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Set-up for Human Chamber Exposure Studies of Airborne Particles

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Set-up for human chamber exposure studies of airborne particles

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Humans spend a major part of their time indoors, at their workplaces and their homes, hence particles in these environments are of special interest from a health perspective. Most of our knowledge concerning this is derived from epidemiological studies based on measurements of outdoor particles. A need for toxicological studies exists, as well as means to assess health effects of particle exposure in humans. When it comes to investigation of acute effects of particle exposure, toxicity studies on animals are often conducted. This kind of studies have their advantages, e.g. that very high concentrations can be used to provoke effects, but problems remain in translating the results to the human physiology. It is therefore of interest to directly investigate how human health is affected by the surrounding air, using relevant particle concentrations and common particle types.

The aim of this project has been to develop and apply a methodology to investigate properties of a real-situation aerosol, generate that aerosol in laboratory settings in a reproducible way and investigate immediate systematic effects on humans when exposed to these aerosol particles in a chamber environment.

Method

The methodology developed for this study is a three-step-process: i) measuring in real world environments and studying the literature to characterize particle concentration and chemical particle composition, ii) generating an aerosol with similar properties in controlled laboratory settings, and exposing healthy human volunteers iii) investigating the health effects of the aerosol by looking at biological markers.

Three types of common workplace and indoor aerosols are studied: welding fume, candle smoke and particles formed by terpene

reactions with ozone. The generation system is shown on the left side in figure 1. On the right side in the figure is the measurement system, by which the chamber air is constantly monitored.

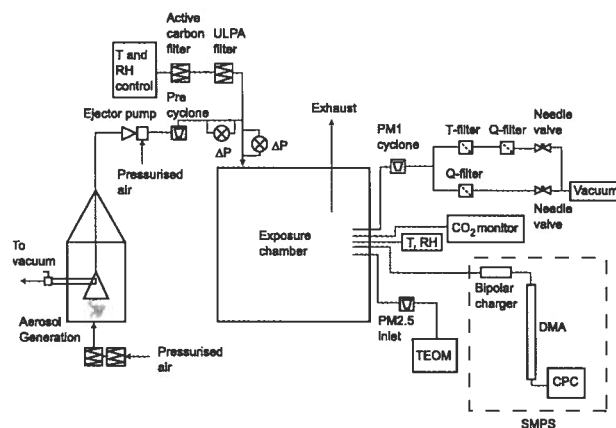


Figure 1. Generation- and monitoring system.

Human test subjects, one at a time, spent 6 h (welding fume, N=31) or 3 h (indoor particles, N=18) in the chamber at each occasion. The person were exposed twice, at one occasion to welding fume and at the other to virtually particle free (< 20 particles/cm³) air. Exposures were double blind. Before and after exposure, samples of venous blood, urine, breath condensate and nasal lavage were taken for analysis of biological markers (oxidative stress and inflammation). The lung function and nasal patency were measured. Several ten minute series of ECG were regularly registered during the exposure event.

Conclusions

Human exposure studies can serve as bridging the gap between epidemiology and toxicology, and helping in extrapolating the results from animal studies to the human system. The methodology described has successfully been used in later studies, and will be used in human exposure studies of other indoor sources.



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