

DEVELOPMENT OF AN OFF-GAS TOOL UNDER THE SCOPE OF CIRCRRURAL 4.0

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ABSTRACT

Aeration flow operational costs are among the most important economic factors in the operation of a wastewater treatment plant (WWTP). Moreover, nitrous oxide (N₂O) emissions have been reported as an important source of green-house gas (GHG) emissions in WWTP operation. Our approach consists in measuring the off-gas mole ratio using an oxygen-sensitive gas sensor and calculating the percentage of oxygen transferred to the wastewater, which can be represented by oxygen transfer efficiency (OTE). This off-gas technique allows the simultaneous measurement and evaluation of both GHG emissions and the OTE. The integration of these measurements in a life cycle assessment (LCA) will contribute to minimizing emissions of GHG and aeration costs. The development of an off-gas analysis system capable of coupling the techniques for N₂O measurements and OTE evaluation was investigated. The developed tool was successfully applied in field measurements in the Charneca de Óbidos WWTP, operated by Águas do Tejo Atlântico (AdTA). The obtained results for OTE presented similar values for both off-gas and in-situ oxygen uptake rate methods. Several locations within the biological reactor were tested in order to study the variability of measurements regarding OTE and N₂O emissions. The obtained results for OTE ranged between a minimum value of 3.2 and a maximum of 34.1, with an average value of 17.97% ± 5.38. It was also performed an analysis of N₂O emissions, concluding that the conformation type of the biological reactor at Charneca de Óbidos WWTP results in low emissions during the treatment by activated sludge. Moreover, several important parameters regarding the discharged water quality were analyzed in order to understand the performance of the WWTP regarding nutrient removal. The data will be used for a LCA of the WWTP. The same approach will be applied in the Fregenal de la Sierra WWTP, operated by Promedio.

Keywords: Oxygen transfer efficiency; Nitrous oxide; Green-house gas; Wastewater Treatment Plant; Life Cycle Assessment



Figure 1 – Off-gas tool (1) and sensors for liquid phase measurements (2)

ACKNOWLEDGMENTS

This work was performed under the co-finance of the Interreg Sudoe program during the implementation of the project “CircRural4.0” (SOE2/P1/E0539). This work was supported by the Applied Molecular Biosciences Unit - UCIBIO which is financed by national funds from FCT (UIDB/04378/2020).

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