**Challenges and advances in quantifying odour emissions from industrial sources: a case study on oil refinery tanks**

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Odour emissions from industrial activities are an increasingly relevant concern due to their impact on the quality of life in surrounding communities and the frequent emergence of complaints. In response, many countries have adopted regulatory frameworks that include Odour Impact Criteria (OIC), which define compliance based on odour concentrations and their allowed frequency of exceedance. However, the lack of international harmonisation leads to divergent assessment approaches and inconsistent mitigation strategies.

From a technical standpoint, several challenges complicate odour quantification. Many sources—such as wastewater basins, fugitive emissions, or hydrocarbon tanks—are diffuse, intermittent, or difficult to access. Standardised sampling and measurement methods are often lacking, and national practices vary considerably.

To assess population exposure, atmospheric dispersion modelling is widely recognised as a fundamental tool. However, its reliability is influenced by various factors. Meteorological inputs—whether from local observations or prognostic models—can lead to markedly different predictions. Model validation is also difficult due to the lack of reliable methods for measuring odour in ambient air. A particularly critical issue is the prediction of short-term peak concentrations, which are central to odour perception and regulatory thresholds. Unlike conventional air pollutants regulated by long-term averages, odour is driven by transient high-intensity fluctuations caused by turbulent dispersion. Accurately capturing these peaks requires temporally resolved emission data. This is especially relevant for hydrocarbon storage tanks, whose emissions are not continuous but occur as sporadic and intense events. Relying on average annual emissions can therefore underestimate the actual impact on receptors.

This study investigates the influence of the temporal variability of emissions on odour impact predictions for oil refinery tanks. Using real-world data, odour emissions were simulated with the CALPUFF atmospheric dispersion model, employing both annual-averaged and high-resolution time-resolved inputs. Results show that for fixed roof tanks, time-resolved data produced impact areas up to four times larger and local peak concentrations up to 300% higher. Conversely, for floating roof tanks, discrepancies between the two approaches are minimal, with variations typically below 10%, suggesting that a time-averaged approach may be adequate for this tank type. In this context, the study aims to contribute to the broader field of chemical engineering by advancing environmental assessment methodologies and promoting more reliable tools for managing diffuse emissions and supporting regulatory decision-making.

**Keywords**: *odour emissions, dispersion model, hydrocarbon storage tanks*