Household products and indoor air quality: emission, reactivity and by-products in both gaseous and particulate phases

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In western countries, where people spend most of their time in confined areas, indoor air quality is recognized as a public health issue. Among multiple indoor air pollution sources (building materials, furniture, heating) the use of housecleaning products is still poorly characterized.

It is well known that limonene, a good Secondary Organic Aerosols (SOAs) precursor towards ozonolysis (Chen and Hopke, 2010), is widely employed in scented products such as freshener and household cleaners (Nazaroff and Weschler, 2004). Besides, indoor ozone levels can be high enough to initiate gas phase chemistry (Weschler, 2000) and possibly to lead to the formation of indoor secondary products which may be of health concern. Investigations are therefore necessary to characterize the chemical composition of particles and gases formed during housecleaning use and to evaluate real population exposure.

The ADOQ project (Activités DOmestiques et Qualité de l'air intérieur) aims at identifying and quantifying VOCs, SVOCs and particles emitted and/or secondarily formed consequently to the use of housecleaning products. In the frame of this project, emissions of 54 housecleaning products representative of domestic activities have been characterized using an emission test chamber. The housecleaning products displaying the most intense VOCs emission (particularly limonene) have been selected and tested in real indoor conditions inside the experimental house MARIA (Maison Automatisée pour des Recherches Innovantes sur l'Air).

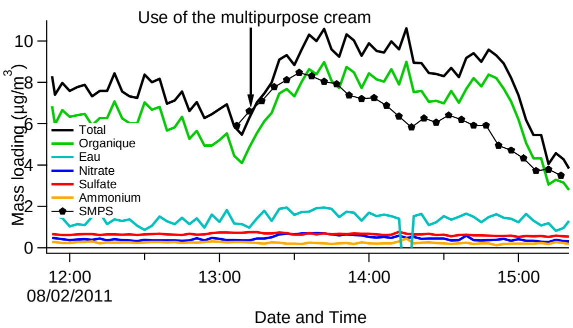

Figure 1. On-line particles mass loading evolution using an AMS and a SMPS and the chemical speciation as a function of time upon application of the surface cleaning cream.

For each housecleaning product physical characterisation of particles (mass, size and number distribution evolution which enabled the observation of nucleation events) has been performed. Chemical speciation of both gas and particulate phases was achieved using TD-GC-MS techniques (Rossignol et al., 2012). Some cleaning products have been extensively studied using an Aerosol Mass Spectrometer Aerodyne, allowing on-line and in-situ analysis of particulate matter below 1μm. Application of a surface cleaning cream, shown in Figure 1, suggests its relevant contribution to the total organic loading of PM_1 (with an increase from 6 to 10 μg/m^3).

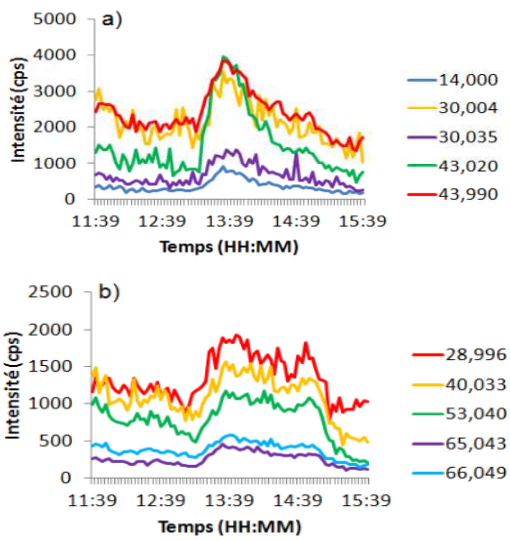

Figure 2. On-line ion fragments associated to (a) "primary-type" time evolution and (b) "secondary-type" time evolution behaviour.

The AMS further indicates different time evolution for the identified ion fragments, as shown in Figure 2.

Finally, comparison between on-line and off-line techniques confirms the importance of secondary aerosol formation when high limonene amount are present.

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