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ASSESSING THE PARAMETERS AFFECTING THE PROCESS OF pH-INDUCED FLOCCULATION IN THE FRESHWATER MICROALGAE *Chlorella vulgaris*

J. Saúl García-Pérez
Water Center for Latin America and Caribbean, ITESM, Monterrey, México, garcia.saul@live.com

Annelies Beuckels
KU Leuven KULAK, Kortrijk, Belgium, annelies.beuckels@kuleuven-kulak.be

Diana L. Cárdenas
Water Center for Latin America and Caribbean, ITESM, Monterrey, México, diana.cardenas@itesm.mx

Faculty Mentor:
Koenraad Muylaert[a] and Roberto Parra[b]
[a]KU Leuven Kulak, Kortrijk, Belgium, Koenraad.Muylaert@kuleuven-kulak.be
[b]Water Center for Latin America and Caribbean, ITESM, Monterrey, México, r.parra@itesm.mx

ABSTRACT

Microalgae are photosynthetic microorganisms capable to convert solar energy into biomass. During the growing process, CO_2 can be mitigated, wastewater can be depurated of several contaminants and also it's possible to produce high value products. Prior the downstream process it's necessary to harvest the biomass, steps usually accomplished by centrifugation which accounts approximately 70% of the total energetic cost in the whole process. pH flocculation induced by MgOH is a cost-effective alternative to harvest microalgae and it doesn't affect the bioproduct recovery. In this work, several parameters are tested to enhance the flocculation process of the microalgae *Chlorella vulgaris* are assessed, such as the flocculation efficiency and the compaction factor in response to different pH levels and biomass concentration.

1. INTRODUCTION

Microalgae are capable of growing in less area than normal crops and it's considered that they have a great potential as a source of biomass (Lee, 2011). Some of the current applications of microalgae are biofuel generation, wastewater treatment, CO2 mitigation and high value products generation (Del Campo,et al, 2007). The two major drawbacks in the microalgae bulk production for cost-effective fuels and feed are in first place the high culturing costs and in second place, the harvesting step which usually is achieved by high-speed centrifuges (Schlesinger, et al, 2012). The total harvesting costs are estimated at 18.5% of the total production costs (Smith & Davis, 2012) which is unacceptable in low-cost applications. Centrifugation represents the major fraction of the total energy needed for production (Uduman, et al, 2010). As an alternative, the flocculation based on pH increase, usually referred as autoflocculation, has been suggested. It has been demonstrated that it's possible to flocculate algae by addition of Mg^{2+} and pH increase (Vandamme, et al, 2012). The objective of this work was to test parameters of practical importance related to the pH induced flocculation process in order to enhance it.

2. METHODS

Chlorella vulgaris was used as a model species. *Chlorella* was cultured in WC medium (Guillard, et al, 1972) in a 30L plexiglass bubble column photobiorreactor stirred by aeration with 0.2 um filtered air and pH control to 8.0 by automatic CO_2 addition. All of the experiments were carried out in the stationary phase (one week old). The flocculation experiments were performed in two different scales (100ml and 1000ml). The microalgae was transferred to the beakers and stirred. The pH was adjusted by addition of 0.5 M HCl or 0.5 M NaOH and the suspension was mixed for 10 minutes and settled for 30 min. The flocculation efficiency was assessed by measuring the optical density at 750 nm. The

pellet volume was measured transferring the suspension to a measuring cylinders or cones.

3. RESULTS.

When magnesium concentrations (added as $MgSO_4$) were tested in different levels (0.01, 0.03, 0.1, 0.3 and 1 mM) and at different pH levels (10 to12 with 0.5 steps), it was observed that the flocculation efficiency is clearly affected by pH at any magnesium concentration. Different biomass concentrations were tested as a factor influencing the flocculation efficiency, taking as a basis 0.5 g/L of biomass concentration as the dry weight (DW) and 0.25DW, 0.5DW, 1DW, 2DW and 4DW were tested at two different magnesium concentrations (0.5 and 1.5 mM) and it was observed that the most higher values of biomass were inhibiting the flocculation process, possibly because of the ions lack needed for the neutralization of the cell wall surface. The pellet volume was also tested at different Mg concentrations (1,5,10 and 15 mM) at three pH levels (10.5, 11 and 12) and it was observed a clear effect of the magnesium concentration in this parameter: the most Mg concentration the most big pellet was observed. It also was found a relationship between this and the percentage of magnesium remaining in the medium after flocculation.

4. CONCLUSIONS.

Some of the most important parameters affecting the pH induced flocculation of *C. vulgaris* were assessed, discovering some important practical implications such as the importance of the magnesium concentration, pH level and biomass concentration in the flocculation efficiency and pellet volume.

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