Evaluating the performance of low-cost Alphasense OPC-N3 in an indoor environment

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Keywords: Indoor air quality, Low-cost sensors, Particulate matter, Reference instruments, Exposure.
Associated conference topics: 3.6, 4.9
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Air pollution is associated with an increased health risk and estimated to cause millions of premature deaths worldwide every year. Moreover, it represents a risk factor for the entire ecosystem and materials of anthropogenic origin (such as cultural heritage and high-tech artifacts). The characterization of air pollution is strongly tied to the diversity between indoor and outdoor environments, which may seem distinct from each other, but are in fact strongly interconnected; in addition, the indoor environment has its own and strong spatial heterogeneity, with great variability of pollutants between different spaces. Nowadays, air quality monitoring activities are carried out mainly for scientific research purposes or the assessment of compliance with legislation. The chemical and optical analysers needed to monitor air pollution, while providing accurate measurements, require a considerable investment, constant calibration and maintenance and are thus restricted to a limited number of applications [1], resulting in an inadequate spatial and temporal coverage. The development of low-cost sensors can enable the acquisition of high-resolution air quality data and the creation of a larger network [2], thus helping the characterization of pollutant emissions and the assessment of real-time exposure, facilitating the search for emission mitigation strategies. In this context, a measuring campaign was conducted at the National Research Council (CNR) site in Portici (Naples, Italy), where a pilot facility of the BIOMAT project, a highly innovative European project aiming to enable, accelerate and facilitate the uptake of innovative bio-based materials, was installed. This monitoring campaign was aimed to assess the potential occupational exposure to harmful particulate matter (PM), during the production process of nano-enabled PUR foams. For this purpose, four low-cost optical particle counters (Alphasense, OPC-N3) were deployed alongside two reference instruments (OPC Grimm 1.107). The data obtained for the OPC-N3 sensors show comparability between the values, both in terms of the overall trend over time and PM10 concentrations. The first comparison with the reference OPC (Grimm 1.107) shows good agreement between the trends of the two instruments (Figure 1), successfully characterizing PM_{10} concentration peaks over time. The difference between the curves obtained for the Alphasense and that of the reference optical counter highlight the inability of the low-cost sensors to correctly estimate the absolute value of PM_{10} concentrations. This first campaign showed how the exposure of the facility workers was mainly attributable to the coarse fraction of particulate matter, mainly caused by dust uplift phenomena and the weighing of chemical fillers required by the project.

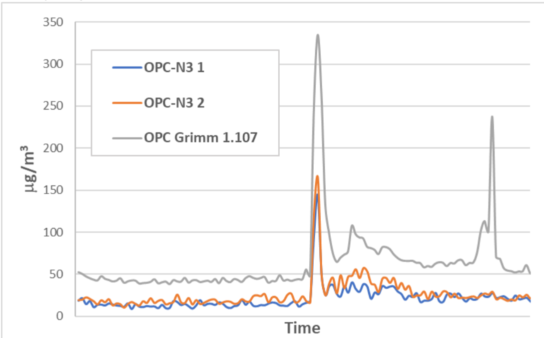

Figure 1. PM_{10} concentration over time of two Alphasense OPC-N3 and the OPC Grimm 1.107.

Future developments will see the application of low-cost sensors in additional indoor and outdoor environments, and laboratory testing through use of an Aerosol Exposure Chamber.

This work was supported by the European project BIOMAT H2020-953270 and by the MUSA – Multilayered Urban Sustainability Action – project, funded by the European Union – NextGenerationEU, under the National Recovery and Resilience Plan (NRRP) Mission 4 Component 2 Investment Line 1.5: Strenghtening of research structures and creation of R&D “innovation ecosystems”, set up of “territorial leaders in R&D”.

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