ECWS-8 2024 Conference
The 8th International Electronic Conference on Water Sciences
14–16 October 2024 | Online
MDPI

Optimizing the dissolved oxygen requirements for effective pollutant removal from coastal aquaculture wastewater aiming at water recycling

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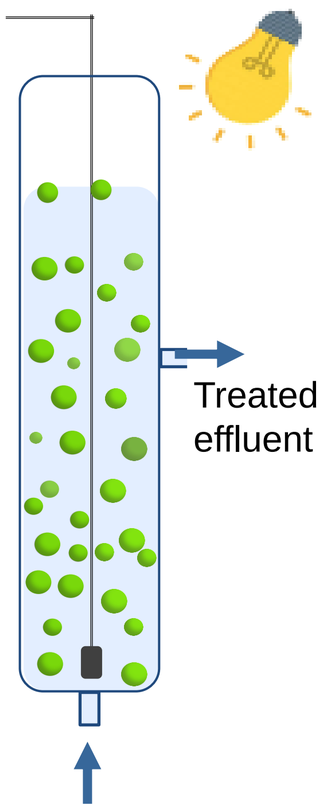
INTRODUCTION & AIM

Wastewater treatment presents a pressing global challenge, emphasizing the urgent need for more sustainable solutions. In the pursuit of energy and carbon neutrality, microalgal-bacterial granular sludge (MBGS) systems have emerged as a promising alternative, leveraging the symbiotic relationship between microalgae and bacteria within granules in terms of gas exchange. MBGS systems offer efficient treatment but also hold the promise for substantial energy savings and greenhouse gas emissions reduction.

This study aimed to ascertain on the dissolved oxygen threshold required for efficient pollutants removal from coastal aquaculture aiming at water recycling in industrial settings.

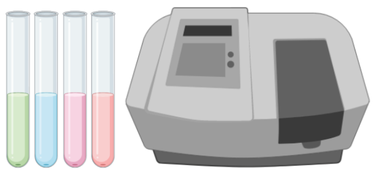
METHODOLOGY



The MBGS system was subject to a gradual reduction of the airflow rate

Phase	Operational days	Airflow rate (L min $^{-1}$)
I	0 - 79	3.0
II	80 - 106	2.5
III	107 - 120	2.0
IV	121 - 134	1.5
V	135 - 141	1.0

Evaluated parameters over time:



Nutrients removal performance

Granules morphology

RESULTS & DISCUSSION

Nutrients removal performance

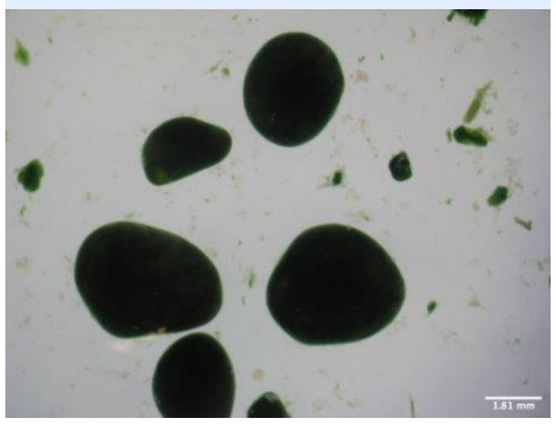
	Concentration (mg L^{-1})					
	NH_4^+-N		NO_2^--N		NO_3^--N	
Phase	WW	Effluent [a]	WW	Effluent [a]	WW	Effluent [a]
I		0.02 ± 0.03		1.09 ± 0.71		2.15 ± 1.45
III		0.00 ± 0.00		2.33 ± 0.38		2.17 ± 0.59
III	0.30	0.00 ± 0.00	0.25	2.65 ± 0.35	8.0	2.10 ± 0.00
IV		0.00 ± 0.00		1.50 ± 0.71		1.15 ± 0.07
V		0.00 ± 0.00		0.35 ± 0.00		0.70 ± 0.00

[a] Mean ± standard deviation

- Regardless of the airflow rate, complete ammonium removal was consistently achieved.
- Lower airflow rates appeared to enhance nitrite and nitrate removal.
- The composition of treated effluents met toxicity limits for fish, enabling water reuse in aquaculture facilities.

Granules morphology

Phase IV



Phase V

- Airflow rates below 1.5 L min^{-1} promote the outgrowth of filamentous microorganisms on granules surface, compromising their efficient separation from the treated water.

CONCLUSION

MBGS systems can effectively reduce aeration needs, up to a certain level, without compromising the treatment performance, thus improving the ecological footprint of the treatment process.

ACKNOWLEDGMENTS

This work was financed by Norte 2020 through the Project 3BOOST (POCI-01-0246-FEDER-181302). Authors thank the CBQF scientific collaboration under the FCT project UIDB/50016/2020.