Development of a rapid and portable analyzer of gaseous formaldehyde

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Formaldehyde is a major pollutant of indoor air where its sources are multiple (materials, combustion, etc.). Currently, no analytical technique of formaldehyde does combines good sensitivity, good temporal resolution, small size and low cost. The objective of this work is to develop a selective and portable analyzer for gaseous formaldehyde, with a time resolution of a few minutes, a sensitivity of less than 1 μg m⁻³ and a relatively low cost to purchase and then for its operation.

The principle of this analyzer is based on the reaction of formaldehyde with a selective agent derivative (fluoral-p) to form a fluorescent species (DDL). The analyzer measures concentrations of formaldehyde in 3 steps strongly coupled to each other: 1) the uptake of gaseous formaldehyde into an aqueous solution, 2) the selective derivatization of formaldehyde by reaction with fluoral-P, 3) the analysis of the reaction product by fluorescence spectroscopy.

First, a calibration of formaldehyde in aqueous flow was performed using a specific flow cell. The quantification limit obtained for aqueous formaldehyde is about 10 to 100 ng L⁻¹ for a signal to noise ratio of 10. Besides, the addition of other aldehydes into formaldehyde solution does not cause significant interference.

The second part of our study concerns the analysis of formaldehyde in air. To properly evaluate the performances of our analyzer in the gas phase, a calibrated source of gaseous formaldehyde was first developed. Then, formaldehyde uptake, derivatization and detection by fluorescence spectroscopy have been optimized. The analytical method developed in this work has been patented in June 2009 (Le Calvé et al., 2009). From our manual system, a first automatic prototype has been achieved since the end of October 2009. The various experiments performed with this prototype shows that our analyzer can highlight fine temporal variations of formaldehyde concentrations in indoor or outdoor atmospheres. It actually responds to the specifications originally planned, and even allows to measure formaldehyde levels 30 times lower (0.03 μg m⁻³) than the detection limit of 1 μg m⁻³ originally contemplated.

In the near future, the effects of parameters such as relative humidity and temperature on the performances of the analyzer will be studied. Our analyzer will be validated by comparison with the conventional technique of derivatization by DNPH coupled to analysis by HPLC / UV on synthetic air samples generated in smog chambers. Measurements in real indoor atmospheres under various scenarios will then be performed.

**Keywords** : Rapid analyzer, portable, formaldehyde, indoor air.