Environmental Engineering Experiments and design

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1. Topic:

Biorefinery: Production of useful platform chemical from low-grade biomass

2. Objectives:

1) To provide the student with the opportunity to conduct basic experiments which is essential for environmental engineering
2) To provide the student with the fundamental background in anaerobic fermentation technology
3) To provide the student with the basis for design carbon recovery system from bio-resources

3. Background:

To construct sustainable society, new industrial paradigm which can substitute conventional petroleum based industry is needed. Therefore, researches on biorefinery, which uses renewable biomass as raw material, is actively under way.

However, biorefinery have obvious limitation in the aspect of economic and productive feasibility compared to conventional refinery. Therefore, many researchers are trying to develop the biorefinery system which uses organic waste as raw material to lower the raw material price which is one of the main causes of high production cost. However, organic wastes are highy complexed substances and the degradability is low in most cases.

In this lecture, experiments related to hexanoic acid production will be carried out which is state of the art technology in biorefinery field. Hexaonic acid has higher volumetric energy density than other biorefinery technology product and also can be used as fragrances, food additives, and so on.

4. Course grading:

Attendance:	30%
Participation:	30%
Reports:	30%(10% each)
Quiz:	10%

	Week	Date	Course Outline
Lecture & Experimental Plan	1	3/4 3/6	● Lecture: Introduction ● Lab safety training and introduction of experimental equipment
	2	3/11 3/13	● Lecture: Fundamentals of environmental microbiology ● Experiment: Characterization of Organic Waste Resources: TS, VS, FS
	3	3/18 3/20	● Lecture: Anaerobic fermentation technology ● Experiment: Anaerobic digestion using unit substances
	4	3/25 3/27	● Lecture: Principle of chromatography ● Experiment: Anaerobic digestion using organic waste
	5	4/1 4/3	● Experiment: Anaerobic digestion using organic waste
	6	4/8 4/10	● Experiment: Acidogenic fermentation using unit substances
	7	4/15 4/17	● Experiment: Acidogenic fermentation using organic waste
	8	4/22 4/24	● Experiment&Design: Production of target fermentate and mass balance calculation
	9	4/29 5/1	● Review & Quiz
	10	5/6 5/8	● Lecture: Chain elongation: production of hexanoate from short chain carboxylates ● Experiment: Enrichment of hexanoate producing microbiome
	11	5/13 5/15	● Experiment: Production of hexanoate from lactate containing wastewater in batch reactor
	12	5/20 5/22	● Experiment: Production of hexanoate from lactate containing wastewater in batch reactor
	13	5/27 5/29	● Experiment: Determination of optimal conditions for hexanoate fermentation
	14	6/3 6/5	● Experiment: Operation of continuous reactor under optimal operation condition
	15	6/10 6/12	● Experiment: Operation of continuous reactor and mass balance calculation