

Integrated assessment of odour emissions using field olfactometry and chemometric modelling on the case of a municipal sewage pumping station

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The sewage systems are a critical infrastructure, and odour emissions from these installations are a considerable environmental and social concern in metropolitan settings. The objective of the research was to develop a comprehensive methodology for the qualitative and quantitative examination of odour emissions in real-world scenarios and evaluate the impact of odour using a municipal sewage pumping station as an example. The study integrated field measurements using dynamic olfactometry and sensor techniques with the examination of quantities of certain odoriferous substances (H_2S , NH_3 , VOCs). Meteorological characteristics, including wind speed, wind direction, air temperature and air humidity, were considered, facilitating the identification of circumstances favourable to odour occurrences. The study scope included a biennial measurement cycle, during which a series of measurements were conducted at the facility site, accounting for seasonal and daily variations. The methods used in the environmental impact assessment included perceptual, chemometric and statistical analyses. The investigation included Principal Component Analysis (PCA), generalised additive models (GAM, VGAM), and Cumulative Link Mixed Models (CLMM), with the creation of a Synthetic Odour Index (SOI) that integrated chemical, sensory, and meteorological data. The findings demonstrate a significant fluctuation in odour strength based on air temperature, wind velocity, and H_2S content. Emission patterns typical of background circumstances, seasonal episodes, and local exceedances of odour annoyance threshold values were determined. An integrated methodology that incorporates field measurements, chemometrics, and statistical modelling is an effective instrument for forecasting and alleviating odour emissions in wastewater systems. The findings validate the exceptional applicability of chemometric models in the examination of odour phenomena and provide a foundation for the creation of comprehensive odour monitoring systems in urban infrastructure.

Keywords: chemometric analyses; field olfactometry; Odour Activity Value; odour nuisance; odour perception modelling; Synthetic Odour Index; wastewater pumping station