Environmental Engineering Experments and Design

Introduction

Soil Quality Lab Kyoungphile Nam

Objectives

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

Agenda 2030_Sustainable development goals



Agenda 2030. UN

Balance economic, environmental and social needs



Goal 6: Ensure access to water and sanitation for all

- **Goal 7**: Ensure access to affordable, reliable, sustainable and modern energy for all
- **Goal 9**: Build resilient infrastructure, promote sustainable industrialization and foster innovation
- **Goal 12**: Ensure sustainable consumption and production patterns
- **Goal 13**: Take urgent action to combat climate change and its impacts
- **Goal 14**: Conserve and sustainably use the oceans, seas and marine resources
- **Goal 15**: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

	Substance	Technology	Matrix
Resource	Organic	Fermentation	Organic waste
Ricovery	Nitrogen	Membrane	Wastewater
	Organic	Adsorption	Wastewater

	Substance	Technology	Matrix
Pollutant Reduction	Heavy Metal	Stabilization, adsorption	Soil
	Micropollutant	Catalyst	Wastewater
	ТРН	Biodegradation	Soil



- Establishment of remediation goal through risk assessment of contaminated sites
- Enhancement of the efficiency of the technology through Life Cycle Assessment

Biorefinery



* Petroleum Based Refinery









Biomass Based Refinery



Biorefinery Platforms

✓ Sugar Platform





Feedstock

Sugar Extraction



- **Ethanol fermentation** •
- High yield, High cost •

✓ Syngas Platform





- Wood-Ljungdahl Pathway • $CO/CO2/H2 \rightarrow Acetate$
- Diverse raw material, Low ٠ yield

Carboxylate Platform \checkmark





- Acidogenic fermentation •
- Anaerobic Digestion •
- Highest yield, Mixed • product

Anaerobic Fermentation without biogas

Table 1

Approximate price (Euro) per kg and per kmol electrons obtained upon combustion to carbon dioxide for different organic compounds (June 2013)

		EUR/kg	EUR/kmol-e
Coal	С	0.05	0.2
Methane (US June 2013)	CH ₄	0.20	0.4
Methane (Europe June 2013)	CH ₄	0.40	0.8
Oil (June 2013)	CH 2	0.64	1.5
Hydrogen	H 2	2.0	2.0
Sugar (June 2013)	$C_{6}H_{12}O_{6}$	0.28	2.1
Ethanol (2013)	$C_2 H_6 O$	0.52	2.0
1 Hexanoic acid	$C_{6}H_{12}O_{2}$	1.00	3.6
2рнв	CH 30	2.00	12.4

Kleerebezem et al. (2015)