Investigation of the closed loop processing systems developed for microalgal biofuels.

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Declaration for a thesis that contains publications

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Thesis by publication

This doctoral thesis is submitted as a portfolio of peer-reviewed publication according to the “PhD Rules & Specification for Thesis” of the University of Adelaide. The journals in which these papers were published or accepted are closely related to the research field of this work. The citation information is listed and the journals ranked in the order of impact factor in reference to their scientific significance.

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The thesis is composed of the following papers:


The following additional outcomes resulted from PhD work associated with the research carried out:

Mason Erkelens, Peter Forward, Martin Lambert, *The bacterial community within a 28km bore system with iron bacteria.* Submitted.


Awards

2012 Awarded Travel research scholarship

2012 Joint Research Engineer scholarship

2012 EMBL PhD travel symposium scholarship

2012 Awarded EMBL PhD research travel scholarship
If I want to summarise my thesis in one sentence, I would say:

“Looks like pea soup, but it’s actually the future of crude oil production.”

Mason Erkelens

December 2014.
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Abstract

The algal biofuels industry is under development and being investigated at large scale all around the world. To improve the viability of algal biofuels the ability to use closed loop systems that recycle waste and water thereby decreasing the overall waste produced while increasing profitability is being investigated. The aim of this work was to investigate closed loop systems associated with the algal biofuel production, focusing on its effects on the production of algal biomass and lipid and on the natural microbial community. The key areas of algal production that have been the focus of the research are the introduction of water, and the recycling of water and the recycling of waste produced during the biomass to biofuel stage of the microalgal biofuel process. Water is a key part of microalgal biofuel production; the source of water can contain many different microorganisms that can affect microalgal growth.

Recycling waste streams back into the culture as a nutrient stream is an effective way to reduce the cost of production. Within this thesis I investigated two waste streams as a potential nutrient stream, microalgae digestate and the hydrothermal liquefaction aqueous phase (Chapter 3 and 4). I observed that high concentrations of either of the waste streams resulted in reduced growth in comparison to F/2 media. Negative growth was associated with high concentrations of ammonia, and the effect of the use of waste streams was species dependent.

There is currently little known about the changes in the bacterial and algal communities during the harvesting/recycle process. Within chapter 5 and 7 I investigated the bacterial and algal diversity present during these processes. It was observed that while the electroflocculation stage had little impact on the bacterial community, the centrifuge stage was shown to have a much higher impact on the bacterial community. The recycling process also increased the dominance of Tetraselmis MUR233 over various recycle stages. A benefit of recycling is the
prevention of undesired microorganisms entering into the culture. One microorganisms that is of interest is Protozoa, due to the potential damages to microalgae biomass production.

Within chapter 6 I observed the effects of protozoa within the culture; it was observed that was no significant difference between the final total lipid or final total dry weight produced in the presence and absence of protozoa. This study shows the ability of *Tetraselmis MUR233* to outgrow any potential damage caused by the presence of the protozoa.

Developing further understanding of these processes can help improve potential outcomes when these processes are undertaken.
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Abstract

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