

Indoor Air Pollutants

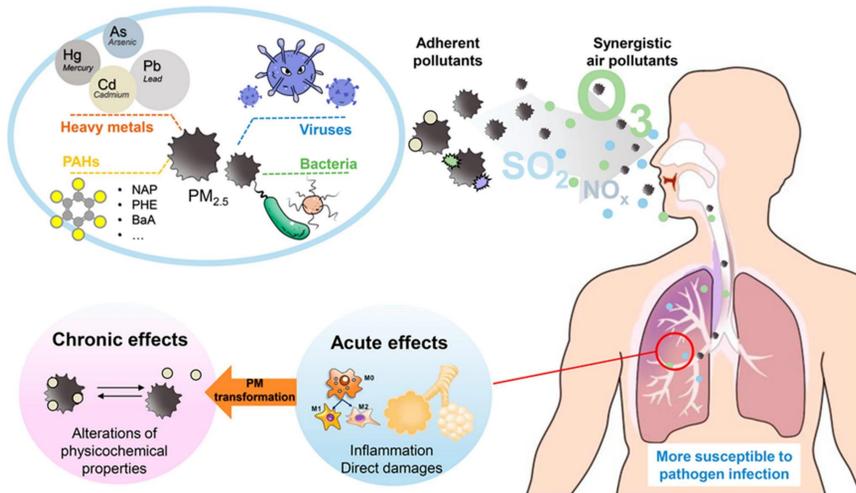


Figure 1 shows the health effects of particulate matter along with pollutants and microbes affecting respiratory system (Source: <https://doi.org/10.1016/j.envres.2020.109949>)

- Indoor Air Pollutants possess a great challenge for human health. Health effects of these indoor pollutants affects the quality of life.
- Indoor Aerosol dispersion plays a key role in disease transmission.
- Understanding the dispersion behaviour of these aerosols is vital and this can be achieved with the development of novel aerosol tracing techniques in comparison with tracer gas.

Materials & Methods

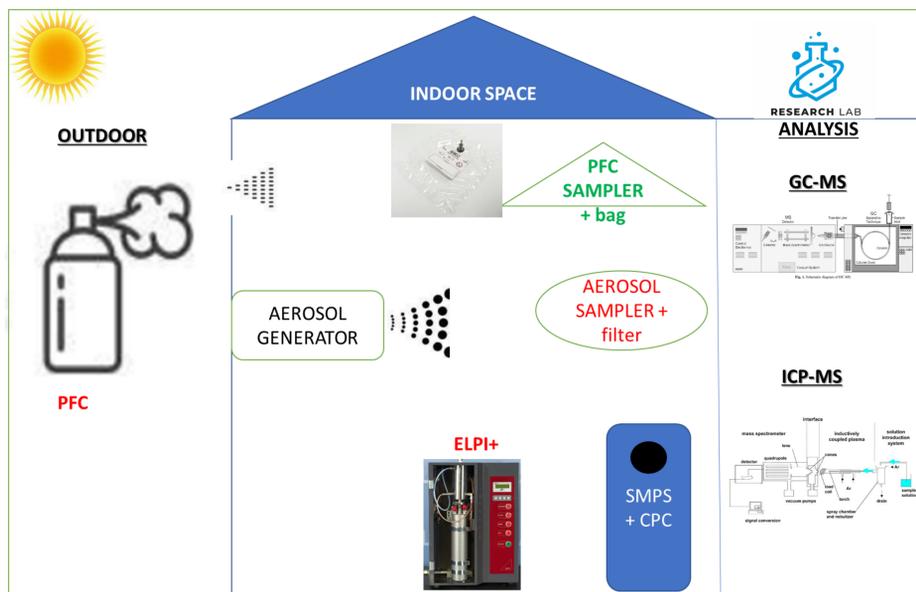


Figure 2. Schematic representation of Experimental Design

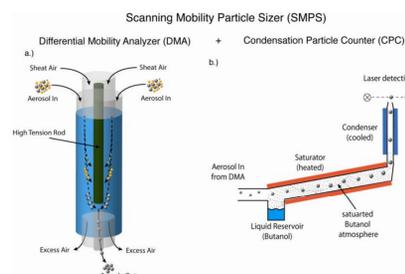


Figure 3. SMPS

Analysis of the tracer gas samples are done using Gas Chromatography and Mass Spectrometry (GC-MS) techniques as shown in Fig 2.

Analysis of metal element composition of the aerosols are done using Inductively-coupled plasma-mass spectrometer (ICP-MS) techniques as shown in Fig.2.

Flame Ionisation Detection Gas Chromatography (FID-GC) is used in analysis of organic compounds such as Glycerol.

SMPS

The SMPS (Fig.3) includes a differential mobility analyser (DMA), which separates various sizes of particles based on electrical mobility and then fractionated particles lead to a condensation particle counter (CPC) where these particles are counted.

ELPI

Fig 4. from Jarvinen et al shows the working principle and components of the Electrical Low-Pressure Impactor which utilizes the cascade impaction principle with a direct reading capability used to determine the concentration and particle size distribution in real-time.

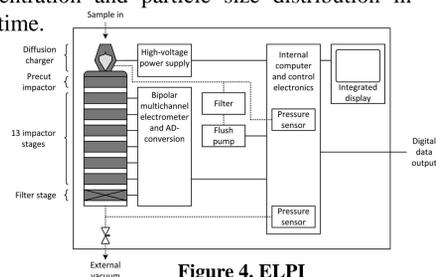
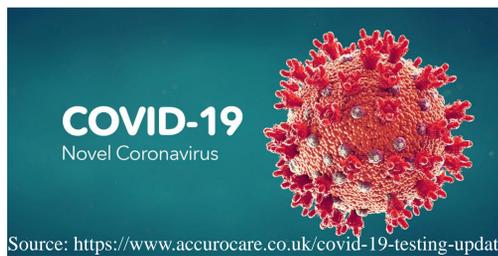


Figure 4. ELPI

Objectives

- Objective 1. Through systemic literature review understand the health effects of the indoor aerosols affecting the Neuro, Cardio and pulmonary system.
- Objective 2. Develop novel aerosol tracer techniques in comparison with gas tracer experiments to understand the Dispersion behavior of these aerosols.
- Objective 3. Define Experimental design of indoor space and repeat experiments in different locations
- Objective 4. Complete placement from UK Health Security Agency (formerly PHE), Oxford which includes the design of the aerosol generation and exposure study, collection and analysis of the aerosol data and this data will be combined with modelling of concentrations in the indoor environment to assess potential health risks via inhalation exposure.
- Objective 5. Analyze experimental data and publish results useful in developing new or update in existing policy.

Background



Source: <https://www.accurocare.co.uk/covid-19-testing-update>

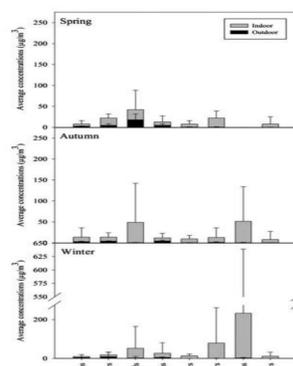
SARS-COV2 Pandemic has created an international awareness of the importance of indoor space, ventilation and disease transmission.

Common Indoor Air Pollutants



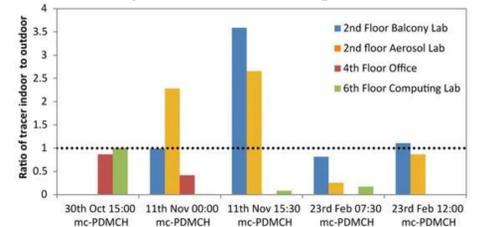
Source: www.teachengineering.org/lessons/view/cub_air_lesson09/

Indoor pollutants are generated from various sources such as Outdoor Pollutants (PM 10), cooking oils, biological aerosols, cross-reaction with household chemicals, VOCs, exhausts from e-cigarettes, PM 2.5 and especially PM 1 are associated with many health effects causing damage to the hearts, lungs and brain.



This figure 5 from P. N. Pegas et al, clearly shows the average concentrations ($\mu\text{g m}^{-3}$) of all individual VOCs and carbonyls in all schools that the indoor air pollutants concentration is more than the Outdoor air pollutants.

Figure 6. PFC Tracer Experiments



This figure 6 from J.C.Matthews et al, shows the ratio of tracer measured inside and outside three rooms within the test building for mc-PDMCH tracer released ~100 m away. The dashed line represents unity where indoor and outdoor concentrations are equal.

Scientific Policy & Innovation

- Is it ethical? Are there social, environmental, or political implications for performing experiments with tracer gases?
- Will the data from the project be useful to develop mitigations and policies in handling/ minimizing the exposure of indoor aerosols/ pollutants?
- Will the developed novel aerosol tracer technique will open new line of scientific enquiry?

References & Acknowledgement

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