Analysis of gaseous and aerosol particle concentration in college classes during COVID-19 pandemic

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Nowadays, the importance of indoor air quality (IAQ) is more important than ever due to COVID-19 transmission in indoor environments. In these places, such as office or classes environments, people spend more than 80 % of time. Thus, the study of the evolution of gaseous and particle number size distribution (PNSD) in indoor places (e.g. during class) is important to evaluate the possible transmission of viruses with different ventilation conditions (Blocken et al., 2021).

The main aim of this study is the analysis of PNSD and gaseous before (1 h), during and after (1 h) college classes. The concentrations of particles by sizes -modes (nucleation: <30 nm; Aitken: 30-100 nm; accumulation: 100-1000 nm; coarse: >1000 nm) and gaseous (NO_2, SO2, CO, CO_2 and VOCs) have been included.

In order to analyse the IAQ in the classes, the following equipments were used: i) a Scanning Mobility Particle Sizer spectrometer (TSI-SMPS Model 3938) to measure the aerosol concentration between 14 and 763 nm in 110 channels; ii) an optical spectrometer PCASP-X to measure the aerosol concentration between 0.1 and 26.8 µm; iii) an automatic infrared monitor from Gray Wolf (WolfSense IQ-610) to register temperature, relative humidity, CO, CO_2 and volatile organic compounds (VOCs); and iv) three portable gas sensors of Aeroqual series 500 to measure O_3, NO_2 and SO_2.

The students (N=20-40) and the teacher constantly wore masks and the safety distance between seats of 1.5 m was respected, so there were no students less than that distance from the sampling point. The doors were constantly open while the windows were opened intermittently during class and were always opened between classes.

Preliminary results indicate a clear increase of CO_2 concentration between before (435 pp) and during class (899 ppb), CO concentration (1.4 to 1.9 ppm) and nucleation mode concentration (mean increase of 46 %). It also emphasizes the increase of VOCs during classes (24 %). The mean particle concentration registered during class was: nucleation - 375 cm^{-3}; Aitken- 688 cm^{-3}; accumulation 274 cm^{-3}; coarse: 55 cm^{-3}. Other parameters such as Aitken (before: 601 cm^{-3}) or accumulation (before: 286 cm^{-3}) concentration did not change during classes. The maximum CO_2 concentration registered was 1102 ppb during class.

Between classes, there was ventilation and cleaning of class with a sharp decrease of CO_2 concentration (Figure 1) and an increase of aerosol concentrations related with dry cleaning of floor and the movement of the exit of the students. Other study in nursery schools (Mainka et al., 2015) recommended wet instead dry cleaning of floors in order to reduce aerosol concentrations after class.

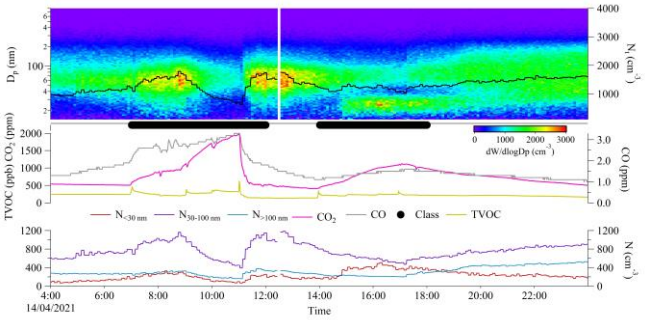

Figure 1. An example of the evolution of particle number and gaseous concentration in the classroom at 14/04/2021. The thick black line indicates class periods.

The study of the evolution of PNSD and gaseous compounds during the classes may allow us to analyze the possible transmission of viruses under different ventilation conditions. It should be completed with the determination of particulate matter composition, a complicated aim given the noise of the particulate collectors.

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Blocken *et al*., 2021. Build. Environ. 193, 107659. doi:10.1016/j.buildenv.2021.107659
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