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ABSTRACT

ESTIMATING GAS-SIDE MASS TRANSFER COEFFICIENT FOR VOLATILISATION INSIDE A FLUX HOOD USING COMPUTATIONAL FLUID DYNAMICS

Kamila F. Cupertino[a], Ademir A. Prata[b], Bruno Furieri*[a], Richard Stuetz[b] and Jane Meri Santos[a]

[a]Federal University of Espirito Santo, Department of Environmental Engineering, Av. Fernando Ferrari – 514, Vitoria, ES, Brazil

[b]UNSW Water Research Centre, School of Civil and Environmental Engineering UNSW Sydney, NSW, 2052, Australia

Summary

Potential sources of odour emission in urban areas are wastewater treatment plants (WWTP) and landfills. Emissions occur on the passive surfaces of WWTP or landfills due to the interaction between the turbulent air flow sweeping the liquid-air or solid-air interface. Enclosed devices (such as flux hoods and portable wind tunnels) are usually employed sample emissions from passive surfaces in a controlled environment. Flux hoods were designed to produce homogeneous mixing and consequent uniform distribution of concentration inside the device. To create turbulent conditions and improve mixture, many authors have incorporated a fan inside the flux hood. Although some authors have pointed out that the compound can accumulate in the device, affecting sampling representativeness, the real conditions of odorous compounds concentration distribution is not available in literature. Especially, the effects of the fan mixing on the mass transfer phenomena and concentration distribution inside the headspace of the flux hood is not well known compared to the more standardized no-fan configuration. The present work proposes to understand the concentration distribution and to estimate the mass transfer coefficient of a gas phase-controlled compound (acetic acid) inside a flux hood using Computational Fluid Dynamics, evaluating the effect of varying sweep air flow rate and fan inclusion. The governing equations of continuity, momentum and chemical species conservation were solved using the finite volume numerical method implemented in the commercial software Ansys CFX. The main boundary conditions are: (i) no-slip conditions at walls and interface, (ii) prescribed air flow rate at the four holes, (iii) prescribed outflow rate at the probe and (iv) for chemical species equation, a fixed concentration was calculated for the interface based on the acetic acid liquid solution. The fluid flow was presumed Newtonian, isothermal, incompressible and steady. The no fan configuration showed particularly good agreement with the experimental work of Prata et al. (2018) considering the solution of turbulent effect through Reynolds Average Navier-Stokes turbulence modelling (κ-ω SST model). A laminar flow condition was also simulated for the no fan configuration to verify the implications of the turbulent flow assumption. Numerical simulation of flux hood modified by a fan evaluated if the interplay of fan

size, flow direction and inlet sweep air flow may change the sampling performance inside flux hood, in terms of mass transfer coefficient.

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¤ Odour/VOC measurement, monitoring&sensor technologies.
☐ Odour/VOC perception, impact, formation and dispersion.
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☐ Source characterization and odour/VOC mapping.
☐ Odour/VOC abatement, mitigation and neutralization.
☐ Odour/VOC from waste water, sewer systems and livestock.
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