

Intensively developing industry, construction and transport all contribute to air pollution. The main and most dangerous pollutant is particulate matter (PM). This microscopic pollutants consists of particles with aerodynamic diameters within the range of 0.001–100  $\mu\text{m}$  and can be suspended in the air for weeks. Industrial and urban areas, as well as areas with high traffic, are recognized as having the highest levels of PM contamination. Moreover PM is global problem, because it can be transported by wind for long distances from its sources.

PM is formed by both natural processes (volcanic activity, forest fires, geochemical processes, etc.) and human activities. PM of anthropogenic origin is frequently enriched with heavy metals (HM), black carbon (BC), dibenzofurans (PCDF), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Recent studies showed that one of the components of PM can be microplastic particles (MP). It was demonstrated that MP can reach almost one third of the PM in the air in polluted areas and they were found in snow of the Pyrenees, Alps, in the Arctic and even at the peak of Mount Everest.

PM adversely affects people's well-being and health. Even a slight increase in PM concentration in the air increases the number of respiratory and cardiovascular problems. Particles can also be the cause of exacerbation of symptoms of asthma, allergies and increases the risk of heart attack and cancer. Contamination of the atmosphere by PM causes about 2.1 million premature deaths annually around the world, including in Europe as many as 154000. Unfortunately, one of the countries with the most polluted air is Poland. In many cities PM concentration limits are exceeded for most of the year.

When pollutants are already in the atmosphere, one of the ways to purify the air is with the use of phytoremediation technology - a method in which plants act as biological filters. It involves planting in cities and near transport routes of suitable plant species that accumulate harmful PM on their leaves. Trees, shrubs and climbers are best suited for this role due to their large active surface area but another consideration is that PM may also cause damage to plants and interfere with photosynthesis.

The aim of this project is to understand the importance of vegetation planted along communication routes in cities in reducing and accumulating particulate matter, microplastic particles and carcinogenic heavy metals. During the project a variety of plants will be studied and compared. In the first task different species of trees growing around the world in big cities (Warsaw, Krakow, Gdynia, Athens, Oslo, Rome, New Delhi, Beijing, Sydney) will be examined for PM, microplastic and heavy metals accumulation. This type of measurements will be conducted for the first time in such a big scale. In the second task the effectiveness of PM accumulation by various types of sound barriers covered with climbers, herbaceous plants and perennials in comparison to unadorned sound-absorbing barriers will be investigated. The health of these plants will also be compared to those growing in a clean environment, because, suspended PM adversely affects the growth and development and physiological status of many plants. Moreover in the third task the impact of pollution on insects living on sound barriers will be investigated, because, PM also can also poses a threat to these organisms. The last fourth task is entitled "Green lungs of the city..." In this task for the first time an attempt will be made to evaluate air phytoremediation of PM based on both model data and fields measurements of all groups of plants (trees, shrubs, lawns, flower meadows) growing in one of the most recognizable Polish squares in the heart of the capital city of Warsaw and along a string of well-known streets in Warsaw called The Royal Track.

The research proposed in this project will make a significant contribution to the development of phytoremediation technology. This may result in the development of appropriate recommendations for the phytoremediation of air pollution in urban areas and the development of "green tools" for landscape architects and road engineers. Thanks to this, it will be possible to reduce the level of particulate matter, microplastic, heavy metals other pollutants in the air, while maintaining the right balance between the economy and improving the quality of life of urban residents.