



**PHYSICAL CHARACTERISTICS OF
PLEUROCHRYSIS CARTERAE IN RELATION TO HARVESTING
POTENTIAL FOR BIODIESEL PRODUCTION**

By

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A thesis submitted for the degree of Master of Engineering Science

March 2009

Declaration

This work contains no materials which have been accepted for the award of any other degrees or diploma in any university or other tertiary institution, to the best of my knowledge and belief and contains no material previously published or written by another person, except where due reference has been made in the text.

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Marjan Rahbari

Feb2009

Acknowledgements

First and foremost, I would like to express the sincerest appreciation to my supervisors, Dr Peter Ashman and Dr David Lewis. I have learnt a lot especially when it comes to learning in English as second language. I would like to thank them for their technical and academic supervision.

I have been very fortunate in the support of my family. As for my Parents, my brothers, sister-in-law, nephews and my little angel Negar, I appreciate you for all you have done.

My special thanks also go to my close friends in Adelaide especially Ms Homeyra Bozorgmehr and Johnson's family for their wonderful support and encouragement.

The other people I also like to thank the Chemical Engineering school staff, in particular, Mr Andrew Wright and Mrs Mary Barrow and colleagues in the MERG group. Their help and contributions made this work possible. Thanks to Dr Bill Wisner for editing this thesis.

Last but not least, I will forever be grateful to Mr Shamsoldin Haeri (Ershad Ali). I thank him for his spiritual advices. I owe you so much for your help over the past years.

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Abstract

During the last three decades, microalgae has been suggested as a potential source of biofuel, with a number of advantages over other energy crops. These advantages, including high lipid content, fast growth rate, reduced requirements for land and the possibility of utilizing marine water systems constitute the most likely sources for CO₂ reduction systems. However, no commercial plant has been established to date. This is because of the high capital cost of microalgal systems and the many uncertain aspects of harvesting small cells (<20µm) from dilute cultures (~1g/l). Therefore, this project aims to investigate the physical characteristics of *Pleurochrysis carterae*, a potential biofuel feedstock, with a view to understanding the fundamental characteristics of this species during large-scale harvesting.

The preliminary study of cell growth cycle in the laboratory showed that; *P. carterae* grows quickly in BG11 media with 1.8% salinity. The maximum cell concentration after 20 days was ~0.5 g/l. Also, large flocs (120µm) were observed early in the growth phase (day 4) and the stationary phase (day20).

In order to calculate the theoretical settling rate some parameters, such as cell size distribution and medium viscosity, were measured. The results indicated that cell size grew from 3.8µm at the inoculation to 11.7 µm at the end of the growth cycle. Also, the viscosity of the suspension was independent of cell concentration and is identical to that of seawater (0.001Pa.s). The theoretical settling rate, based on Stokes' law yielded, 1.4×10^{-6} m/s. Screen tests from column settling tests showed that the terminal settling rate of *P. carterae* cells is 4×10^{-4} m/s, which is faster than the predicted rate. It was estimated that 91% of cells, without any pre-treatment, and during 12 hour experiments, settled to the bottom of the columns. It shows flocculation is a potential method for a low cost harvesting in large scale biomass production.

The effect of shear stress on cell viability after centrifugation with various gravity forces was also assessed. The results showed that the number of broken cells

increased at higher shear stress and that maximum cell disruption occurred after harvesting with $11000 \times g$ force.

Results from laboratory in this study indicate that further optimisation need to be done to increase *P. carterae* harvesting efficiency toward the minimum cost, thus achieve economic biodiesel product.

P. carterae is a potential candidate for commercial scale biofuel production with significant advantages including high growth rate, low contamination risk and fast settling velocity. The use of a primary flocculation stage with secondary continuous centrifugation is potentially suitable for low cost commercial harvesting. However, still more work needs to be done to demonstrate the feasibility of large-scale production of biofuel from microalgae.