Particle emissions from residential wood and biodiesel combustion

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Akademisk avhandling

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Avhandlingen kommer att försvaras på svenska.

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Abstract
Emissions from anthropogenic combustion sources, such as vehicles and biomass combustion, contribute significantly to ambient particulate matter (PM) both on a local and global scale. Exposure to ambient PM and air pollution in general is linked to a variety of different health effects and it has been estimated that as many as 2.1 million premature deaths each year, due to cardiopulmonary disease and lung cancer, are caused by the changes in anthropogenic air pollution since pre-industrial times. There is today still a lack of information regarding the emissions of different specific particulate emission components, e.g. soot, polycyclic aromatic hydrocarbons (PAHs), oxy-PAHs combined with details about the behaviour of different fuels under varying combustion conditions. The overall objective of this work was to provide new knowledge regarding physical and chemical properties of PM from solid and liquid biofuels, which are important for the viewpoint of human health and atmospheric pollution. This was achieved by experimental studies of the combustion of biomass using a residential wood stove and by introducing biodiesel to an off-road engine, thereby investigating two major emission sources for PM and gaseous emissions.

From the two papers regarding biodiesel included in this thesis, it can be concluded that the introduction of the biodiesel, and potentially other renewable fuels, can in a considerable way change the exhaust particle emissions. This could have implications for the assessment of exhaust from engines running on biodiesel fuels, especially when introducing biodiesel in existing and older engines.

The results from the wood combustion research performed showed some important considerations regarding both specific particle properties and the influences of different burning conditions and fuels. One major finding, based on several of the included studies, was that a proper operation of a wood stove is of major importance to avoid unfavourable burning condition and elevated emissions of soot and organic particles, regardless of the wood species used. Some specific occasions during the burning phases in batch wise wood combustion were also identified as important for the overall emissions. The results from this research has given new specific insights into the emissions from wood stoves and should be of relevance for both technological development of residential appliances, emission testing/certification, information to users and legislation.

Keywords
Combustion, biomass, wood, biodiesel, particulate matter, emissions, aerosols, physicochemical properties, size distribution, PAH