1. Abstract for the general public

One of the most significant factors which affect normal function of the whole ecosystem and health of people is air quality. Air pollution is associated with a broad spectrum of acute and chronic illness, such as lung cancer, chronic obstructive pulmonary disease (COPD) and cardiovascular diseases. Long-term exposure to high levels of these particulates has been linked to a rise in morbidity and mortality. In many European countries problems with particulate matter concentration in ambient air, which also contribute to deterioration of air quality were recognized. There are many sources which produce particulate matter pollution and this project will deal with one of the most important group, which includes small combustion appliances for biomass combustion. In order to minimize the production of particulate matter (PM), different filters and separators are added to the boilers, but the installation and operation is costly for the owners and often difficult to maintain. Therefore, solutions are sought that will meet the requirement to reduce the concentration of PM while at the same time being financially least demanding. Such a solution is also a modification of a fireplace construction, which have an effect on the discharged amount of PM, and will increase the efficiency, and lifetime of filters, electrostatic precipitators, etc. The construction can affect both the amount of produced particles (in the combustion chamber) and the concentration of trapped PM (in the flue gas tract-gas path). There is lack of knowledge about the motion of particles flow in the construction of heat sources, and especially in the flue gas tract. The effect of particulate matter size and shape (sphericity) on the trajectory is still not fully understood as well. Knowing the impact of PM shape on the trajectory is important in terms of eliminating them and suggesting possible effective measures. In terms of behaviour it is particularly important the velocity distribution of particles in the fireplaces, which are entrapped by the air supply. The detail analyses of these factors may provide a feasible option for reduction of particulate matter. On the basis of these and other knowledge, it is possible to modify a fireplace so as to decrease the particle discharge into the chimney and to the surrounding environment.
The main objective is to reduce formation of PM during the combustion of biomass. Therefore is expected to understand the motion of particles with different shape, size and density. These parameters mostly influences the trajectories and the gravitational forces acting on the particle can affect the acceleration and hence the overall result. The CFD simulation together with particle image velocimetry (PIV) visualization method can be appropriate solution how to identify the flow of particles in a heat source. The deeper knowledge about the influence of shape and size of PM on the particles trajectories, will contribute to investigate the options of geometrical optimization of a fireplace with the effect on PM reduction. This issue has been poorly studied, and results of research can bring innovative solution how to increase the amount of trapped PM by construction of device with minimal costs, and can be used in addition to filters, separators, etc.
This proposal includes both the transfer of knowledge to the host institution and the training of the candidate in new advanced techniques.