

CPPL and Economics of Lignocellulosic Biomass Conversion



American Science and Technology



A Foundation for Future Energy



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Cellulose Processing Lab

- Education
- Basic R&D
- Applied R&D
- Workforce Development
- Analytical Services
- Process/Products Evaluation

Pilot Plant Bio-Refinery

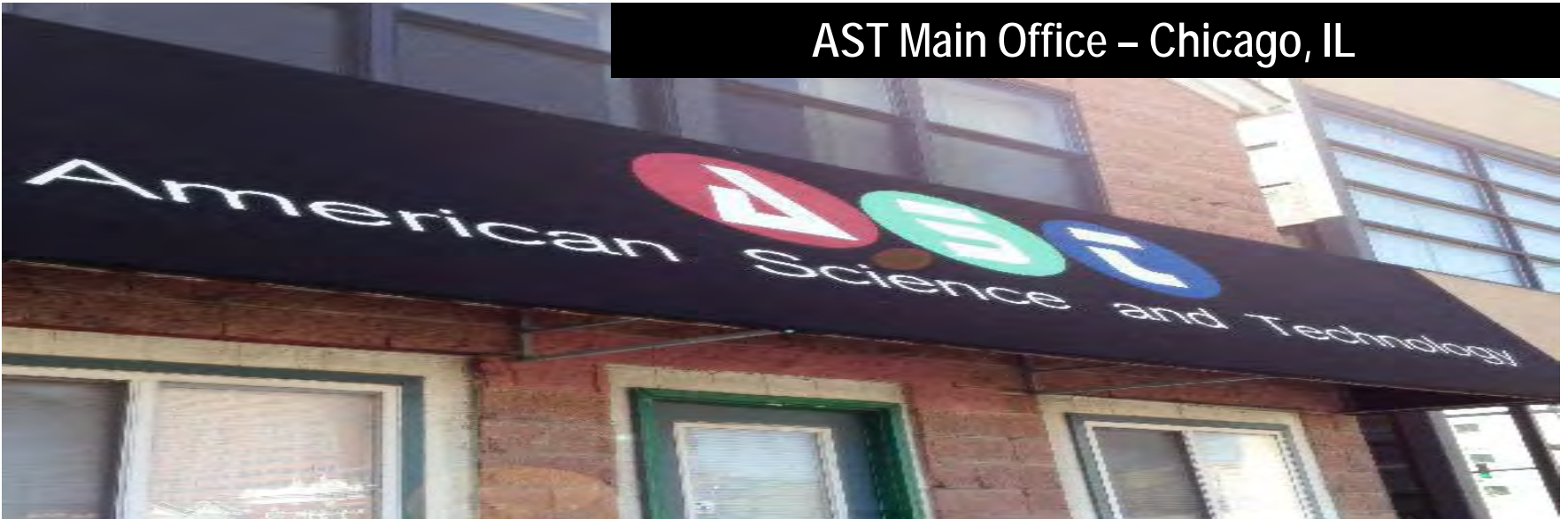
- Applied R&D
- Technology Development
- Product Development
- Process Improvement
- Manufacturing
- Workforce Training

- During the past 8 years, American Science and Technology (AST) has been working with several universities to develop an Organosolv process to refine lignocellulosic biomass into marketable products;
- AST has a license agreement with the University of Wisconsin to use their patented Organosolv process for fractionation of lignocellulosic biomass. AST also has several patent pending applications to cover its activities;
- AST owns and operates a complete integrated lignocellulosic fractionation and biorefinery pilot plant in central Wisconsin, which is now in the process of being scaled up from 200 kg/day to about 2 ton/day for the purposes of R&D, product / process development, mass / energy balance study, data collection, and limited productions;
- AST has developed expertise in biomass fractionation and the production of pulp, sugars, pure lignin, and biochemicals;
- This presentation will discuss the latest developments and progresses on our new scaled up pilot plant and the economic viability of the Organosolv process.

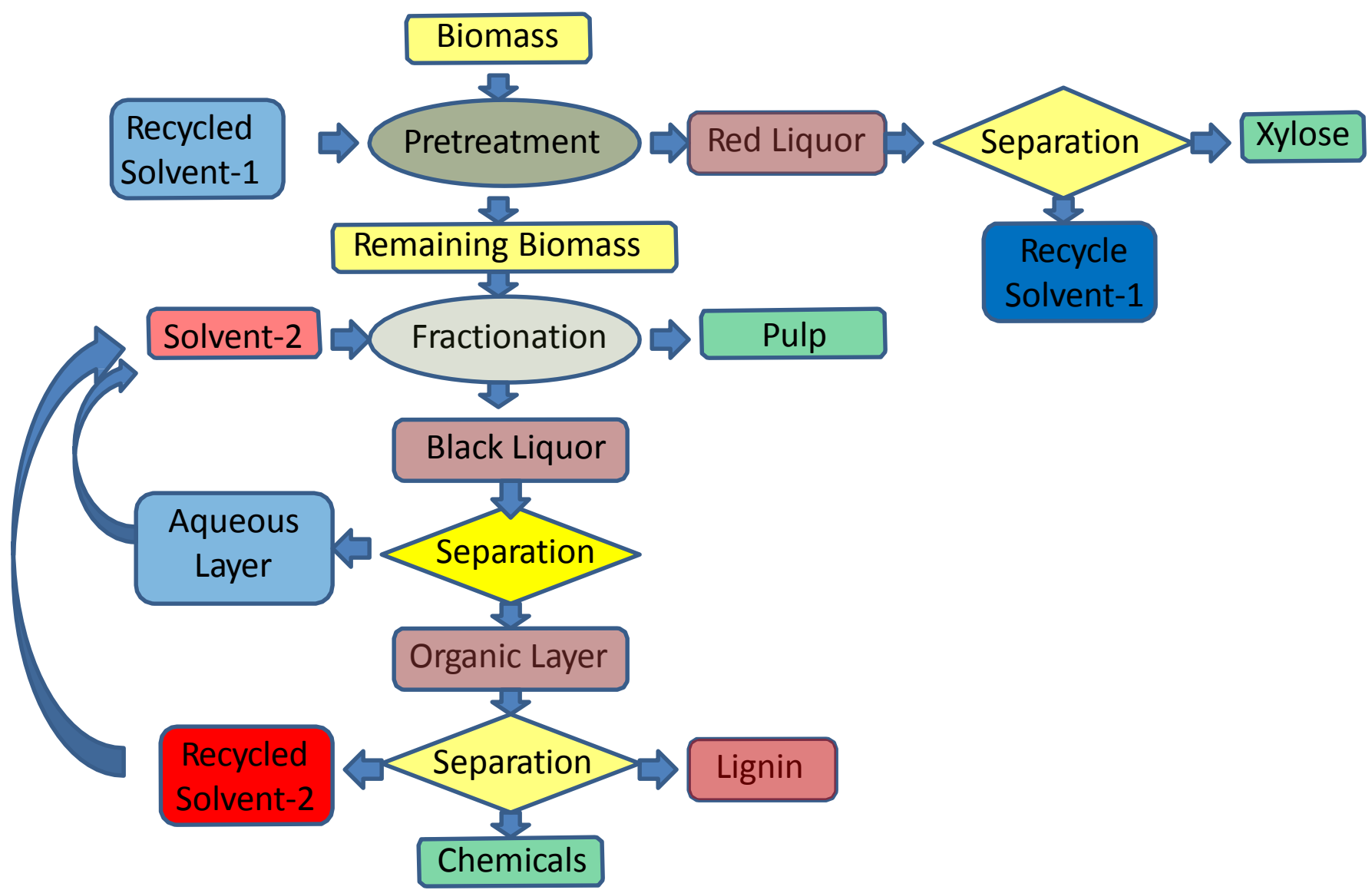
AST Biorefinery Facilities – Wausau , WI



AST Main Office – Chicago, IL



Biomass Fractionation Process



Feedstock from Non-Edible Renewable Resources



Agricultural wastes,
forestry products/wastes,
and other lignocellulosic
waste materials



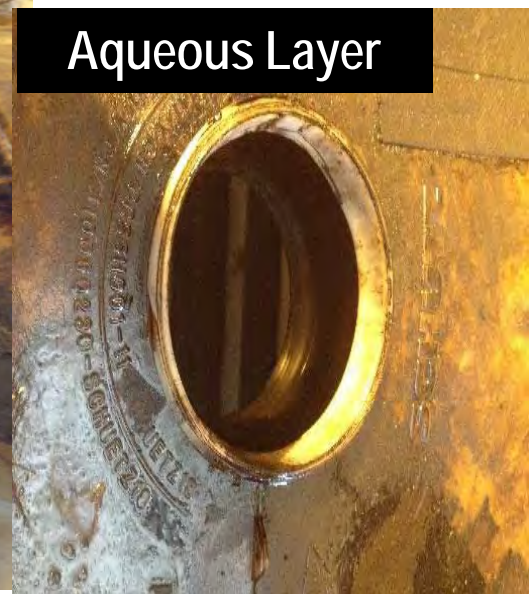
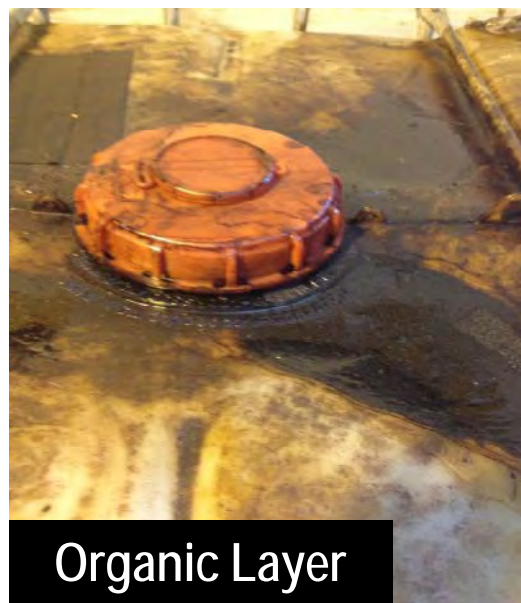
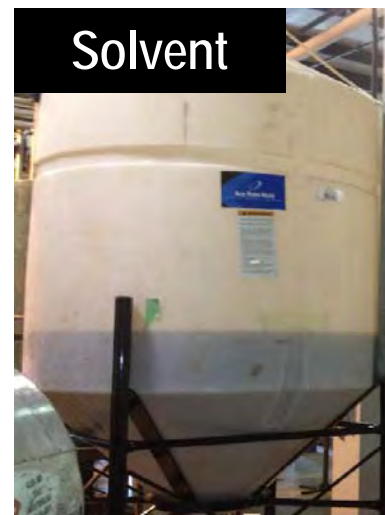
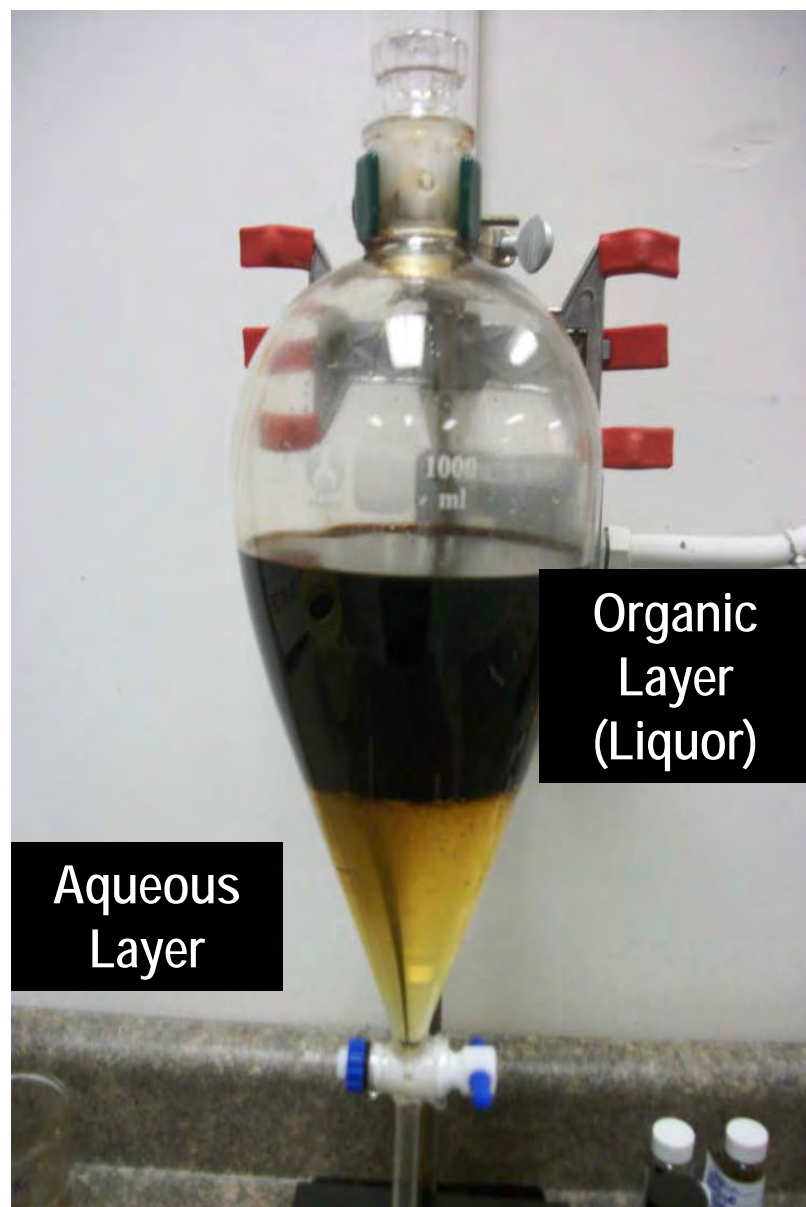


Bio Renewable Chemical (www.BioRenChem.com), a subsidiary of American Science and Technology (AST), is focused on biomass conversion and chemical manufacturing technologies.

The Fractionation Reactor – The Main Part of the Integrated Bio-Refinery Pilot Plant



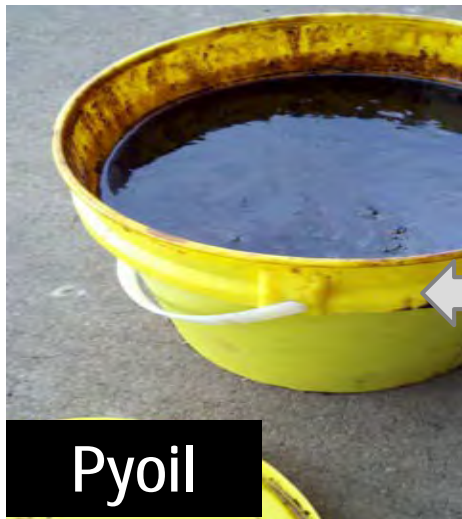
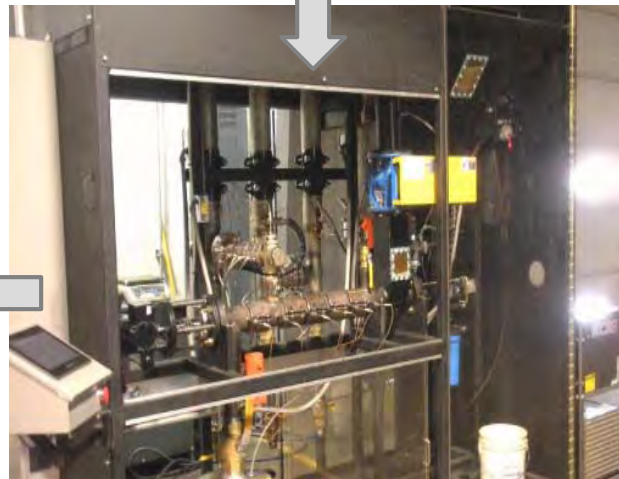
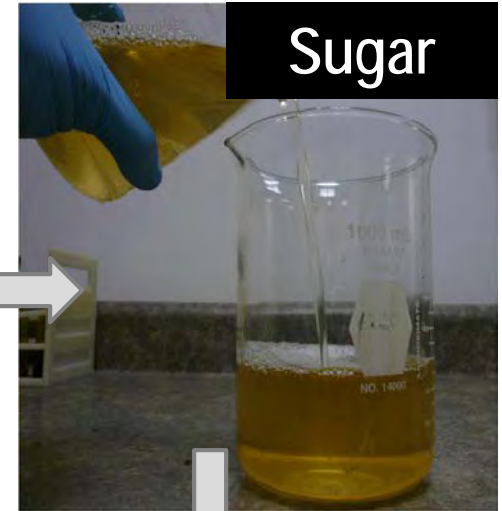
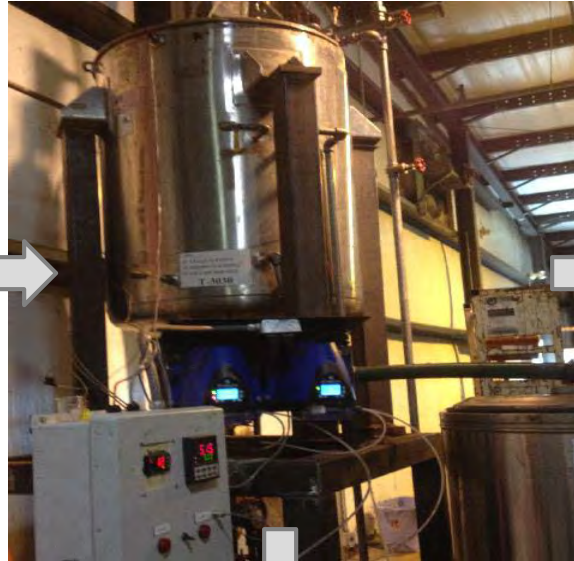
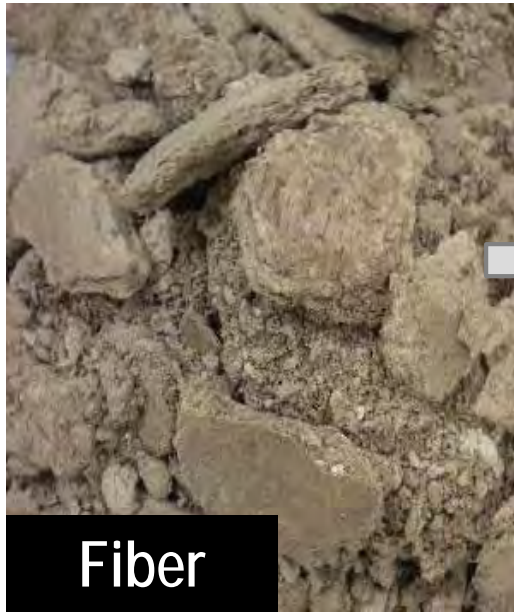
Products of Fractionation

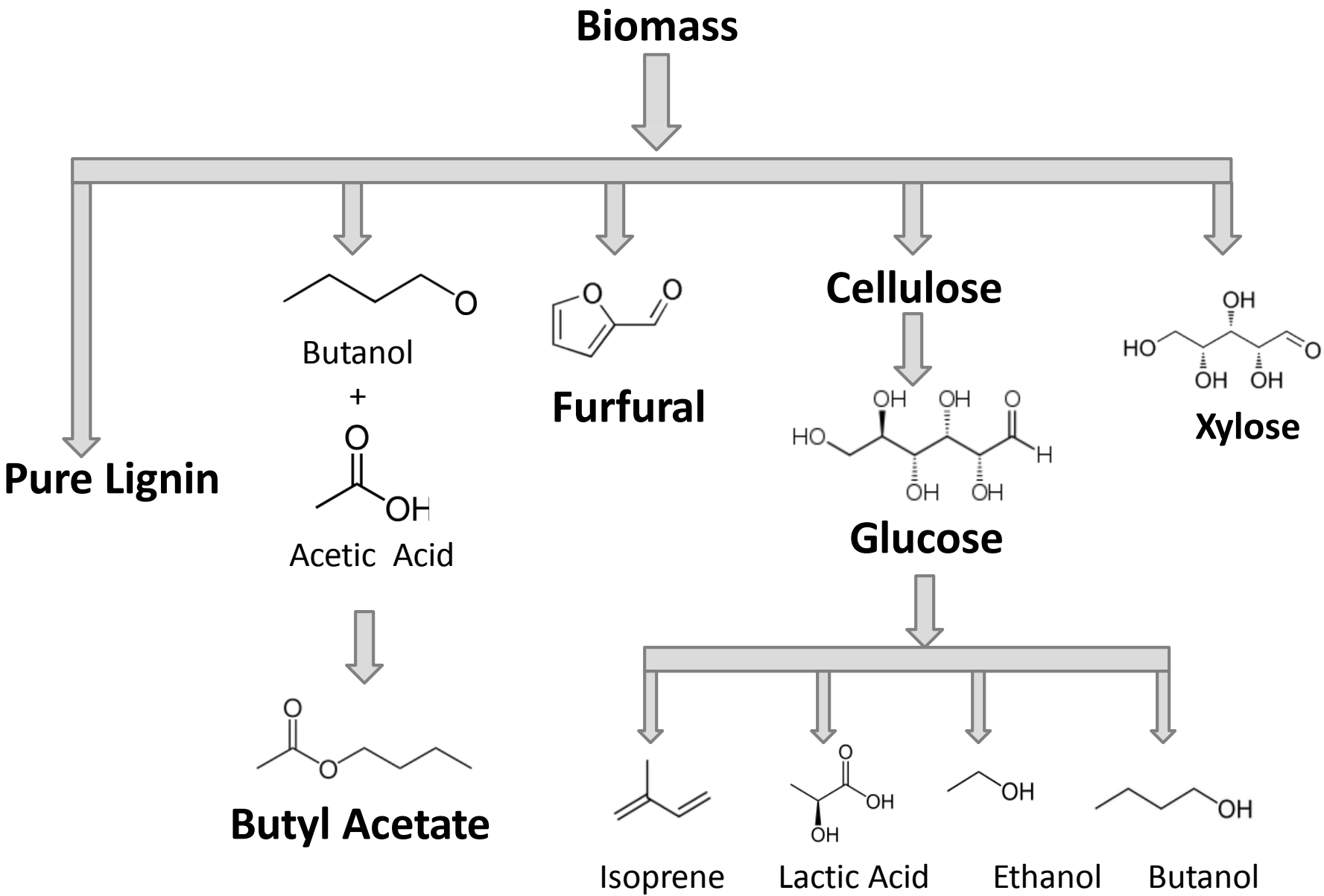


Lignin Recovery - Part of the Integrated Bio-Refinery Pilot Plant



Fiber to Sugar - Part of the Integrated Bio-Refinery Pilot Plant

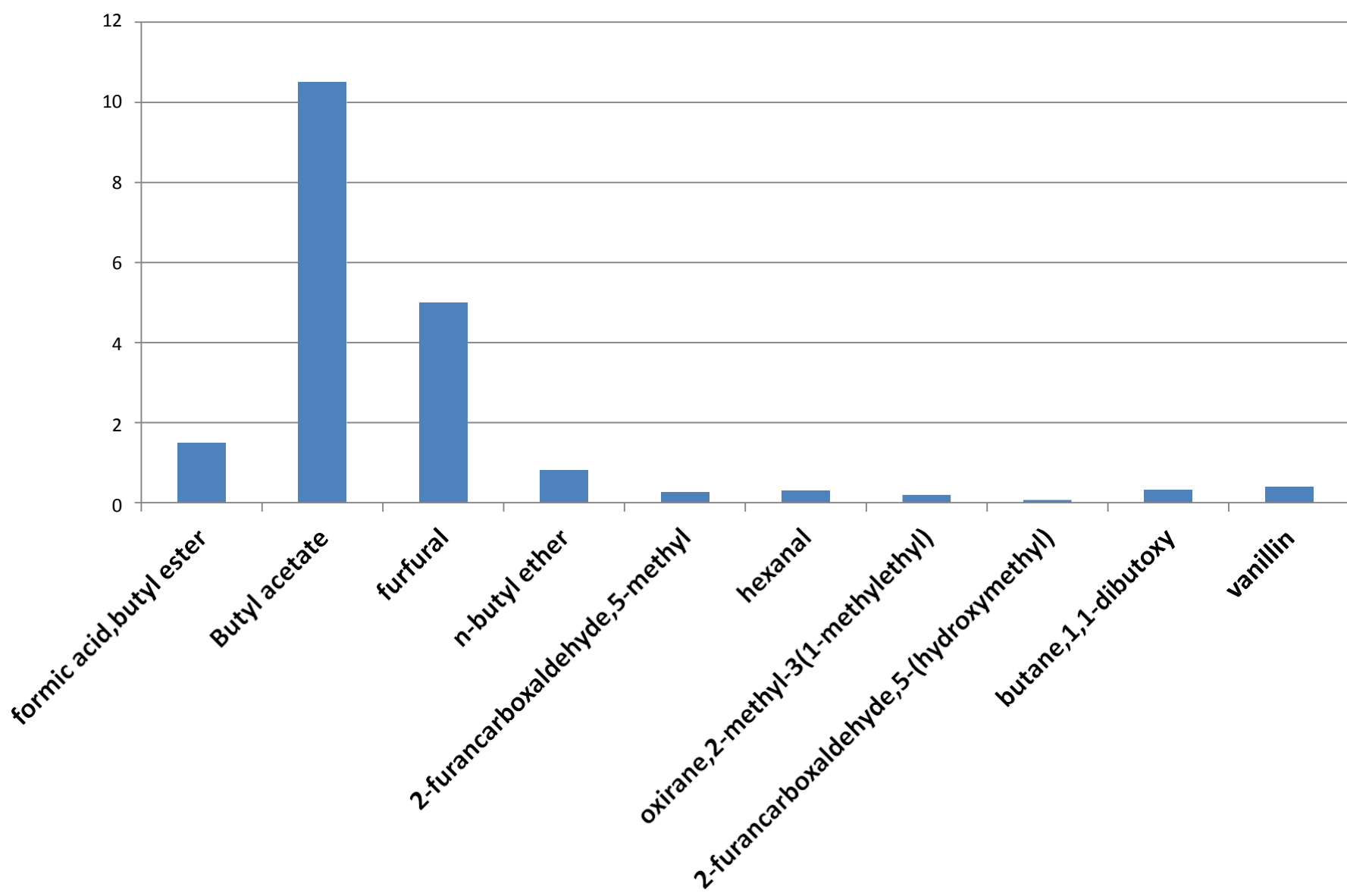


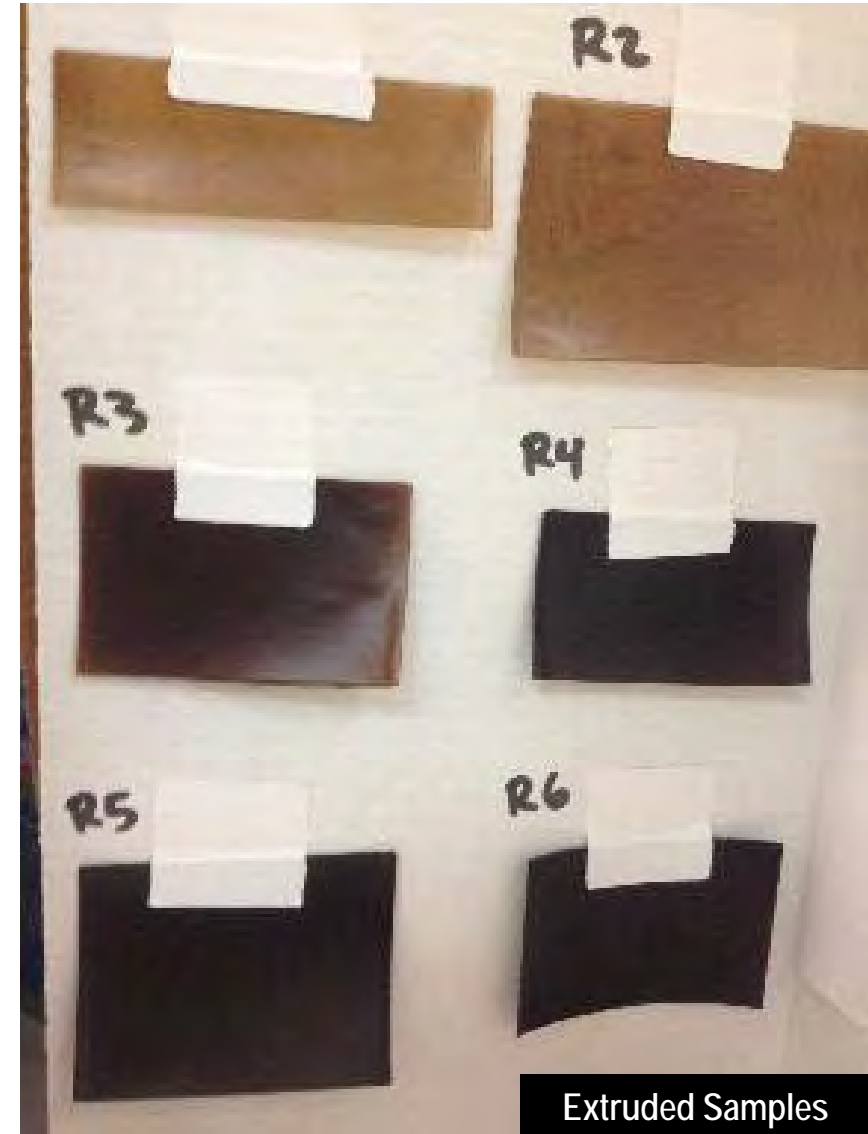
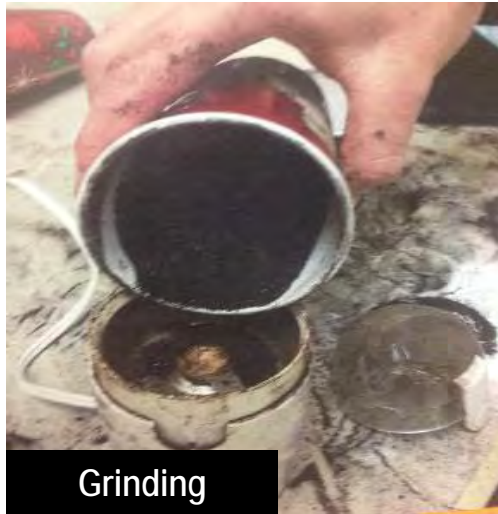


Typical Products Recovery	Min	Max
Lignin	10%	30%
Cellulose	35%	50%
Xylose	15%	35%
Chemicals	5%	30%
Extractives, Others	2%	10%



Products from Organic Layer





Lignin as an Additive for Polymers





Injected Test Samples
at UWP

Lignin as an Additive for Polymers



Cost Model – Products & Economics

Per One Ton of Dry Biomass	% Product	\$/Ton	Value
Xylose	15%	\$400	\$60.00
Lignin	20%	\$500	\$100.00
Fiber	45%	\$400	\$180.00
Chemicals	10%	\$600	\$60.00
Total	90%		\$400.00
Costs of Raw Materials		\$100	\$100.00
Processing Costs		\$250	\$250.00
Total			\$350.00
Potential Net Profit			\$50.00

Pulp Market

- Pulp is being traded at \$0.25 to \$0.45/Lb internationally;

Sugar Market

- In addition to Xylose, we can convert our fiber to glucose;
- Raw sugar is being traded at \$0.17 to \$0.25/Lb internationally;

Organic Chemical Market

- **Furfural** - The current global production capacity is roughly 300,000 to 450,000 tons annually with prices in the range of \$1000 to \$1500/ton.
- **Butyl Acetate** - The current global consumption is approximately 1.1 million tons, priced at \$1200 to \$1400 per ton for a total global market value of about \$1.32 - \$1.54 billion.

Lignin Market

- Lignin as an additive (renewable polymer) to polymer is about \$25 Billion/Y;
http://utr.f.tennessee.edu/abstracts/11023_Baker_Lignin.pdf
- Lignin as the main source of renewable aromatics is about \$13 Billion/Y;
<http://www.frost.com/prod/servlet/press-release.pag?docid=269974856>
- Lignin as the main source for Carbon Fiber is gaining traction as well.

- Our flexible process can produce Xylose, pulp, cellulose, organic chemicals, and pure lignin;
- Per market demands, we can easily change the production ratio of our products;
- Working with UWSP, we have been able to produce pulp with an acceptable quality for paper production;
- Working with UWP, we have been able to use lignin as an additive with polymer to increase its value;
- Producing valuable products has made Organosolv fractionation more profitable than other processes.

- As part of CPPL, AST is scaling up its processing capacity from the current 200 kg to about 2 tons of biomass per day;
- AST is committed to complete the expansion by the end of 2015;
- The CPPL facilities are available to biomass owners, biomass users, and technology developers for R&D purposes;
- The scaled up pilot plant will be a state of art biorefinery that will be used to design larger scale commercial production plants;
- CPPL will provide testing capabilities to help the paper industries reinvent themselves and save jobs in rural areas;
- As of now, AST has completed the new scale up process flow diagram and is in the process of ordering the main reactors.

Cellulose Pilot and Processing Lab (CPPL)

One Stop R&D Shop for Biomass Processing and Products Evaluation

For more information, please contact:



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