Implementation of an ultrafiltration membrane in the thin-layer fotobiorreactors for terciary wasterwater treatment

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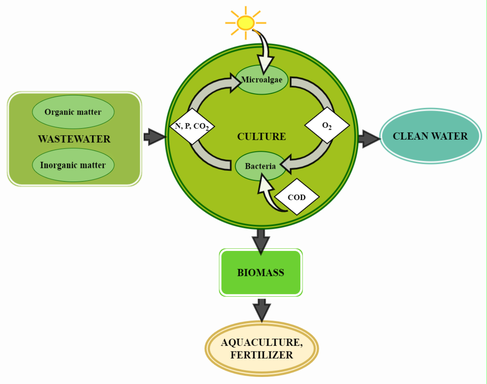
INTRODUCTION

A solution to the problem of scarcity of water resources is wastewater treatment. However, conventional technologies used to imply a high economic and environmental cost due to the associated energy consumption and greenhouse effect emissions. As an alternative, a treatment based on the existing consortium between microalgae and bacteria is proposed. To remove large amounts of nitrogen and phosphorus and therefore treat large volumes of effluents, a short hydraulic residence time and a long cellular residence time are necessary, which can be obtained with the introduction of ultrafiltration membranes.



OBJETIVE

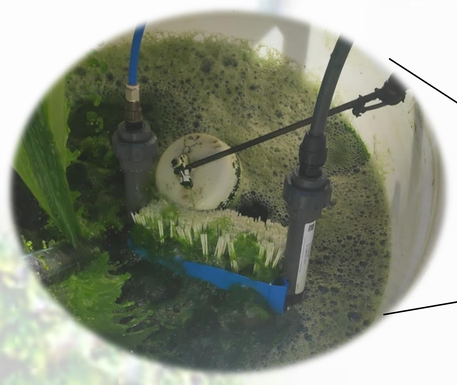
IGreater availability of nutrients avoiding limiting effects on biomass growth, in addition to increasing the capacity for removing nutrients from the medium

MATERIALS AND METHODS

Culture parameters

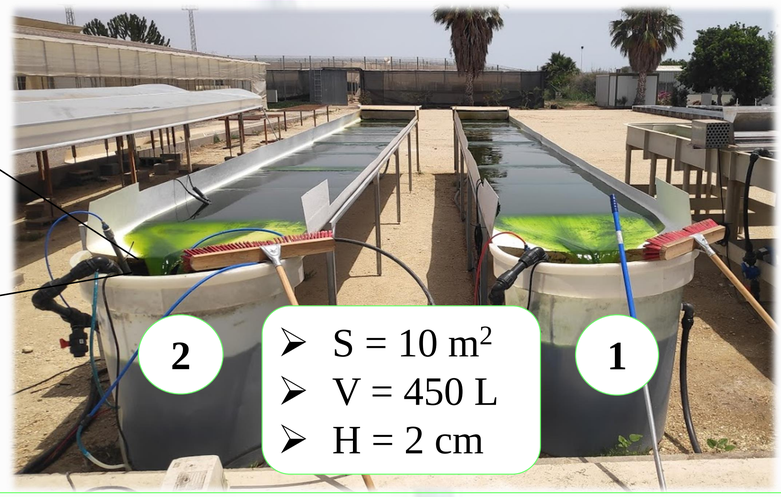
- Semi-continuous mode, 0.3 d^{-1}
- Strain *Scenedesmus* sp.
- Setpoint pH 8.0

Ultrafiltration membrane



- Poro size = 0.3 µm
- Qmáx = 80 L/h

Thin-layers



- S = 10 m^2
- V = 450 L
- H = 2 cm

RESULTS

THIN-LAYER 1											
TASK	OPERATING CONDITIONS	MEDIUM	CRT (day)	HRT (day)	Coefficient N (gN consumed/ gBiomass produced)	Coefficient P (gP consumed/ gBiomass produced)	Productivity (g/(m^2day))	Removal N-Total (g/m^2day)	Removal P-PO_4 (g/(m^2día))	Removal N-Total (kg/(ha·year))	Removal P-PO_4 (kg/(ha·year))
1	D = 30 % (135 L)	Fertilizer medium	3	3	0,10	0,020	27	2,75	0,45	8250	1350
2	D = 30 % (135 L)	Fertilizer medium	3	3	0,10	0,020	34	2,71	0,36	8130	1080
3	D = 30 % (135 L)	Fertilizer medium	3	3	0,11	0,020	23	2,55	0,47	7650	1410
4	D = 30 % (135 L)	Fertilizer medium	3	3	0,13	0,020	21	2,64	0,47	7920	1410
5A	D = 30 % (135 L)	Wastewater secondary	3	3	0,08	0,001	11	0,82	0,01	2460	30
5B	D = 30 % (135 L)	Wastewater secondary	3	3	0,13	0,006	10	1,32	0,06	3960	180
THIN-LAYER 2											
TASK	OPERATING CONDITIONS	MEDIUM	CRT (day)	HRT (day)	Coefficient N (gN consumed/ gBiomass produced)	Coefficient P (gP consumed/ gBiomass produced)	Productivity (g/(m^2day))	Removal N-Total (g/m^2day)	Removal P-PO_4 (g/(m^2día))	Removal N-Total (kg/(ha·year))	Removal P-PO_4 (kg/(ha·year))
1	D = 30 % (135 L)	Fertilizer medium	3	3,0	0,10	0,020	31	2,73	0,45	8190	1350
2	D = 30 % (135L) with double medium input of N	Fertilizer medium, N (200%)	3	3,0	0,15	0,020	37	3,80	0,15	11400	450
3	D = 30 % (135L) + UFM (135 L) = 270 L médium	Fertilizer medium	3	1,7	0,23	0,050	15	3,37	0,76	10110	2280
4	D = 30 % (135L) + UFM (51 L) = 186 L médium	Fertilizer medium	3	2,4	0,18	0,035	18	3,19	0,63	9570	1890
5A	D = 30 % (135L) + UFM (400 L) = 535 L médium	Wastewater secondary	3	0,8	0,30	0,0014	8	2,38	0,01	7140	30
5B	D = 30 % (135L) + UFM (600 L) = 735 L medium	Wastewater secondary	3	0,6	0,40	0,014	14	5,58	0,20	16740	600

CONCLUSIONS

With a 1 ha reactor, it would be possible to eliminate 16740 kg N·$year^{-1}$. Indeed according to Annex III of Royal Decree 261/1996, the maximum amount of nitrogen from conventional treatment that can be disposed directly into the soil cannot be larger than 170 kg·ha^{-1}·$year^{-1}$. Microalgae was shown as an alternative and solution to remove more nitrogen from waste, minimizing land requirements and producing valuable biomass that could be further used for agricultural applications.

ACKNOWLEDGEMENTS

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