Should aerial drones replace flux chambers and wind tunnels to sample odorous atmospheres emitted by area sources?

Jean-Michel GUILLOT [1], Toon VAN ELST [2]

1. *IMT Mines Ales, LSR, Ales, France*
2. *Olfascan, Ghent, Belgium*

jean-michel.guillot@mines-ales.fr

Topic II – Sources sampling and characterization

Abstract: Sampling is a key step in environmental analysis and typically for odorous atmospheres to carry out olfactometric or chemical analyses from sample bags. However some protocols like VDI-3880 define how to sample area sources, it was demonstrated by the last version of European standard (EN-13725:2022) that a consensus is impossible to fix a sampling method for such emission sources. Studies showed that the device (Flux chamber CF or wind tunnel WT) is highly influencing the sampling and also the expected result. It means than the real emission is hard to predict with these methods and the resulting value is probably underestimated or overestimated. The result of sampling with CF or WT is always linked to conditions and gives relative values comparable only with the same device used in the same conditions for the same type of source. The uncertainty of CF and WT is too important; moreover these methods present lots of drawbacks: difficulty to place devices on a surface (without leaks on a solid surface or with acceptable floatability on a liquid source); difficulty for operators to place and move the device in different locations; necessity to have odourless flux air for inlet in the device, limitation in surface that is effectively sampled… So, without a clear method for sampling, without consensus about values obtained using CF and WT, the question of a paradigm shift using aerial drones is clearly posed to improve assessment of real emission rate from large area sources and their impact after dispersion.

This paper deals with all advantages and drawbacks of approaches and illustrates that the shift is probably inevitable. Firstly, operators can stay out of the emission source that is a real improvement for safety conditions, without risk of falls or drowning and with less exposition to odorous pollutants. Secondly, the possibility in terms of sample numbers in increased with the easiness to change the sampling point and, it also gives a stronger flexibility to average emission from different points. During last years, several examples were given combining aerial drones and chemical sensor technologies (e-noses). It illustrates the great advantage of drone to be equipped with different types of sensors/detectors. With a thermal camera, a drone can map a surface and help distinguishing active or non-active parts on e.g. composting piles or biofilters. An e-nose with a sampling line gives data about level of detected compounds over the surface. The drone also allows both vertical and horizontal profiles and so a three-dimensional characterization of the source when previous sampling methods only led to partial two-dimensional data. All types of sensors can be included in the sampling drone to improve the efficiency of emission assessment. To replace CF or WT, the drone must be able to collect air for analysis. A small canister (mini-can) with vacuum inside is enough to collect approximatively 1L of air for chemical analysis but for olfactometric analysis a vacuum box with a pump is needed to fill sampling bags of few liters. Some studies indicate that downdraft from wind drone rotors can be limited if the drone is at least 8 m from the source so future improvements concerns sampling lines, their warranty to be at controlled distance from the source and also the position of the vacuum box between the sampling inlet and the drone. Technical aspects and improvements are discussed in this paper.