

## Accepted Manuscript

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PII: S0960-8524(17)30180-3

DOI: <http://dx.doi.org/10.1016/j.biortech.2017.02.057>

Reference: BITE 17629

To appear in: *Bioresource Technology*

Received Date: 25 December 2016

Revised Date: 14 February 2017

Accepted Date: 15 February 2017



Please cite this article as: Najm, Y., Jeong, S., Leiknes, T., Nutrient utilization and oxygen production by *Chlorella Vulgaris* in a hybrid membrane bioreactor and algal membrane photobioreactor system, *Bioresource Technology* (2017), doi: <http://dx.doi.org/10.1016/j.biortech.2017.02.057>

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# Nutrient utilization and oxygen production by *Chlorella Vulgaris* in a hybrid membrane bioreactor and algal membrane photobioreactor system

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## Abstract

This work studied oxygen production and nutrient utilization by *Chlorella Vulgaris* at different organic/inorganic carbon (OC/IC) and ammonium/nitrate ( $\text{NH}_4^+\text{-N}/\text{NO}_3^-\text{-N}$ ) ratios to design a hybrid aerobic membrane bioreactor (MBR) and membrane photobioreactor (MPBR) system. Specific oxygen production by *C. vulgaris* was enough to support the MBR if high growth is accomplished. Nearly 100% removal (or utilization) of  $\text{PO}_4^{3-}\text{-P}$  and IC was achieved under all conditions tested. Optimal growth was achieved at mixotrophic carbon conditions ( $0.353\text{ d}^{-1}$ ) and the highest  $\text{NH}_4^+\text{-N}$  concentration ( $0.357\text{ d}^{-1}$ ), with preferable  $\text{NH}_4^+\text{-N}$  utilization rather than  $\text{NO}_3^-\text{-N}$ . The results indicate the potential of alternative process designs to treat domestic wastewater by coupling the hybrid MBR - MPBR systems.

**Keywords:** Algae; Membrane bioreactor; Membrane photobioreactor; Nutrients; Specific oxygen production

## 1. Introduction

An imbalanced relationship between urban growth and available fresh water supply is creating a worldwide demand for sustainable technologies involving the reuse of treated wastewater. Membrane bioreactor (MBR) process, which combines microfiltration (MF) or ultrafiltration (UF) membrane

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