Biodiesel and Bio-Hydrogen Co-Production with Treatment of High-Solids Food Waste

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Sources and quantities of raw material

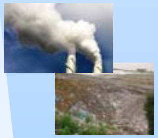
Food waste was investigated as a potential source of renewable energy in this project. The knowledge and technology obtained can be used for application against other Ecology-identified Washington State organic wastes, as shown below.

Washington State's Biomass Inventory (Frear *et al*, 2005).

Available waste	Total volume in (Tons of Dry Biomass/year)
Food waste	246,011
Cheese whey	44,255
Cull potatoes	91,412
Cull apples	41,039
Grape pomace	19,254
Dairy manure	457,032
Cattle manure	242,404
Horse manure	407,160
Poultry manure	784,577
Potato solids	19,177
Apple pomace	27,794

Treatment methods

➢Landfill and incineration are not preferred choices due to scarcity of land, transportation costs, and potential for uncontrolled contamination and release of greenhouse gases.



➢Composting provides a potential solution; however, it is energy negative and raises air quality concerns.

➢Biological conversion for fuel production offers a green waste management strategy: reduction of organic matter and recovery of hydrogen, methane, biodiesel, and other useful byproducts.

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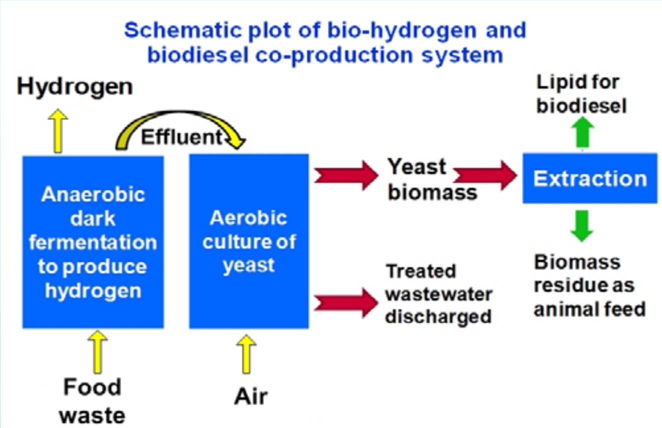
Two-stage conversion process

1. Anaerobic digestion (AD): fermentative bacteria can use carbon derived from food waste to produce hydrogen and volatile fatty acids (VFAs) (e.g., acetate or butyrate)

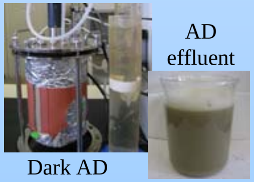
$$C_6H_{12}O_6 + 2H_2O \longrightarrow 4H_2 + 2CH_3COOH + 2CO_2$$
$$C_6H_{12}O_6 \longrightarrow 2H_2 + CH_3CH_2CH_2COOH + 2CO_2$$

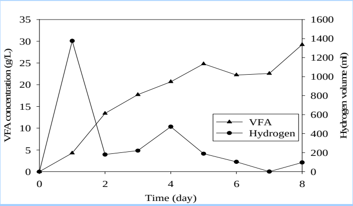
2. Aerobic process: oleaginous (oil producing) yeasts can take up VFAs to accumulate lipids in the biomass.



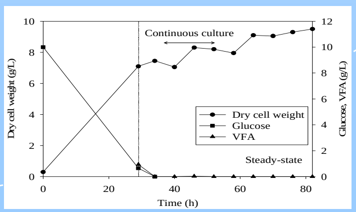
Experiments and results

➢Lab-scale bio-hydrogen and VFA production process from food waste.

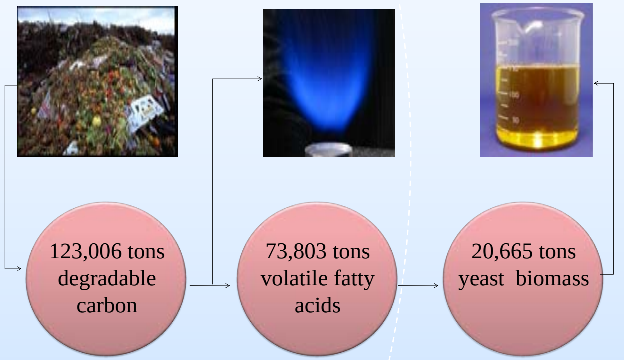




➢Lab-scale continuous yeast culture by feeding with AD effluent.



Process efficiency assessment



Beyond waste

➢Lipids and yeast biomass can be used as feedstock to produce biodiesel and animal feed respectively.

➢The production cost for this process includes power for agitation and aeration of the operation.

➢No liquid or solid wastes will be produced. CO_2 is considered the only waste by-product, but it is carbon neutral.

➢The project will benefit the local economy in addition to providing job opportunities.

➢Biodiesel and bio-hydrogen from the waste offers energy security in addition to economic benefits.

Acknowledgements

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