Evaluation of air quality in indoor and outdoor ambients: Impact of anti-COVID-19 actions

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22/06/2021

This study determined the presence of Volatile Organic Compounds (VOC) in different classrooms of a school in Tarragona, differentiating between VOCs, Emerging Organic Compounds (EOC) and solvents, with a total of 79 compounds. The monitoring campaign designed to determine their presence in indoor environments was conducted between April and June 2021. Seven -day indoor sampling campaigns were carried out in seven classrooms with differing characteristics (*i.e.* volume, level in the school building, activities or internal covering) from a conventional school in Tarragona. Passive sampling was performed with Carbopack X tubes, as specified in USEPA methods 325A and 325B (USEPAA, 2017; USEPAB, 2017) for the determination of VOCs from Fugitive and Area sources. A total of 21 Carbopack X tubes were needed. To determine these VOCs thermal desorption was employed coupled to gas chromatography with mass spectrometry. The analytical method used was previously developed by Maceira *et al.* (2017) and Vallecillos *et al.* (2020) .

Moreover, the presence of nine aldehydes was also determined in indoor and outdoor environments. The monitoring campaign to determine these was conducted between April and June 2021. The sampling campaigns have been conducted in parallel to VOCs determinations with seven -day indoor measurements carried out in same seven classrooms from the school in Tarragona. Three living rooms of different houses were also analysed to compare them with the concentrations found in the school. For outdoor measurements, fourteen-day outdoor campaigns were taken in three different points near a perimetral fence of a plastic printing company, the city centres of Tarragona and Salou and three towns in the vicinity of the North Industrial Complex in Tarragona (Constantí, Sant Salvador and Perafort). The sampling of aldehydes was carried out with Radiello® tubes (57 tubes). These adsorbent tubes are coated with 2,4-dinitrophenylhydranzine (2,4-DNPH), a derivatizing agent that contributes to the retention of aldehydes by reducing their volatilities. The derivatization reaction of aldehydes with 2,4-DNPH leads to the formation of the corresponding 2,4-dinitrophenylhydrazone. The extraction of these hydrazones involved the liquid desorption with acetonitrile in an ultrasound bath for 30 min and the determination was done by liquid chromatography with UV detection. The separation by LC-UV was optimized (flux, gradient, temperature and detector's wavelength) from the proposed protocol of Supelco. As individual standard solutions of the target compounds were not available, a LC-Orbitrap mass spectrometer was employed to ensure a correct identification of the target compounds made by LC-DAD.

The risk values for exposure of the population to these aldehydes in outdoor environments have been calculated and compared with the effect of VOCs.