MIXING TIME AND GAS HOLD-UP OF A DOUBLE-RISER RECTANGULAR AIRLIFT PHOTOBIOREACTOR WITH OFF-CENTERED DIFFUSER

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Introduction. Although microalgal biomass has proved its potential in different areas, microalgal biotechnology has progressed slowly due to the relatively high production cost of microalgae. It´s necessary to design novel production systems to make it cost- and energy-effective in order to achieve new industrial processes, environmentally friendly. Closed photobioreactors (PBR) can support higher photosynthetic activity and biomass productivity than open systems, but many engineering aspects remain unsolved.
The aim of this work was to evaluate the mixing time (t_m) and gas hold-up (ε) of a rectangular airlift photobioreactor with double-riser zone.

Methods. A double-riser rectangular airlift PBR with off-centered diffuser, 5 L working volume operating as a biphasic system (air-water) was used in this work (A_d / A_r = 0.66). Mixing time was evaluated by mean of the colorant method [1]. Gas hold-up (ε) was evaluated by mean of volumetric expansion method [2]. Mixing time and gas hold-up (ε) were determined at different superficial gas velocity (Ug) values, and then was related with calculated volumetric power (P/V) values [2,3].

Results. Figures 1 and 2 shows the values of t_m and ε dependent on Ug.

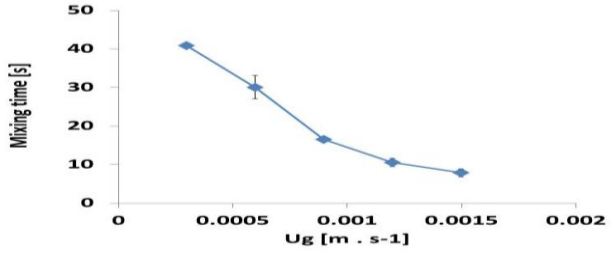

Fig.1 Mixing time (t_m) vs. superficial gas velocity (Ug).

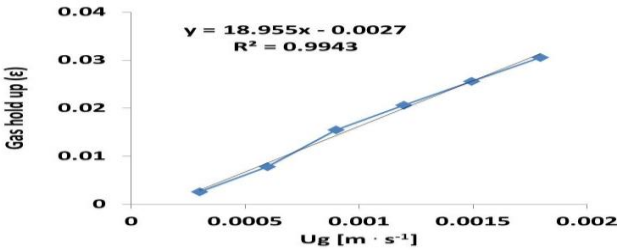

Fig.2 Gas hold-up (ε) vs. superficial gas velocity (Ug).

The relationship of t_m and ε with volumetric power (P/V) is shown in figures 3 and 4.

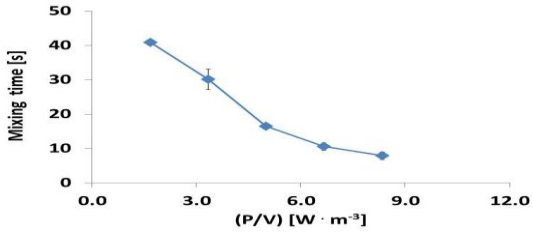

Fig.3 Mixing time (t_m) vs. volumetric power (P/V).

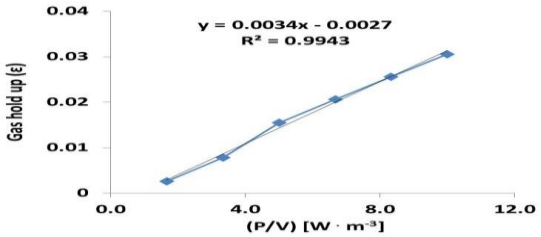

Fig.4 Gas hold-up (ε) vs. volumetric power (P/V).

Table 1 compares the ε and t_m values obtained in this work with values reported in literature for other PBR configurations.

Table 1. Comparison of ε and t_m among different PBR configurations.

PBR	Ug [m s^{-1}]	t_m	ε	Ref.
Flat-Panel	0.0180	33	0.007	(3)
Rectangular	0.0360	ND	0.016	(4)
H tubular	0.0120	39	0.067	(5)
Double riser	0.0014	8	0.026	This work

The t_m in our PBR was at least 300 % less than other PBR configurations; also the PBR shown ε values between 38 and 365% higher than other PBR reported previously.

Conclusions. Our results shown that hydrodynamic and P/V consumption in this PBR made it a promissory prototype for scale-up and application on microalgal biomass production systems.

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