Impact of household daily activities on indoor air quality

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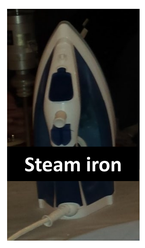
Introduction

In industrialized nations, people spend the majority of their time indoors (Schweizer et al., 2007). As consequence, most of the exposure to environmental pollutants occurs in indoor environments where the indoor concentrations of many pollutants are higher than their outdoor levels (Morawska et al., 2013). Besides penetration of outdoor particles, indoor sources include cigarette smoking, cooking, combustion/thermal related activities, cleaning among others (Géhin et al., 2008; McCormack et al., 2008; Salthammer et al., 2014). Different types of indoor activities release particles with different characteristics. In this study, the impact of four standard vacuum cleaners and two flat irons on indoor particulate matter levels were studied.

Methods

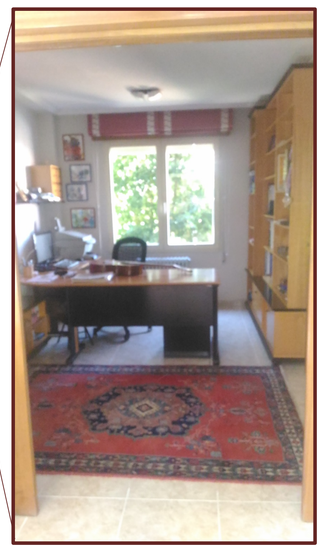
4 Vacuums

2 Flat Irons



Doors and windows kept closed
Situation 1

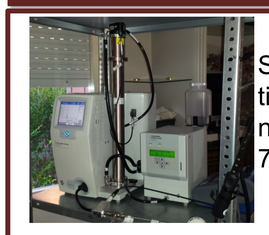
4 Vacuums
2 Irons



Room doors opened and windows kept closed
Situation 2

1 Iron
Flat Iron

Sampling Instruments



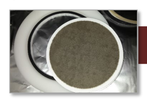
Scanning Mobility Particle Sizer = Real time particle size distributions and number concentrations in the range from 7.64 to 310.6 nm

Laser photometric instrument = Real-time particulate matter concentration

High volume air MCV (model CAV-A/mb) instrument = Gravimetric PM_{10} quantification

Gravimetric Quantification

Quartz Filters



Thermo-optical method: OC and EC

Results

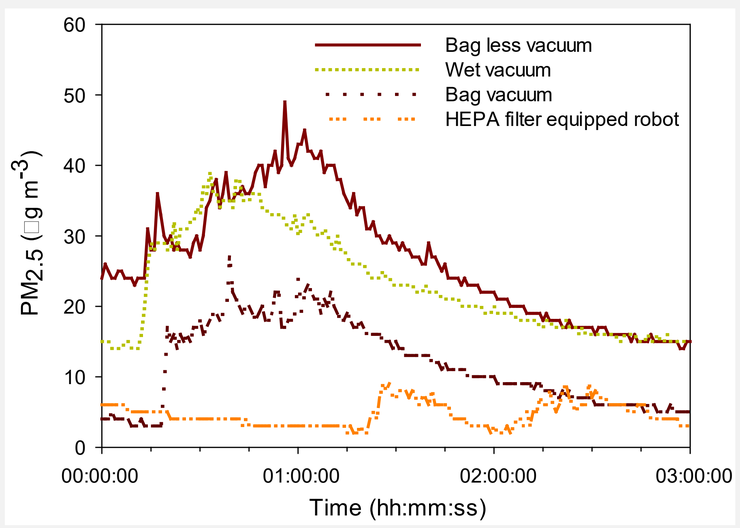


Fig. 1 Typical evolution of the $PM_{2.5}$ mass concentrations during vacuum cleaning.

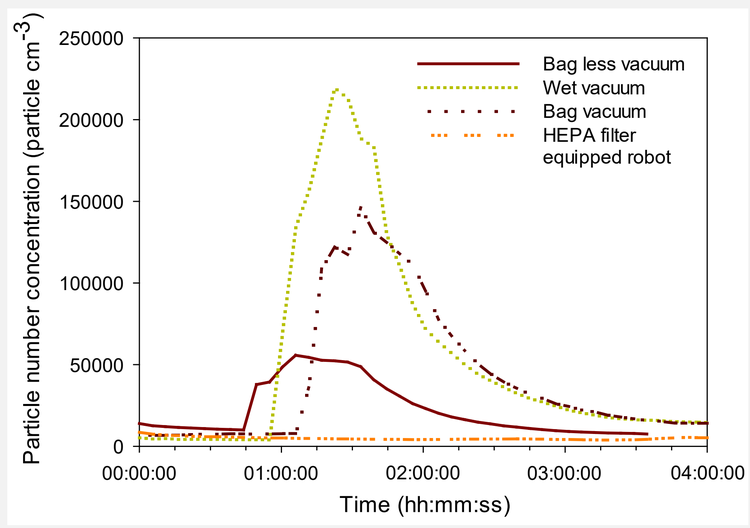


Fig. 3 Typical evolution of the particle number concentrations during vacuum cleaning

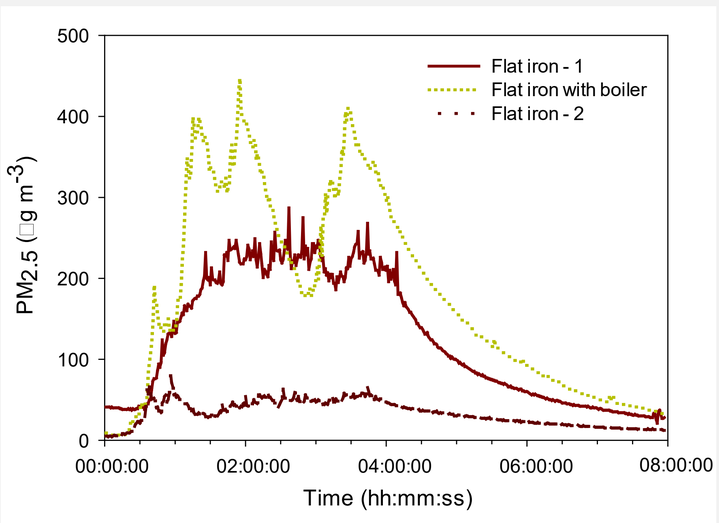


Fig. 2 Typical evolution of the $PM_{2.5}$ mass concentrations during ironing.

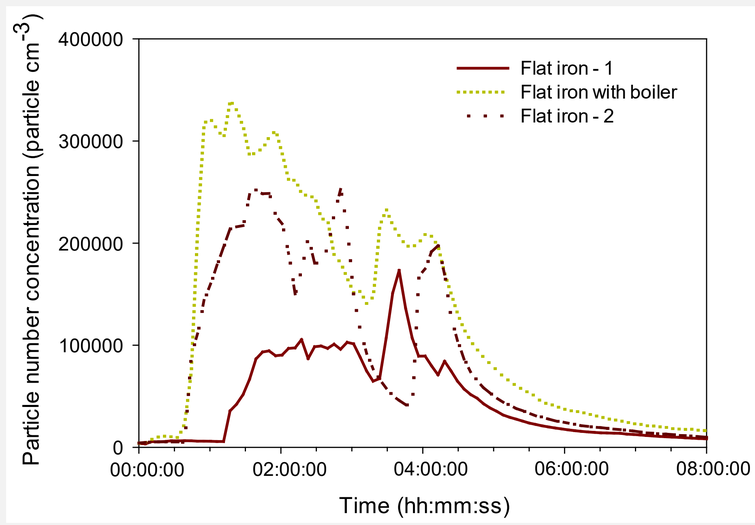


Fig. 4 Typical evolution of the particle number concentrations during ironing.

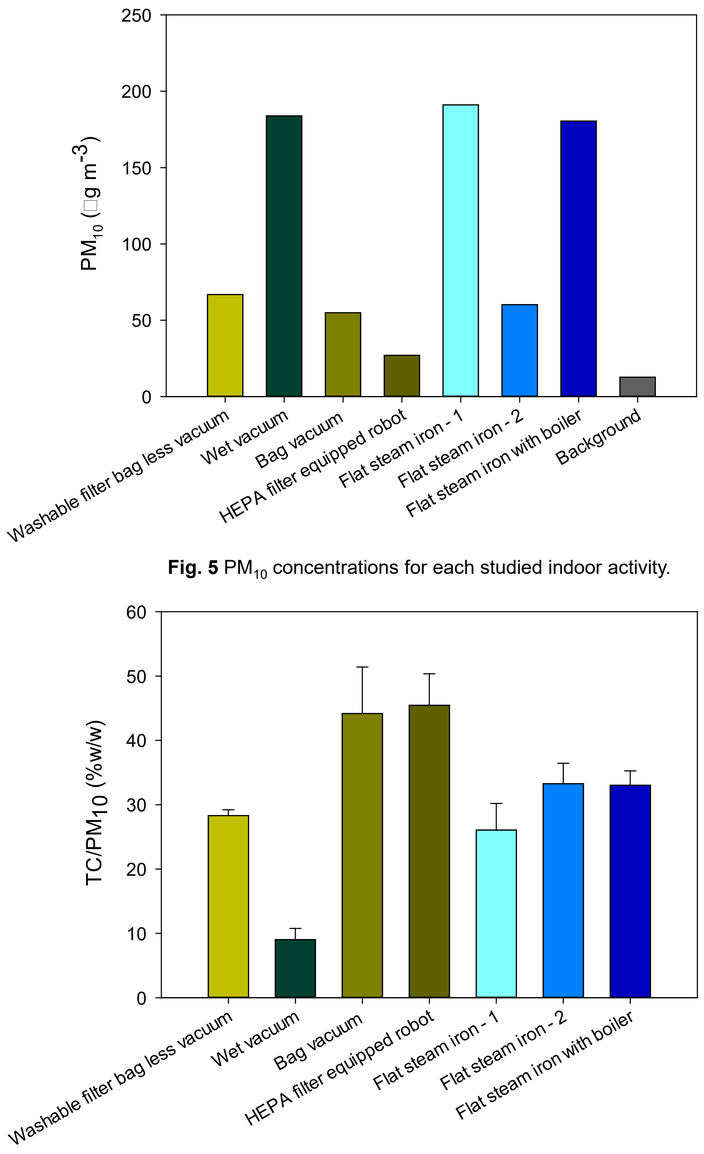


Fig. 5 PM_{10} concentrations for each studied indoor activity.

Fig. 6 TC/PM_{10} ratios for each studied indoor activity.

Conclusions

- Indoor particle concentrations were significantly elevated as a result of ironing and vacuum cleaning, as can be concluded from the ratios of concentrations during the activity to the background level. Ironing generated the highest particle number and mass concentrations.
- Particle number concentrations were increased over the background levels by 16 - 97 times and by 3 - 47 times during ironing and vacuum cleaning, respectively. No increase over the background concentration was observed cleaning with the HEPA filter equipped robot.
- Vacuum cleaning predominantly generated particles in the nucleation mode (Dp < 30 nm), while particles generated from ironing were found mainly in the Aitken mode (30 < Dp < 100 nm).
- Total carbon had low contribution to PM_{10} mass during wet vacuum cleaning (9.0 ± 1.8 %w/w). In particles generated from ironing, TC accounted from 26.0 ± 4.14 to 33.3 ± 3.17 % w/w.

References:

Géhin, et al. (2008) Atmos. Environ. 42, 8341–8352.
McCormack, et al. (2008) Environ. Res. 106, 148–155.
Morawska, et al. (2013) Indoor Air 23, 462–487.
Salthammer, et al. (2014) Chemosphere 103, 205–211.
Schweizer, et al. (2007) J. Expo. Sci. Environ. Epidemiol. 17, 170–181.

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