



Pulse respirometry for characterization of aerobic biodegradation process

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Introduction. Pulse respirometry consists in measuring the dissolved oxygen (DO) concentration after the injection of a defined concentration of substrate (S_p) into the system. The exogenous oxygen uptake rate (OUR_{ex}) curves reflect the kinetics and stoichiometry of the aerobic biodegradation process. In this work pulse respirometry of increasing concentrations was used in a bubble column to characterize the process.

Methods. The respirometric method used can be found in Ordaz et al., ⁽¹⁾. The bubble column had a volume of 4 L and it was inoculated with a mixed culture from a wastewater treatment plant. A concentrated solution of sodium acetate was prepared to inject pulses of varying volume into the reactor to reach a final concentration of 6.79, 13.57, 27.14, 40.72 and 54.29 COD L⁻¹. Equation 1 was used to calculate the growth yield ($Y_{X/S}$) and substrate oxidation yield ($Y_{O_2/S}$).

$$Y_{X/S} = 1 - Y_{O_2/S} = 1 - \frac{k_L a_{O_2} \int_0^t (C_b - C) dt + (C_0 - C_f)}{S_p} \quad (1)$$

Results. Figure 1 shows an example of respirograms obtained after the injection of 5 different substrate concentrations. Figure 2 shows the plot of Observed OUR_{exmax} against S_p of the respirograms presented in Figure 1. A clear Monod shape was observed, that was successfully linearized by the Hanes Woolf method (Eq. 2). The Hanes Woolf linearization allowed the estimation of maximum oxygen uptake rate and the substrate affinity constant.

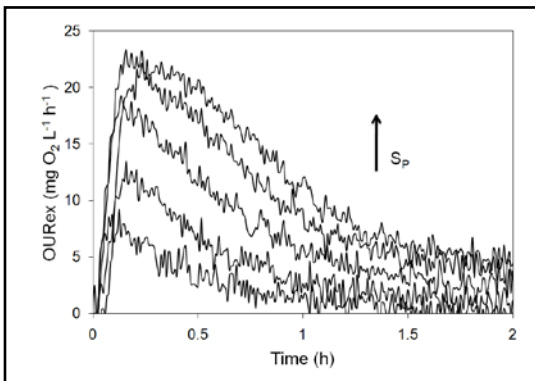


Fig.1 Observed OUR_{ex} at S_p of 6.79, 13.57, 27.14, 40.72 and 54.29 mg DQO L⁻¹

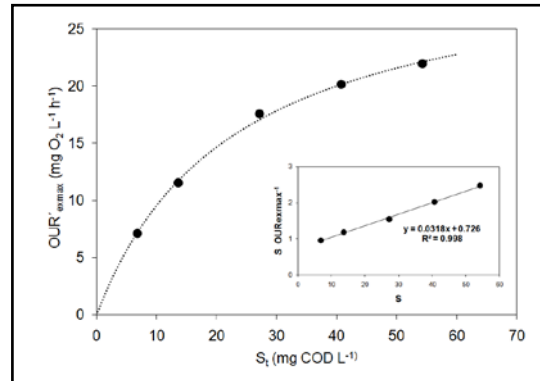


Fig.1 Monod curve of OUR'_{exmax} at S_t 6.79, 13.57, 27.14, 40.72 and 54.29 mg DQO L⁻¹. Figure within the main frame corresponds to the Monod model adjustment by Hanes Woolf linearization.

$$\frac{S_p}{Obs\ OUR_{ex\ max}} = \frac{1}{OUR_{ex\ max}} * S_p + \frac{K_s}{OUR_{ex\ max}} \quad (2)$$

From analysis of respirogram shown in Figure 1 and 2, four kinetic and stoichiometric parameters were obtained, including the affinity constant of acetate. Values obtained were similar to those reported in literature ⁽²⁾ when a mixed culture was used to degrade acetate.

Table 1. Kinetic and stoichiometric parameters

Parameter	Value
OUR_{exmax}	31.44 mg O ₂ L ⁻¹ h ⁻¹
K_s	22.83 mg O ₂ L ⁻¹
$Y_{X/S}$	0.39
$Y_{O_2/S}$	0.61

Conclusions. Pulse respirometry of increasing concentrations allows a faster kinetic and stoichiometric characterization of the bioprocess.

References.

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