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Fine particles in a residential apartment

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Indoor sources periodically can generate fine particles (particles smaller than 2.5 μm in diameter) that in number and mass concentrations frequently exceed ambient levels, thus there is an increasing interest in fine particles found indoors. Considering also the fact that we tend to spend 65 % of our time in homes, information on particle characteristics found in residential dwellings is of great importance for health effects assessments. The aim of this study was to investigate characteristics of particles found in a residential apartment, identify sources of the particles and estimate their strengths.

Measurements were performed for ten consecutive days in February 2007 in a residential apartment in Malmö city (Sweden). A log book of occupants' activities during the measurement period was created for the identification of particle sources. Measurements were recorded continuously with the following instruments: an aerodynamic particle sizer TSI APS 3321, a scanning mobility particle sizer (SMPS), (consisting of differential mobility analyzer (TSI DMA) and condensation particle counter (TSI CPC 3010)), and two DustTracks (model 8520 TSI Inc.) The two DustTracks were used for approximate mass concentration measurements of particles smaller than 2.5μm ($PM_{2.5}$) to ~0.1 μm, they enabled simultaneous measurement of indoor and outdoor mass concentration.

Identified sources of fine particles consisted of different types of cooking (frying sausages, onions, vegetables, chicken, omelette, pizza in the oven), burning candles, burning incenses, peeling oranges and tangerines, plugging in air freshener. Due to different types of cooking and candle burning in the apartment short term peak mass concentrations (photometer readings) were observed up to 403 μg m^{-3} and peak submicrometer particle number concentration (PNC) up to 183000 particles cm^{-3}, which were about 20 and 26 times higher than the average ambient concentration, respectively. The occupancy time average PNC (only when occupants indoors - representative for personal exposure while indoors) was determined and accounted for 12000 (min 700, max 183000) and the average approximation of $PM_{2.5}$ mass concentration was 36 (min 5, max 403) μg m^{-3}. During active source period particles smaller than 100 nm contributed to 77% of total submicrometer PNC, while during no source period their contribution accounted for 50%. The active source period was characterised by a smaller average number geometric mean diameter 79 nm in comparison to 91 nm during no source time. Estimated total source strengths for cooking events range from 6.3×10^{11} to 1.7×10^{12} particles min^{-1}. The highest contribution is observed from ultrafine particles (<100 nm), their source strengths range from 5.1×10^{11} to 1.1×10^{12} particles min^{-1}, which accounts on average for 84 % of total generated submicron particles.

Mass and number concentrations of particles in residential apartment can vary to a great extent and these variations depend on numerous factors. To state conclusively typical levels of particles in residential homes more data is needed as this study is limited to just one location at a specific time. Although the results suggest that in order to reduce personal exposure to particles from indoor sources, efforts should be made to enhance ventilation at least in locations where indoor particles are generated frequently, namely in the kitchen.

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