Decomposition is one of the key processes conditioning the matter cycling in the ecosystem. The dynamics of this process is particularly important in post-mining areas lacking well-developed soil. They are characterized by a low content of nitrogen and organic carbon, undeveloped structure, low sorption and water capacity, and susceptibility to erosion. As a result of decomposition, minerals and organic carbon in the form of humic compounds are released into the soil. The importance of the latter cannot be overestimated, as it plays a key role in shaping the physical, chemical and biological properties of the soil. Post-mining areas devoid of soil, with a diversified geological structure, forested with various tree species, are an excellent experimental object. This system makes it possible to test research hypotheses regarding the influence of tree species on the restoration of the forest ecosystem under various abiotic conditions. Knowledge of the factors determining the decomposition rate, biomass production and its accumulation is important when planning post-mining reclamation methods.

Numerous studies indicate that a soil substrate rich in nitrogen promotes a rapid decomposition rate, but little is known about how abiotic soil properties, such as particle size composition, affect the decomposition rate. Tree species that symbiotically fix nitrogen produce large amounts of easily degradable litter and therefore contribute to the accumulation of organic carbon in the soil. In turn, coniferous species favor soil acidification and the accumulation of a thick layer of hardly decomposing litter on the soil surface. Recent research shows that trees are able to survive and shape habitat conditions in a wide range of abiotic conditions. However, it is not clear how the habitat conditions affect the production, decomposition and accumulation of organic matter in the forest ecosystem in habitats degraded by mining activities. The soil texture determines numerous properties important for the decomposition process: humidity, nutrient abundance, pH, the composition of the biota of microorganisms, as well as the diversity and abundance of soil fauna. Temperature is important for the decomposition process; in the warm season, decomposition is faster, as long as there is no water deficit, which may slow down the decomposition rate.

The aim of the proposed research is to identify the impact of habitat conditions and the season of the year on the decomposition rate. We make hypotheses: decomposition (a) it will be fastest in stands where the litter biomass is the lowest, (b) it will be slower in poor habitats, on sandy grounds, (c) it will be faster in summer than in winter, and we also assume that (d) the decomposition rate of cellulose paper will be more related to the habitat conditions than the rate of decomposition of the plant material tea, and that (e) soils where bacteria predominate will have a faster rate of degradation than those where fungi predominate.

As decomposition substrates, I plan to use the standard green and red tea and cellulose paper used in decomposition studies. While the influence of the stand identity on the decomposition rate is well known, little is known about the role of abiotic soil conditions. For the research, I plan to select the stands of pioneering species most frequently used in reclamation: silver birch and Scots pine, as well as species that symbiotically fix atmospheric nitrogen: black alder and black locust. Each of the stands will be selected in two habitat variants, poor, on sandy soil, and fertile, on clay soil. In total, I plan to select 24 plots (4 tree species × 2 habitat variants × 3 repetitions) located on the external dump of the Brown Coal Mine in Bełchatów (Góra Kamieńska). I plan to put out the litter bags in the summer and at the beginning of winter in 3 pseudo-replications, I plan to collect the bags three times: after 2, 4 and 6 months after placing them. In total, I plan to put out 1,296 litter bags. In order to determine the rate of carbon accumulation, I plan to perform an analysis of the content and quality of organic carbon present in the soil, determine the mass of leaf fall and tree needles using litter catchers and the mass of litter accumulated on the soil surface by means of a collection of four plots of 0.5 m^2 each. In order to determine the biomass and the composition of soil microorganisms, I plan to perform a PLFA analysis.