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ABSTRACT

INFLUENCE OF PORTABLE WIND TUNNEL OPERATIONAL CONDITIONS ON THE EMISSION RATE OF AN ODORANT COMPOUND MEASURED OVER A PASSIVE LIQUID SURFACE

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Odorant compounds emitted to the atmosphere by Wastewater Treatment Plants (WWTP) or landfills can cause several deleterious effects on human health and the environment and annoyance to the nearby population. This problem became sharper with the rapidly growth of the population living close to these emitting sites. The portable wind tunnel (PWT) is one of the devices used to sample and monitor the odorant compound emitted from these area sources to a posterior estimation of its emission rate. Its design was made to better represent atmospheric process than the other largely used device, the dynamic flux chamber. The main section of the device is an open bottom channel and is placed over the emitting surface, from which the volatilized compound is transported using a carrier gas to a bag or sorbent tube for posterior chemical analysis or directly quantified using a gas-specific sensor. The mass transfer process inside the PWT is largely dependent on an accurate simulation of the friction velocity and a good mixture of the emitted compound in its inside. Its performance is still a matter of discussion and clearly motivates further investigations. The present work proposes to study the mass transfer coefficient of n-butanol inside the PWT original design by means of an experimental and numerical approach (Computational Fluid Dynamics – CFD). The experiments were done by placing the PWT over a tank filled with an n-butanol solution and using a specific flow rate of carrier gas. Using a spectrophotometer, the concentration in the liquid phase was measured and the mass transfer coefficient is estimated. To assess the influence of the carrier gas flow on the emission rate, this procedure was done for different sweep air flow rates. The temperature of the laboratory, head space of the equipment, and liquid phase was monitored. CFD was performed using the same boundary condition of the experiments (i.e., inlet flow rates, n-butanol concentration, and temperature). The mass transfer coefficients were validated using the data provided by the experiments described above. In literature, few works were found using CFD as a tool to provide a better understanding of the mass transfer phenomena inside the PWT and few experiments have been conducted to validate the numerical simulations. It is expected that the use of these two approaches allied, i.e., CFD and experiments, provides a rich understanding of the mass transfer processes within the device.

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