## UNIVERSITY OF FLORIDA


# *Development of Biofuel Production Processes from Synthetic and Biomass Wastes*


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**Description:** With the ever-increasing price of petroleum and its finite supply, it is of high priority to develop domestic sources of transportation fuel, as well as other chemicals. Ethanol is an attractive alternate fuel that is being produced from corn starch. It is necessary to target other feedstocks for biofuel production and develop processes that have a minimal environmental impact. There is considerable ongoing research on developing processes and catalysts for conversion of biomass to biofuels like ethanol (called cellulosic ethanol process). But this project addresses other feedstocks with the following objectives: 1) development of biocatalysts for the conversion of waste biodegradable poly lactic acid based plastics to ethanol and 2) development of processes that processes for the production of additional fuels like biogas, bio-oil and biochar from the waste and byproducts of a cellulosic ethanol plant for the clean up and reuse of these waste streams

**Budget:** $192,000

**Universities:** UF

**External Collaborators**: UCF

## Progress Summary

**Process development for biogasification and clean up of cellulosic ethanol stillage**

- Biochemical methane potential assays were conducted on stillage obtained from the biofuels pilot plant. Stillages derived from hardwoods and sugarcane bagasse were assayed for its biochemical methane potential.
- It was found that about 5 to 7 L of methane (at STP) can be produced per liter of stillage. Typically this amount of methane can displace 25-30% of fuel consumption in a cellulosic ethanol facility.
- A continuous biogasification process design to efficiently produce methane from cellulosic ethanol stillage is being developed and tested.
- The stillage contained ammonia and phosphate which can be recovered for application as slow release fertilizer.
- The residual organic carbon along with the nitrogen and phosphorous in stillage can be captured for land application and treated effluent (water) can be recycled.

**Biocatalyst development for conversion of waste PLA based plastics to ethanol**

- Hydrothermolysis experiments have been conducted in which different amount of PLA (7.5%, 25%, 50% (w/w)) plastic have been inserted into a stainless steel canister in presence of water, and heated for different heating time (15 min to 720min), at different temperatures (120C and 160C) to dissolve the PLA and produce lactic acid syrup. Higher temperatures gave faster recovery of lactate. The longer the heating time, the less solid that remains in the canister at the end of the treatment. 50% PLA content and 160C are the two parameters that give the highest recovery of lactate with approximately 7M solution recovered after 2hours of treatment. In a more recent study, only 75 min were enough to recover the same amount of soluble lactate.

- *E. coli* cells can directly grow and utilize the lactic acid syrup with no further purification necessary.

- Toxicity of the lactic acid syrup on cell growth was investigated. Results show that at least 400mM of syrup (≈4%) is necessary to observe a toxicity induced by the components of the syrup other than lactic acid itself. Lactic acid toxicity can be observed when it is present at concentration higher than 2%. No growth is observed in cultures containing 8% lactic acid that is either PLA derived or lactic acid bought from sigma in form of sodium salts.

- Ongoing work: Construction of *E.coli* mutant that can convert lactic acid to ethanol.