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ABSTRACT

MICROMETEOROLOGICAL METHODS FOR THE INDIRECT QUANTIFICATION OF ODOUR EMISSIONS

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In the case of odours, source characterization may sometimes become extremely complex. Indeed, odours are typically released into the atmosphere as diffuse emissions from area and volume sources, whose detailed quantification in terms of odour emission rate is often hardly achievable by direct source sampling.
Indirect methods, involving the use of micrometeorological methods in order to correlate downwind concentrations to the emission rates, are already mentioned in literature, but rarely found in real applications for the quantification of odour emissions. The instrumentation needed for the development of micrometeorological methods has nowadays become accessible in terms of prices and reliability, thus making the implementation of such methods to industrial applications more and more interesting.
For this reason, this work aims to provide an overview of micrometeorological methods and investigate their effective applicability to odours, thereby providing a short description of the physics related to such methods and analysing the relevant scientific literature.
In extreme synthesis, a micrometeorological method is a method that calculates the flux as:

$$F_c = \overline{w'c'}$$

Where F_C is the flux of the target chemical at the measurement point, w' and c' are the turbulent contributions of the vertical wind component and the concentration, respectively.
The most direct method to asses Fc is the “Complete Eddy Covariance” method: it is based on the direct quantification of the covariance of high-frequency w and c. While nowadays the use of sonic anemometers, able to provide high frequency wind components and temperature, is widespread, the main shortcoming of this method lies in the availability of instrumentation able to measure high frequency concentration values.
For these reasons, other simplified methods have been studied and developed, which allow to obtain an estimate of Fc without requiring high-frequency concentration measurements, which are thus more applicable to the case of odours.
More in detail, among the existing methods, the Gradient Method and the Relaxed Eddy Accumulation Method were investigated in this study, since they appear to be the most appropriate for the sampling of odorous compounds, because of their theoretical and practical simplicity.

The theoretical basis of these methods is presented, and their advantages and disadvantages are discussed. Moreover, their applicability to the estimation of odour emissions is discussed in detail by providing some practical suggestions about the most up-to-date and suitable ways to evaluate the most critical parameters needed for the calculation of the odour emission rate, and some numerical examples are reported as well.

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