamination, or even old mining and metallurgical dumps are used for biomass production. Thus, the question arises as to how the environmental conditions and the level of pollution affect the magnetic and chemical properties of both fine fly ash particles emitted to the atmosphere and bottom ash increasingly used for soil fertilization.

The aim of the study is to compare bottom ashes and fly ashes after combustion of 6 selected types of biomass and to determine chemical substances and magnetic parameters that may be characteristic indicators of individual types of biomass burning. The second goal will be to determine the influence of the geochemical and geological background and other environmental factors (e.g. air pollution, soil type, soil contamination) on the ecological quality of the biomass and content of potentially toxic elements (PTEs) in bottom ashes and fly ashes.

The research will be carried out on samples of 6 different types of biomass in the form of pellets available on the market, as well as samples of wood biomass obtained from four different locations: forested old metallurgical and mining dumps, on areas of natural magnetic anomaly developed on the rich in magnetite natural igneous or metamorphic rocks, highly polluted areas developed on sandy soils and in "ecologically clean" areas with low deposition level and diamagnetic geological background. Burning of biomass will be carried out in a low-power boiler adapted to biomass combustion, often used in home heating installations, which is equipped with analyzers and control sensors allowing for monitoring and control of combustion conditions. Samples of fly ash (collected on filters) and bottom ash (collected from the grate) will be analyzed in three laboratories: magnetic, geochemical and mineralogical, in order to fully characterize the tested ash and determine the parameters (both magnetic and geochemical) that can be used as environmental indicators of the type of biomass burned. An innovative aspect of the research is the concept of combining magnetic and chemical parameters as potential indicators determining the type of biomass burned and determining the statistical significance of the impact of environmental conditions of biomass growth on its ecological quality, both in terms of hazardous element emission and the potential use of ash as fertilizers.