The TOBICUP (TOxicity of BIomass COmbustion generated Ultrafine Particles) project: first results

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The use of wood/biomass burning for domestic heating is increasing in the last years. Such intensive use raises issues on the possible negative effects on human health of particulate matter emitted by this source. Recent studies have evidenced that inhalation of wood smoke effluents can alter pulmonary immune defence mechanisms, and that the macrophages and lung epithelial cells are the main targets for wood smoke-induced immuno-toxicity. Many epidemiological studies of indoor and community exposure to biomass smoke indicate an association with increased risk of respiratory illness and decreased lung functions. Particularly susceptible subpopulations include asthmatics and children, which is consistent with the results of many studies of the impact of ambient air pollution (reviewed in Naeher et al., 2007). Currently, few information on this topic is available, but it is expected that fine and ultrafine particles (UFP, d<100 nm) can be the major responsible for adverse health effects due to their ability to penetrate deeply into the respiratory system.

The TOBICUP (TOxicity of BIomass COmbustion generated Ultrafine Particles) project was designed to gain deeper insight on this topic, joining information obtained both by sampling emissions from wood/pellets stoves and by ambient air sampling. TOBICUP is based on the following steps:

a) sampling and characterisation (number size distribution, metals, ions, elemental/organic carbon, and PAH content) of UFP emissions by wood and pellets stoves commonly used for domestic heating;

b) sampling and characterisation (number size distribution, metals, ions, elemental/organic carbon, and PAH content) of UFP in ambient air at a sampling site heavily impacted by the use of wood/pellets stoves for domestic heating;

c) characterisation of UFP toxicity on cells by in-vitro models using both laboratory-sampled UFP and ambient UFP;

d) characterisation of the molecular mechanism of action of laboratory-sampled UFP and ambient UFP;

e) identification of the physical-chemical parameters most relevant in the impact on health of UFP generated by wood/biomass combustion;

f) identification of possible synergies with UFP produced by other sources.

UFP sampling was carried out using multistage cascade impactors, considering only particles collected on stages with nominal cut-off <100 nm.

The sampling of wood/pellets emissions was carried out at the Energy and Environment Laboratory of Piacenza (LEAP). Commercially available biomass stoves (8 and 11 kW for wood and pellets stoves, respectively) were chosen for the tests and the combustion cycles used were representative of a typical domestic use.

Ambient sampling was carried out at Morbegno (a small town in the low Valtellina Valley, an alpine valley in northern Italy) during winter 2015 and spring/summer 2015. The choice of the two seasons is aimed at comparing ambient UFP effects during periods when wood/biomass burning is an important source (winter) and other periods. About 20 samplings were carried out overall.

In this work, results of the physical-chemical characterisation of particles collected during the winter field campaign will be presented. Moreover, the first data on toxicological effects of such particles will be shown.

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