Factors that govern indoor SVOC uptake by particles

Experimental study using aerosol mass spectrometry

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SUMMARY
The aim of this study was to understand factors that govern semi-volatile organic compounds (SVOC) uptake on particles. Particles of different chemical composition have been generated in laboratory conditions and passed through a chamber to allow phthalates (SVOC model) uptake. After passing the chamber particles' chemical composition including phthalate uptake was measured using aerosol mass spectrometry. Smaller particles acquired higher mass DEHP fraction, consistent with uptake by *ad*sorption dominating over uptake by *ab*sorption. Understanding SVOC uptake by particles can help in developing effective ways to minimize exposure to health relevant SVOC.

KEYWORDS
SVOC, Phthalates, Indoor aerosol

1 INTRODUCTION

Particles may serve as carriers of SVOC for subsequent inhalation and lung deposition. SVOC are frequently used in consumer products, (e.g., phthalates) and are ubiquitous in indoor environments. Because of their semi-volatile properties, they can migrate from the material into the air. In the presence of particles (from indoor or outdoor sources), SVOC in the gas-phase can sorb to particles, resulting in a change of phase from gas to particles or vice versa. It has been reported that increased levels of particles in indoor air increases fraction of particle bound phthalates (Lunderberg et al, 2019). Some SVOC are carcinogenic or endocrine disruptors (e.g., phthalates). The aim of this study was to understand the factors that govern SVOC uptake on particles which then can help in developing effective ways to minimize exposure to health relevant SVOC.

2 METHODS

We conducted laboratory measurements of SVOC uptake on particles using 1.2L aluminium chamber with PVC flooring containing phthalates (i.e., used as SVOC model) (Eriksson et al, 2020). Particles of different chemical composition namely ammonium sulfate, ammonium nitrate, polystyrene latex (not shown), and malonic acid, proxy for secondary organic aerosol (SOA), have been generated using a nebulizer. Measurements included varying monodisperse aerosols (with mobility diameter between 80 and 400 nm) and varying concentrations ranging from 10^2 to 10^5 cm^{-3} of the three types of aerosols. Size selection of particles was achieved by flow of the aerosol through DMA set to specific size before the chamber. Particles were passed through the chamber and afterwards their chemical composition including phthalate uptake was measured using aerosol mass spectrometry. Measurements with AMS were coupled with CPC

measurements and included assessment of particle losses, decay rates, and uptake dependence on residence time in the chamber.

3 RESULTS AND DISCUSSION

The particles sorbed VOCs, including phthalate ester di-(2-ethylhexyl)phthalate (DEHP) inside the chamber. DEHP mass fractions of 0.5-2.5% were measured after the chamber (see Figure 1), which is in agreement with polydisperse experiments reported in Eriksson et al. This confirms elevated SVOC emission in the presence of particles, as previously reported by e.g., Lunderberg et al.

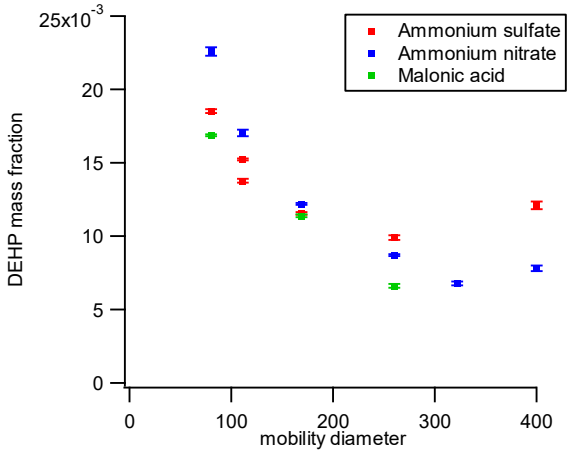

Figure 1. DEHP mass fraction after passing the PVC chamber at 11-minute residence time. Bars show precision errors (95% CI)

4 CONCLUSIONS

Smaller particles acquired higher mass DEHP fraction, consistent with uptake by *ad*sorption dominating over uptake by *ab*sorption. Further experiments are planned to feature more absorption-prone particles as contrast.

There is also an ongoing analysis effort to understand the interplay between geometric particle size (which is different from electrical mobility equivalent size), chamber residence time, and uptake in the experiments already performed. Additional experiments with SVOC uptake on particles from the following indoor sources are ongoing: frying, candles, SOA (from alpha-pinene and ozone reactions) and the results will be presented at the conference.

5 ACKNOWLEDGEMENT

This work was supported the Swedish Research Council for Sustainable Development FORMAS (2020-01370) and Swedish Research Council (Vetenskapsrådet 2021-05049).

7 REFERENCES

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