

Project Number & Title: 4A-108 - Comparison of different cultivation systems for treating anaerobic digestion piggery effluent (ADPE).

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Aims and Objectives

Project aims:

1. Design and construct prototypes of inclined thin layer plate photo-bioreactor and inclined open pond systems.
2. Compare the growth, biomass productivity and nutrient removal (C, N and P) rates of isolated microalgae on inclined pond against paddle wheel driven raceway pond.
3. Optimising growth in both cultivation systems for maximum nutrient removal rates.
4. Analyse the nutrient composition of algal biomass.
5. Undertake a cost-benefit economic assessment and CO₂ bioremediation of large scale production.

Project deliverables:

1. Designing a novel system for treating ADPE.
2. Assessing the biomass productivity of selected microalgae grown on ADPE in all reactors.
3. Assessing ADPE nutrient removal rate grown in different cultivation systems.
4. Assessing the biochemical composition of the biomass (potential suitability as pig feed).
5. Assessing detailed economics.

Key Findings

1. When operated at 1 cm depth, algal culture grown on ADPE in an inclined pond showed higher volumetric biomass productivity and nutrient removal rates compared to culture grown in a raceway pond with the same surface area.
2. Due to large volume of culture in raceway pond, the overall aerial biomass productivity and nutrient removal rate of algal culture grown in raceway pond was significantly higher than inclined pond.
3. *Chlorella* and *Scenedesmus* were the most dominant species in both ponds. During batch growth, *Chlorella* dominated the culture in both ponds. However, when ponds were operated semi-continuously, *Scenedesmus* became the dominant species.
4. Efficiency of Ammonium removal rate in inclined pond was 1.4 times greater than the culture in raceway pond.
5. Algal culture in raceway pond showed significantly higher lipid content compared to the culture in inclined pond.
6. Based on the overall biomass productivity and nutrient removal rate, raceway ponds were found to be a more efficient cultivation system than inclined ponds.

Application to Industry

Our results clearly indicated that both raceway and inclined ponds could be used for treating ADPE. Based on the outcome of the current study, raceway ponds can be recommended to the industry. We have so far treated ADPE using 1 m² and 11 m² raceway ponds. We are currently assessing the economics and design of a large-scale treatment facility based on the outcome of our studies through Pork CRC 4A-106 project (to be completed by February 2018). A detailed pilot and demonstration study is the next obvious stage towards commercialisation of our proposed process.