



Characterisation of the dynamic properties of exhaled aerosol particles following use of electronic and conventional cigarettes

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Little data is available on the effects of exhaled particles on IAQ

Growing discussion amongst public health organizations and the scientific community as to whether the “particles” exhaled following use of e-cigarettes has potential implications for indoor air quality and bystanders.

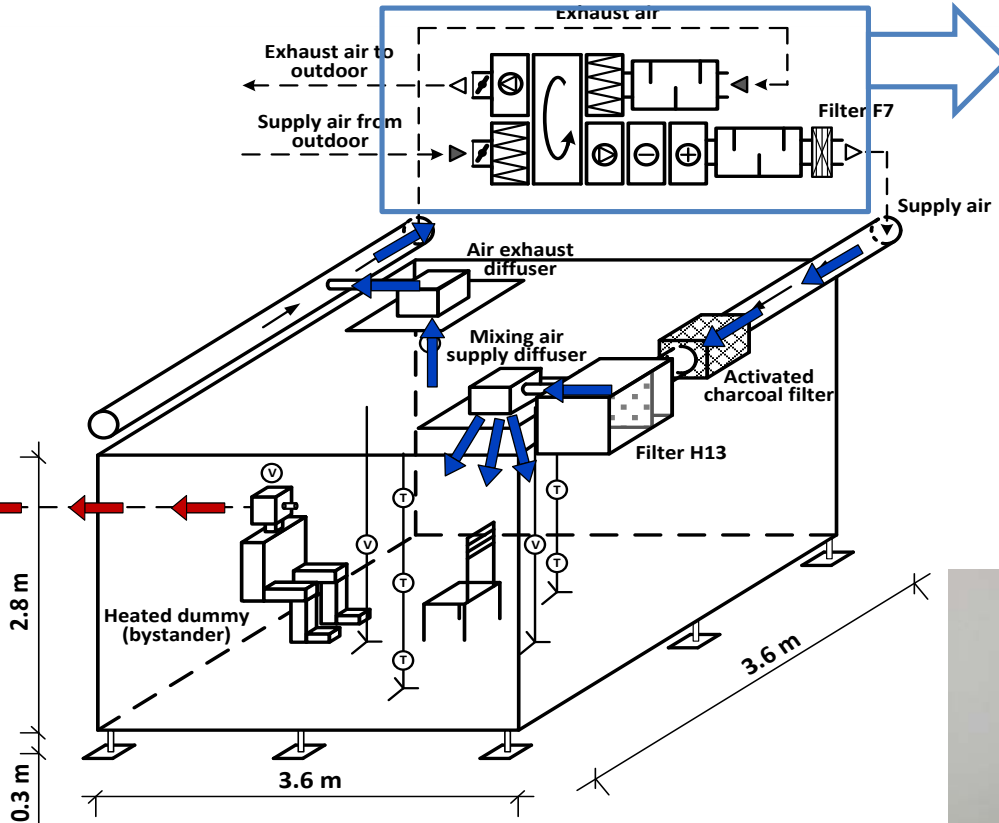
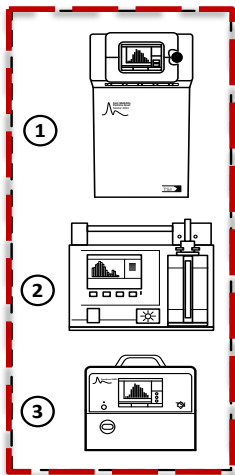
There is little data available on the dynamic properties of exhaled e-cigarette aerosol particles and how they differ to those emitted when a conventional cigarette is smoked (i.e. smoke exhaled + smoke from burning end of cigarette).

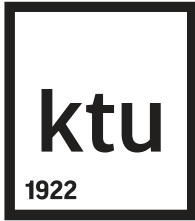
We aimed to investigate the spatial and temporal patterns of the variations of exhaled aerosol particles following use of an e-cigarette and a conventional cigarette in a room under controlled environmental conditions.



METHODS

- Ⓣ Temperature measurement
- Ⓥ VOCs measurement





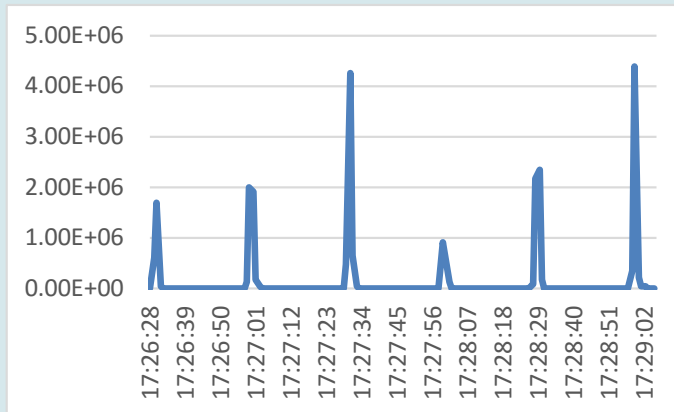
Rapid variation of Particle Concentration

at 0.5 m from bystander; 2 air changes per hour

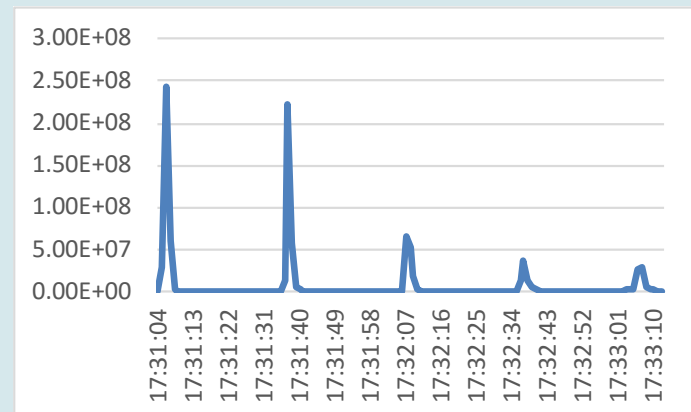
Note differences in scales

Active vaping period

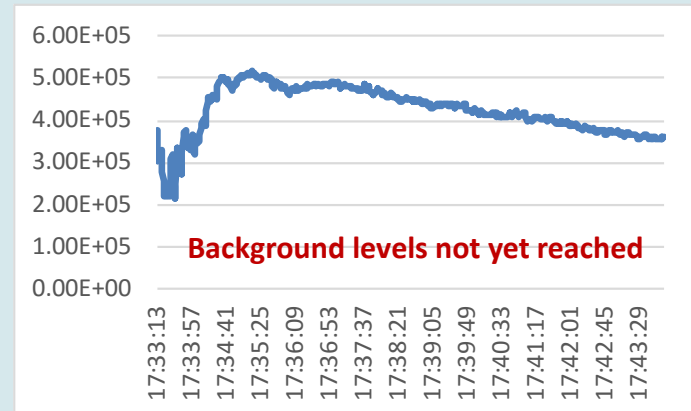
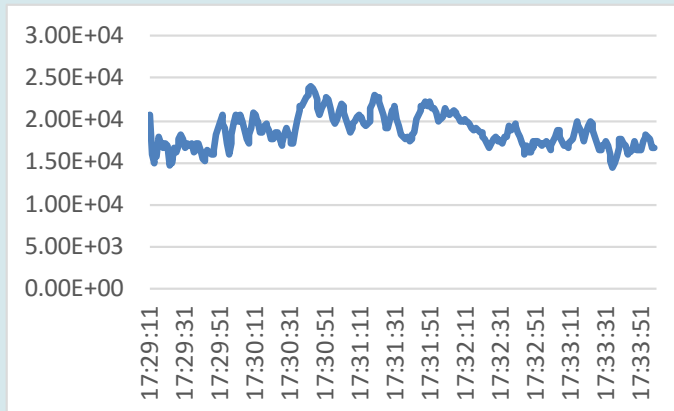
E-cig

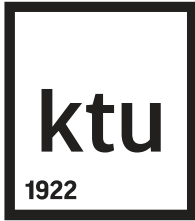


Conventional



“After” period





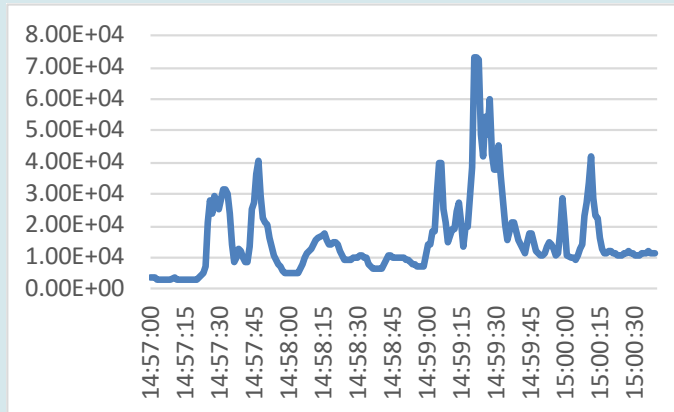
Slower variation of Particle Concentration

at 2 m from bystander; 2 air changes per hour

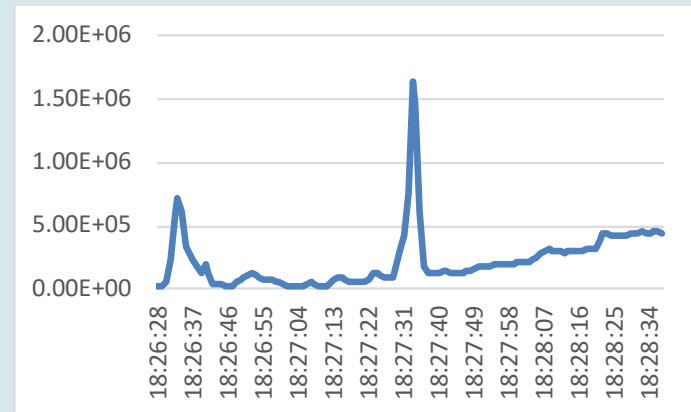
Note differences in scales

Active vaping period

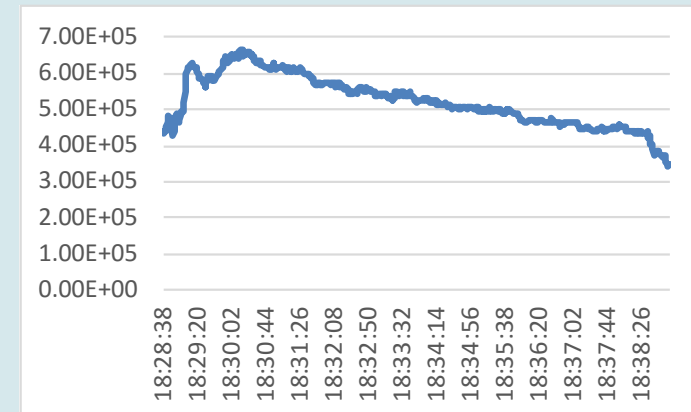
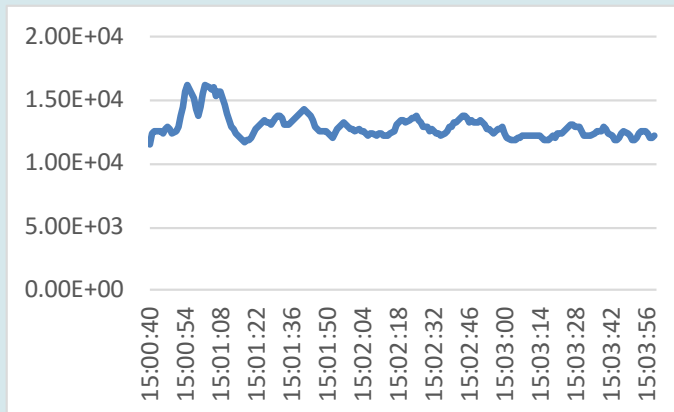
E-cig



Conventional

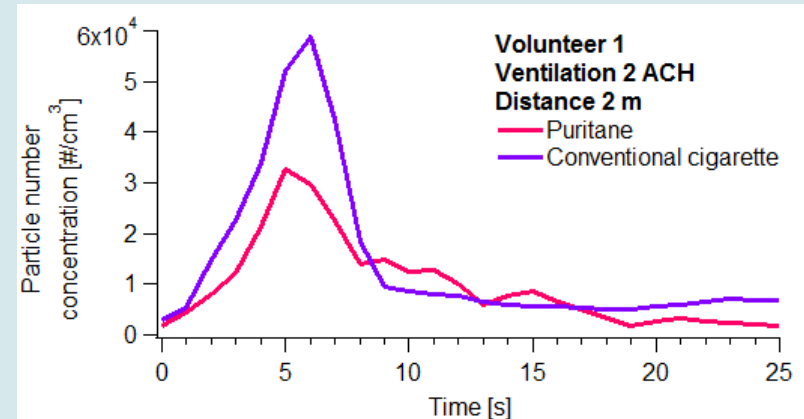
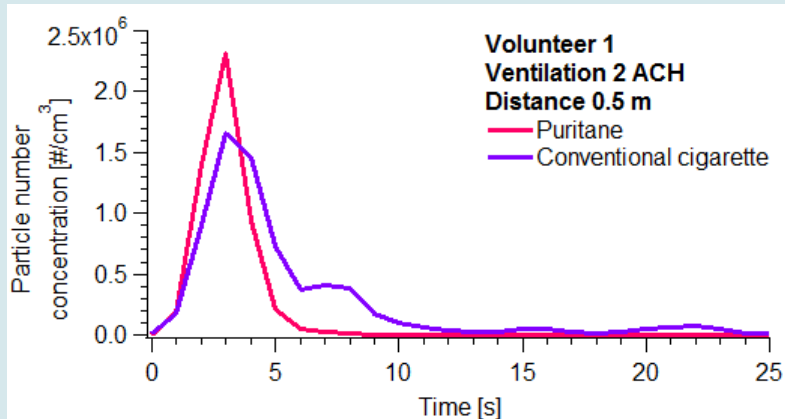


“After” period

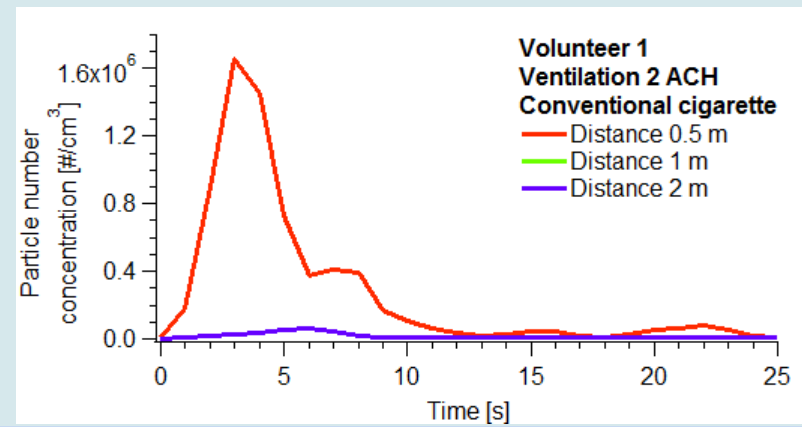
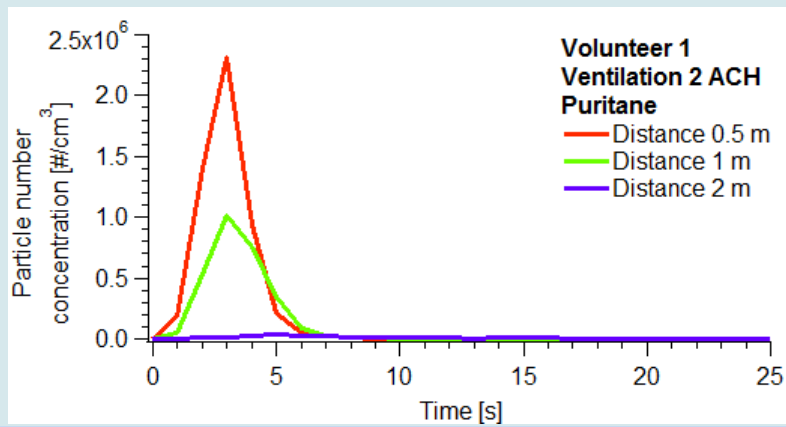


Short term variations comparable

Inter-comparison between **product types**

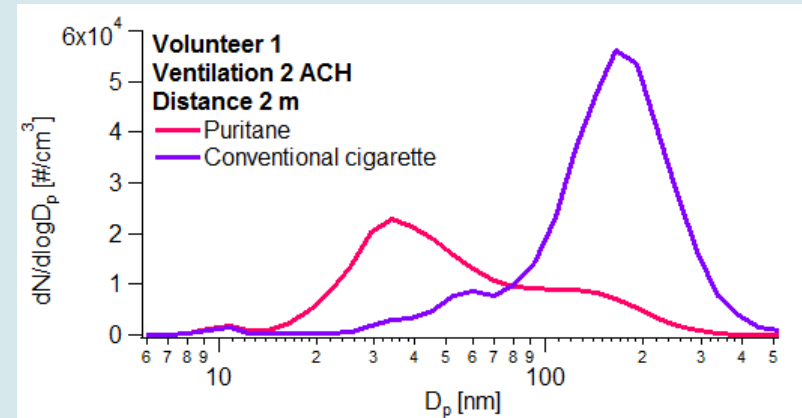
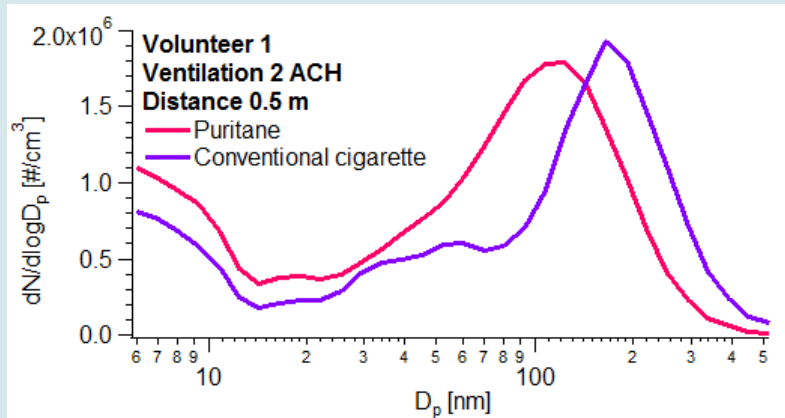


Inter-comparison between **distances** from user and bystander

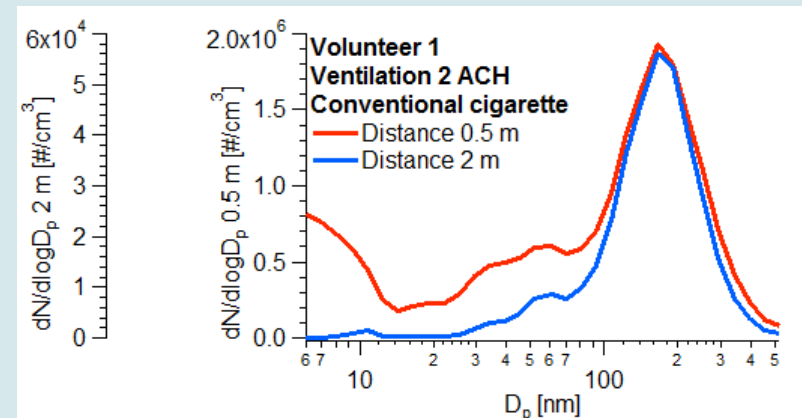
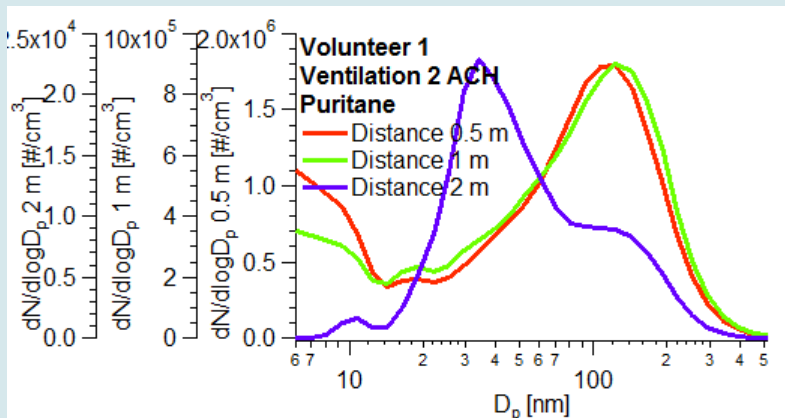


E-cig nanoparticles shrink and evaporate, Conventional don't

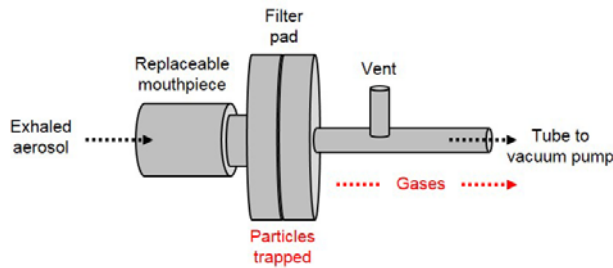
Inter-comparison between **product types**



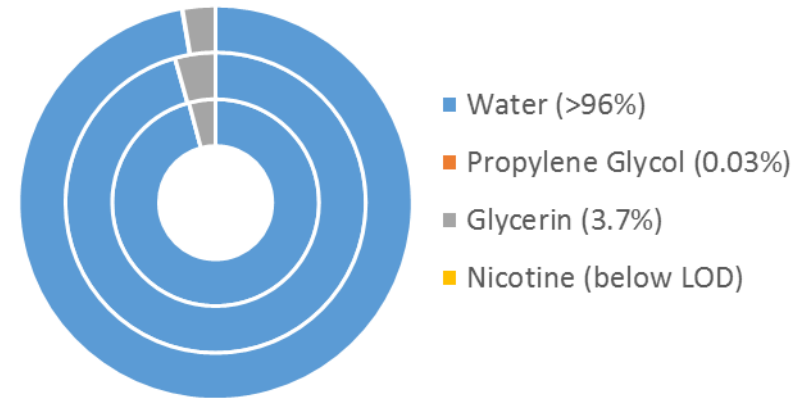
Inter-comparison between **distances** from user and bystander



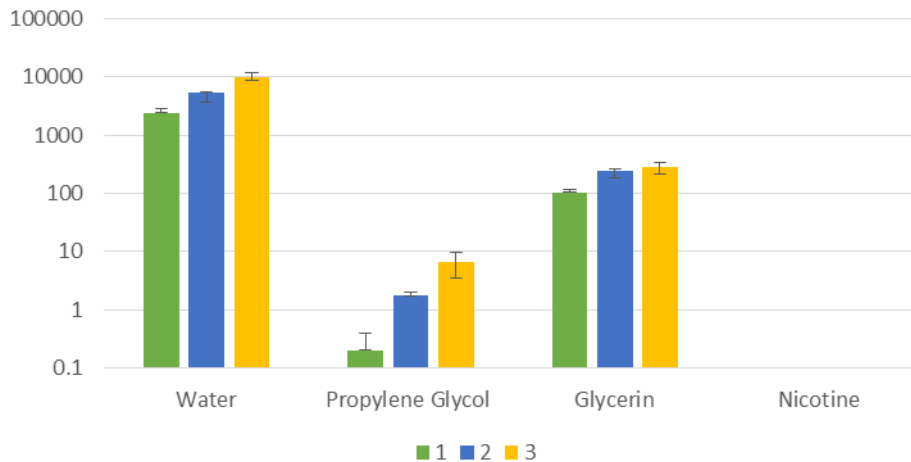
Analysis of the chemical composition of exhaled particles in a single puff



Relative composition of one exhaled puff

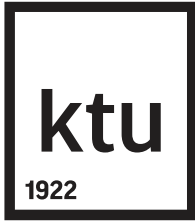


Composition of one exhaled puff, ug/puff



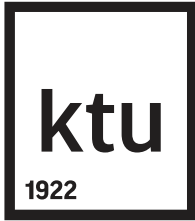
Exhaled gas-phase emissions
previously reported

O'Connell et al. Int J Environ Res Public Health, 2015, 12: 4889-4907



Conclusions

- The variation of PM concentration was **very rapid** as it was associated with the **direct impact of puffs**.
- The concentration increased by **several orders of magnitude** from the background and dropped back to background concentration in 10 seconds during use of electronic cigarette.
- In case of conventional cigarettes, the puffs were also rapid, but after successive puffs, the particle concentration **increased** in the room, showing **accumulation of particles**.



Conclusions

- Particles exhaled after the use of e-cigarettes were in the range 100-150 nm, and shrunk rapidly while being dispersed in the room.
- Conventional cigarette particles were larger (150-200 nm), and were not affected by the distance between the volunteer and the “dummy”.
- Our results suggest that particles from e-cigarettes are mainly liquid droplets constituted of water. These particles evaporate very fast and disappear 10-15 seconds after the puff, transferring to the gaseous phase.
- On the contrary, particles from conventional cigarettes are tobacco combustion particles which are more stable than those from e-cigarettes. The removal of these particles is much longer, and depends on the ventilation rate in the room.