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ABSTRACT

INVESTIGATION OF FLOW INSIDE THE PORTABLE WIND TUNNEL THROUGH PARTICLE IMAGE VELOCIMETRY TECHNIQUE

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Summary

Odour is the sensation deriving from inhalation of certain concentration of a mixture of organic and inorganic substances. Although it is not associated with toxic and harmful health effects, it causes discomfort generating damage to well-being. Odour emission sources in urban regions are the wastewater treatment plants (WWTP) and the landfills, due to the low threshold concentration of the compounds emitted by these sources. Among the direct methods of monitoring, the Portable Wind Tunnel (PWT) has the potential to better simulate the atmospheric flow on the emitting surface and, therefore, better represent the physical processes involved in the emission. Some of the parameters which influence the representativeness of this device is the velocity distribution in the main section, the friction velocity on the emission source interface and the turbulent structures formed inside the equipment. The scientific community study the air flow inside such apparatus through Computational Fluid Dynamics (CFD) and single-point measurements with hot-wire anemometers to understand the flow behavior within the main section. However, there is a lack of available and trustful data for the validation of these numerical simulations and the previous cited experimental measurements may not be the best choice for the fluid flow found inside the apparatus. A non-intrusive, three-dimensional, and high frequency collection data seems to be a good option for solving these issues. Data collected through Particle Image Velocimetry (PIV) technique has been widely used for evaluating certain flows in the last decades, as for validating the numerical simulations. The present work aims to study the turbulent flow inside the PWT by means of PIV technique varying inlet sweep air flow rate and roughness condition, searching for a better understanding of aerodynamics of the device and to obtain experimental data that can serve as benchmark to numerical simulation validation. For this, the experiments were made using a standard PIV obtaining data in the frequency of 15 Hz. The visualization of flow and velocity field was possible by seeding olive oil with 1 μm diameter in the expansion zone of the PWT originally designed by Jiang et al. (1995). The Stokes number of seeding particles is about 10^{-7}, to assure that particles are following the flow. It is expected that the use of a robust technique such as PIV will bring great progress in understanding the flow inside

the device and, consequently, in the equipment's accuracy in measuring the emission from solid and liquid surfaces.

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