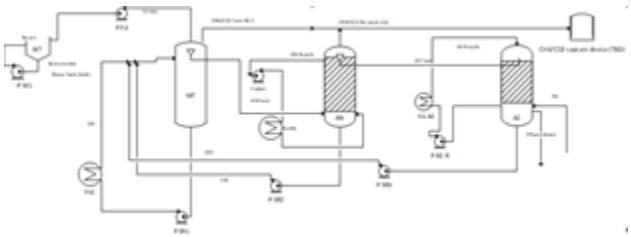
Hawai‘i Natural Energy Institute Research Highlights

Alternative Fuels

High Rate Anaerobic-Aerobic Digestion

OBJECTIVE AND SIGNIFICANCE: To produce a master design, inclusive of PID diagrams, costing, manufacturing, and shipping to build and install a wastewater treatment system designed from past research and commercial demonstration projects. Its importance lies in its commercial scale modular-based designed. The system fits niche opportunities where concentrated wastewater streams need to be treated on-site prior to discharge to pre-existing wastewater lines. The modular nature allows non-concrete permanent installations that can be tailored to specific wastewater flows and concentration of pollutants.

BACKGROUND: Over a number of years, an up-flow anaerobic packed bed reactor was developed. Packed with biochar in various formulations, these reactors were verified at lab and demonstration scale to treat high and low strength wastewaters efficiently. These exercises served to verify lab generated results upon scale up to commercial size and to provide crucial insights for design revision, as well as experience for discussion with manufacturers as well as equipment selection.



From this work, PID diagrams have been constructed that have considered targeted organic loading rates and hydraulic retention times. These designs are accounting for modular fabrication of reactor units, dimensions of reactors and pipes, piping size, recycle lines, details of how to install and connect modules, utilities and electrical, materials of construction, sources of manufacturing, packing materials, shipping and installation issues, among others. Finally, cost estimates for fabrication, shipping, and installation were estimated and three-dimensional renderings were generated.

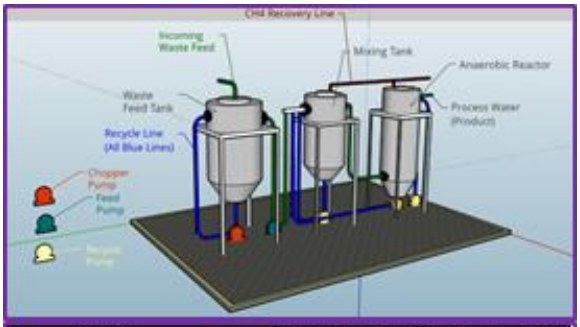


	Table 1	High Carbon Feed	Low Carbon Feed
Subsystems	Tanks/Reactor Vessels	$126,000.00	$126,000.00
	Pumps	$67,742.50	$71,000.00
	Sensors and Heaters	$30,661.20	$30,661.20
	Total	$224,403.70	$227,661.20

PROJECT STATUS/RESULTS: This project has produced a number of works that can be found on the following page. While this project was dormant during 2021, the PI continues to seek industrial partners to apply the system. The PI will support testing.

Funding Source: Office of Naval Research

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ADDITIONAL PROJECT RELATED LINKS

TECHNICAL REPORTS:

1. 2014, M.J. Cooney, **Anaerobic Digestion of Primary Sewage Effluent**, Report produced for the ***Hawai'i Energy Sustainability Program (HESP)***, under U.S. Department of Energy Grant Award DE-EE0003507.

PAPERS AND PROCEEDINGS:

1. 2020, S. Lin, K. Rong, K.M. Lamichhane, R.W. Babcock, M. Kirs, M.J. Cooney, **Anaerobic-aerobic biofilm-based digestion of chemical contaminants of emerging concern (CEC) and pathogen indicator organisms in synthetic wastewater**, Bioresource Technology, Vol. 299, Paper 122554.
2. 2019, M.J. Cooney, K. Rong, K.M. Lamichhane, **Cross comparative analysis of liquid phase anaerobic digestion**, Journal of Water Process Engineering, Vol. 29, Article 100765.
3. 2017, K.M. Lamichhane, K. Lewis, K. Rong, R.W. Babcock Jr., M.J. Cooney, **Treatment of high strength acidic wastewater using passive pH control**, Journal of Water Process Engineering, Vol. 18, pp. 198-201.
4. 2017, K.M. Lamichhane, D. Furukawa, M.J. Cooney, **Co-Digestion of Glycerol with Municipal Wastewater**, Chemical Engineering & Process Techniques, Vol. 3, Issue 1, Paper 1034.
5. 2016, M.J. Cooney, K. Lewis, K. Harris, Q. Zhang, T. Yan, **Start up performance of biochar packed bed anaerobic digesters**, Journal of Water Process Engineering, Vol. 9, pp. e7-e13.
6. 2014, R.J. Lopez, S.R. Higgins, E. Pagaling, T. Yan, M.J. Cooney, **High rate anaerobic digestion of wastewater separated from grease trap waste**, Renewable Energy, Vol. 62, pp. 234-242.

PRESENTATIONS:

1. 2014, M.J. Cooney, **Low Energy High Rate Anaerobic – Aerobic Digestion (HRAAD) and Applications**, Presented at the ECS MA2014-02 Meeting, Cancun, Mexico, October 5-9, Abstract 2288.