**Dynamic properties of exhaled e-cigarette aerosol vs. conventional cigarette smoke**

**Ari Setyan**1,2, Tadas Pranasauskas3, Dainius Martuzevicius3, Grant O’Connell4, Xavier Cahour5, Stéphane Colard6

1 Empa, Laboratory for Advanced Analytical Technologies, 8603 Dübendorf, Switzerland; 2 ETH Zürich, Institute of Environmental Engineering, 8093 Zürich, Switzerland; 3 Kaunas University of Technology, Department of Environmental Technology, 50254 Kaunas, Lithuania; 4 Fontem Ventures B.V., 1083 HN Amsterdam, The Netherlands; 5 SEITA-Imperial Brands, 45404 Fleury-les-Aubrais, France

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**Introduction**

- Growing discussion amongst public health organizations and the scientific community as to whether particles exhaled following the 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 aerosols and how they differ to those emitted when a conventional cigarette is smoked (i.e. smoke exhaled + side-stream smoke).

**Objectives**

- To investigate the spatial and temporal variations of exhaled aerosols following the use of an e-cigarette and a conventional cigarette in a room under controlled environmental conditions.

**Indoor air quality study**

- Experienced adult volunteers smoked conventional cigarettes or vaped e-cigarettes in an exposure chamber under controlled conditions.
- The exposure chamber had a floor area of 13 m², a volume of 35.8 m³, and controllable ventilation rates. A bystander was simulated using a “dummy”. The surface of the “dummy” was heated in the range 31-34°C, similar to the temperature of the surface of the human body.
- The concentrations and size distributions of airborne particles exhaled by the volunteer were measured at the bystander’s position.

**Representative typical cig-a-like e-cigarette:**

Caponetto et al., Journal of Medical Case Reports, 2011, 5:585.

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**Experimental setup:**

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**Results and discussion**

**Inter-comparison between products:**

- At a short distance, no significant difference between products.
- At a large distance, the peak size of particles from e-cigarettes shrank from 150 to 30 nm due to evaporation.

**Inter-comparison between volunteers:**

- In general, important differences among volunteers in terms of total particle concentration, sometimes also in terms of size distributions.

**Influence of the ventilation rate:**

- No significant impact of ventilation rate on particle concentration and size distribution during puffs.

**Influence of the distance between the volunteer and the bystander:**

- Exponential decrease of the particle concentration with the distance.
- For e-cigarette, shrink of the particle size (evaporation) with increasing distance.
- For conventional cigarette, size distribution stable with distance.

**Particle concentration and removal after successive puffs:**

- After successive puffs, clear accumulation of conventional cigarette particles.
- The removal of conventional cigarette particles depends on the ventilation rate.
- E-cigarette particles are removed much faster by evaporation, independently of the ventilation rate.

**Conclusion**

- Particles exhaled after the use of e-cigarettes and conventional cigarettes have different behaviors:
  - **E-cigarettes:** fast evaporation of volatile compounds, particles disappear 10-15 seconds after the puff.
  - **Conventional cigarettes:** particles more stable than those from e-cigarettes, their removal is longer and depends on the ventilation rate.
- The spatial and temporal variations of particles reflect the different chemical compositions of conventional cigarette and e-cigarette particles:
  - solid combustion particles vs. liquid droplets.

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