AEROSOL CONCENTRATION VARIATIONS IN A ROOM DURING USE OF AN E-CIGARETTE

DAINIUS MARTUZEVICIUS[1], TADAS PRASAUSKAS[1], ARI SETYAN[2,3], GRANT O'CONNELL[4], XAVIER CAHOURS[5], STÉPHANE COLARD[5]

Presenting author email: **dainius.martuzevicius@ktu.lt**

[1]Department of Environmental Technology, Kaunas University of Technology, 50254 Kaunas, Lithuania

[2]Laboratory for Advanced Analytical Technologies, Empa (Swiss Federal Laboratories for Materials Science and Technology), 8600 Dübendorf, Switzerland

[3]Institute of Environmental Engineering, ETH Zürich, 8093 Zürich, Switzerland

[4]Fontem Ventures B.V., 12th floor, Barbara Strozzilaan 101, 1083 HN Amsterdam, The Netherlands

[5]SEITA-Imperial Brands, 45404 Fleury-les-Aubrais, France

Background:

- Electronic cigarettes (e-cigarettes) are rapidly increasing in the market as an alternative to conventional tobacco cigarettes.
- E-cigarettes are battery-powered devices that deliver an aerosol to users from an e-liquid. E-liquids typically contain propylene glycol and glycerol in varying proportions as the aerosol formers and may contain nicotine and flavourings.
- E-cigarettes do not contain tobacco, do not require combustion and do not generate side-stream smoke.
- There is little data available on the properties of exhaled e-cigarette "particles" in the scientific literature and as a result there is a growing discussion amongst the public health community as to whether the "particles" exhaled following use of such products has potential implications for indoor air quality and bystanders.

Aim:

- To investigate exhaled aerosol concentration variations during use of a commercial e-cigarette in a room under controlled ventilation conditions.

Methods:

- A room-simulating chamber was developed (**Fig. 1**).
- An occupant bystander was represented by a seated heated "dummy".
- The ventilation air supplied to a chamber was treated with three steps of filtration.
- Variables: three experienced e-cigarette volunteers; ventilation rates of 0, 1 and 2 ACH; distance 0.5, 1.0, and 2.0 metres from the bystander.
- Highly time-resolved aerosol samples were analysed at the bystander's position using a Fast Mobility Particle Sizer (FMPS) and an Electrical Low Pressure Impactor (ELPI+).
- Particle number concentration (PNC) decay rates were calculated as a measure of the removal of particles from indoor air.

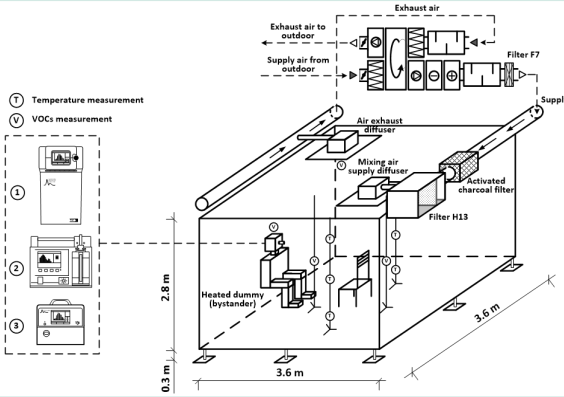

Fig. 1. Room-simulating chamber with heated "dummy" and controlled ventilation. 1 – FMPS; 2 – ELPI; 3 – SMPS; T, V – temperature and VOCs sensors

Results:

- Very rapid fluctuations in aerosol concentration variations were observed during use of the e-cigarette.
- Increase in exhaled particle concentrations were observed during a 2-5 second interval.
- This was followed by a rapid decrease in concentrations, reaching background concentration levels within 10 seconds (**Fig. 2**).
- Indicate exhaled e-cigarette particles are present in the liquid state and evaporate almost immediately upon exhalation.
- A greater distance between e-cigarette user and bystander resulted lower maximum particle concentrations and a slower decay rate **(Fig. 3**).
- No accumulation of particles was registered in the room 30 min after e-cigarette use, unlike that reported for conventional cigarettes.

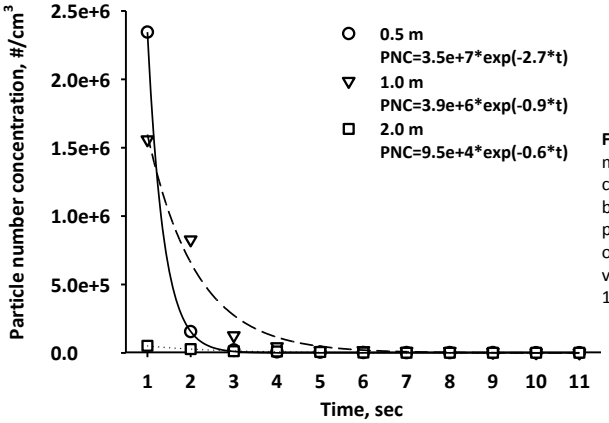

Fig. 2. The decay of maximum aerosol concentrations at the bystander's inhalation point after exhalation of an e-cigarette puff at various distances (ACH 1).

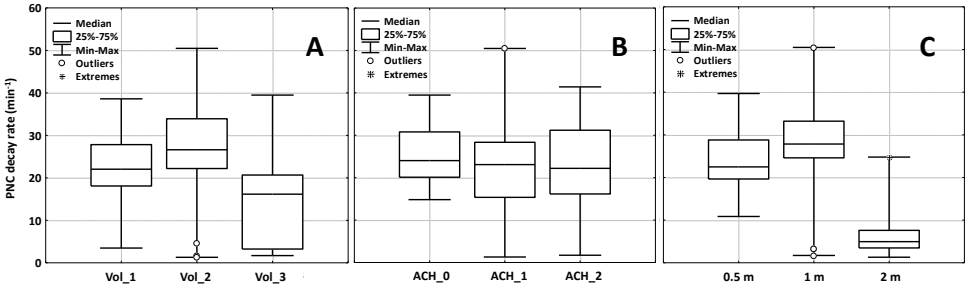

Fig. 3. Distribution of PNC decay rates between different variables: A – e-cigarette user volunteers; 2 – ventilation rates; C – distance.

Conclusion

- This study shows for the first time exhaled e-cigarette particles are liquid droplets that evaporate rapidly upon exhalation. The results presented here may have a positive implication for continued use of e-cigarettes in indoor areas.

This work was supported by Fontem Ventures B.V.