

Idaho Incubation Fund Program

Progress Report Form

Proposal No. IF18-001
Name: Kevin Feris and Erik Coats
Name of Institution: Boise State University
Project Title: Operation, Optimization, and Evaluation of a Pilot Scale Algae Resource Recovery Unit
Reporting Period: July 1, 2017 to June 30, 2018

Information to be reported in your progress report is as follows (attach additional information as needed):

- Summary of project accomplishments for the period just completed and plans for the coming reporting period:

Task 1 – Continue operations and data acquisition from of the ARRU for a full growing season (i.e. through September/October 2018):

The ARRU was operated continuously into September 2017. Operations ended 9-4-17 as night time temperatures were becoming cool, the lagoon water required for one of our treatments was no longer available (the UI dairy had conducted their annual lagoon draining to irrigate local fields), and smoke from wildfires in the region made it unsafe to work outdoors. We focused our efforts on sample analysis and data interpretation. As of 12-18-17 we have completed our algal biomass productivity measures (Figure 1) and our nutrient uptake measurements (Figure 2). Here we present just results of phosphorus uptake, however nitrogen uptake rates illustrate similar patterns. On-going work is measuring the biomass quality of the cultivated algal biomass

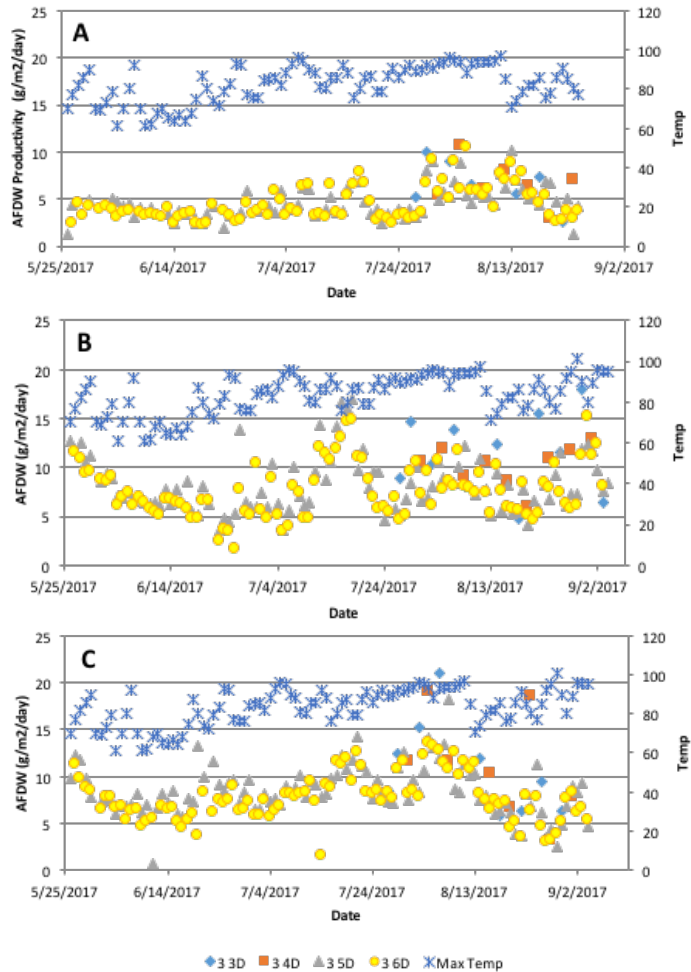


Figure 1. Algal biomass produced in the ARRU across all three treatments (A: Lagoon water; B: AD/PHA effluent mixture (10:90); C: 100% PHA effluent) measured as ash free dry weight (AFDW) and maximum daily temperature.

(i.e. protein content, carbohydrate content, lipid content, and ash content). Information integrated across the full growing season run will be used to estimate capital and operating costs for a full scale ARRU and inform presentation of value propositions for potential commercialization.

Project plans for reporting period 1-1-18 to 6-30-18:

During the final six months of this project we will complete our analysis of the ARRU samples collected during the spring/summer/fall 2017 operational period. This will include finalizing our measures of biomass quality, nutrient capture, and biomass productivity. We will compare these measures to environmental and operational factors monitored during the operational period as a means by which to better understand the limits on algal productivity and nutrient capture. These analyses will then also be used to make projections of the economic potential of the technology when operated as a stand alone system as in concert with a PHA/AD treatment system. These projections will then be used to estimate the economic potential of our integrated system and subsequently be used to present the value of the technology to potential commercial partners.

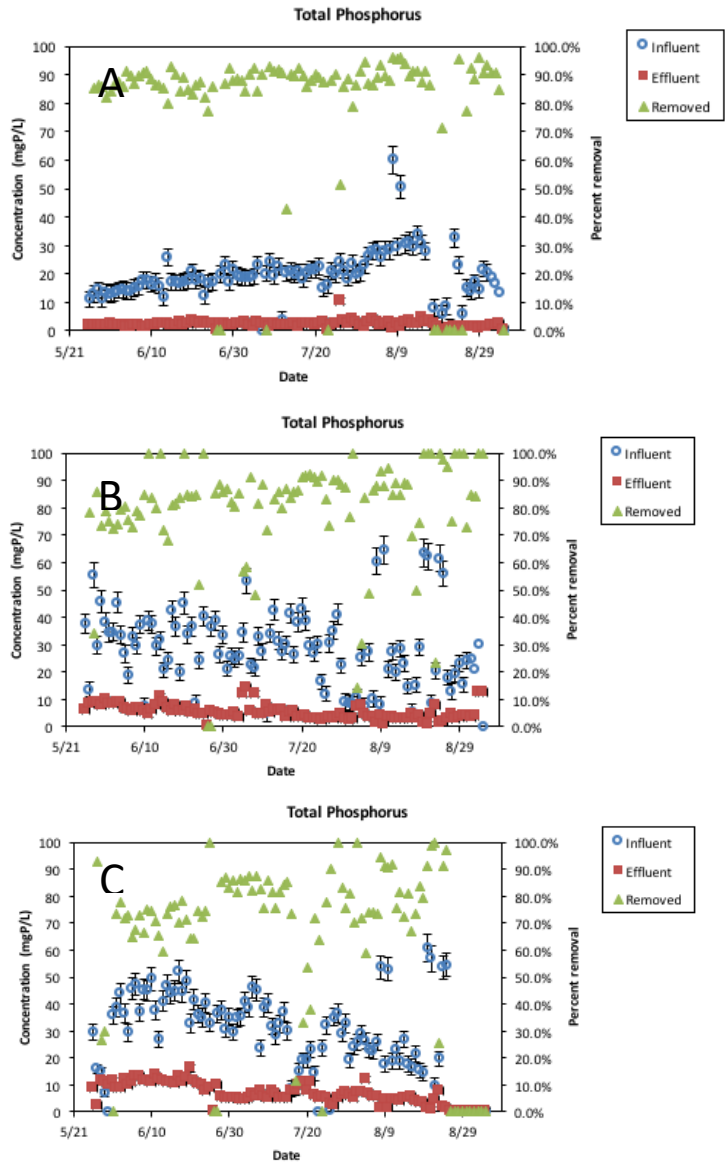


Figure 2. Nutrient update (i.e. Total Phosphorus removal) by the ARRU across all three treatments (A: Lagoon water; B: AD/PHA effluent mixture (10:90); C: 100% PHA effluent) for the full duration of operation.

2. Summary of budget expenditures for the period just completed (include project burn rate):

\$26,134 of the awarded \$34,198 has been expended as of 11-14-17. This represents 76% of the project budget. Given that the majority of the experimental work associated with this proposal was slated to occur between 7-1-17 and 9-30-17 associated with

system operations, it is appropriate for the majority of the funding to be expended during this period. The remaining budget will be expended during the 2nd half of the project to support the remaining data collection and data analysis.

3. Numbers of faculty and student participation resulting from the funding, including internships:

2 tenured faculty:

Dr. Kevin Feris (Boise State University) and Dr. Erik Coats (University of Idaho)

1 PhD student

Nicholas Guho (University of Idaho)

5 Undergraduate research assistants

Gary Dunn (Boise State University)

Katie Maries (University of Idaho)

Alex Crozes (University of Idaho)

Cody Barrick (University of Idaho)

Andrew Blanchard (University of Idaho)

Kyle Allen (University of Idaho)

1 Research Scientist

Cindi Brinkman (University of Idaho)

4. List patents, copyrights, plant variety protection certificates received or pending:

No invention disclosures, patents, copyrights, etc. have been filed as of yet for this project. However, our on-going analyses may yield opportunities for such filings, we are not currently ready to pursue such activities.

5. List technology licenses signed and start-up businesses created:

No technology licenses or start up businesses have been filed or created as of yet for this project. However, we are actively discussing how to pursue commercialization of the technology optimized in this project. However, we will need to finalize our data analysis to as part of that discussion to finalize our strategies.

Status of private/industry partnerships (include enough information to judge level of engagement):

As part of this project we are pursuing development of a Industrial advisory group (IAG) as a means by which to present our findings, gather feedback on the viability of the ideas in real world applications, and seek input on our plans for future commercialization. Our overall goal is to leverage the expertise of these industry professionals to help realize technology commercialization. Currently we are assembling an IAG associated with a new USDA award that consists of members of the Idaho Dairymen's Association and the Washington Dairy Products Commission. We will leverage this group for discussions of the work performed associated with this project as well.

6. Any other pertinent information that will indicate to the council that the project is meeting satisfactory progress.

History and on-going success of the collaboration between Drs. Feris and Coats:

Dr. Feris and Dr. Coats have been collaborating for approximately 10 years on wastewater to biopower-bioplastics-algae systems. We have received funding through the US Department of Agriculture (USDA), Idaho National Laboratory (INL) and the Center for Advanced Energy Studies (CAES), and the Environmental Protection Agency (EPA) in support of this work.

The ARRU pilot-scale system we constructed as part of our prior SBOE award and continued operation and optimization of as part of this project was recently used as the basis for successfully pursuing additional extramural research funding. We recently received word that a pending proposal at the USDA has been selected for funding. That proposal was in part supported by the preliminary data generated from our ARRU and will allow us to continue the work and system optimization well beyond the scope of the project supported by the SBOE. We are optimistic that the SBOE funding coupled with additional USDA support will yield novel insights and further allow us to bring the combined PHA-AD-Algae technology to commercialization.