

Biomass-derived fuels and specialty chemicals: processes and properties



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Oklahoma NSF EPSCoR presentations
November 17, 2011

Thermochemical biomass conversion

- **Biomass is the ONLY renewable source of liquid transportation fuels...
and specialty chemicals, polymers, surfactants, adhesives... most are petroleum-based**
- **Recent biomass conversion research (NSF EPSCoR, DoE, industrial) shows strong potential**
- **Scale, economics may be more favorable than for biofuels; processes can be synergistic (high-value co-product can significantly improve biofuel process economics)**

Biomass conversion processes



Waste fats and oils



High cellulose/hemicellulose biomass



High lignin biomass

transesterification

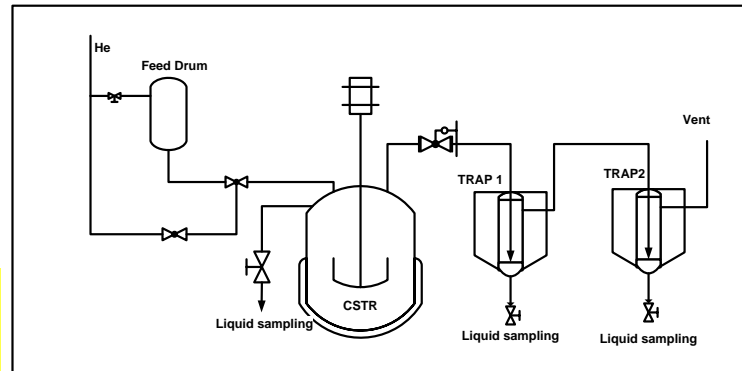
deoxygenation/
isomerization

deoxygenation

reactive
distillation

Biodiesel

Green diesel
(drop-in transportation
fuel)



α -olefins (high-value
specialty chemical –
surfactants, polymers)

Biomass conversion processes



Waste fats and oils

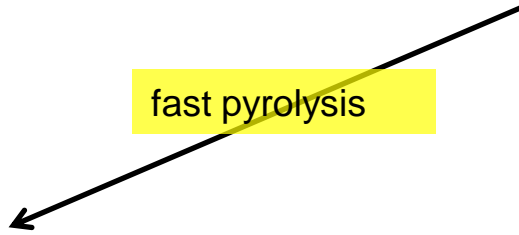


High cellulose/hemicellulose biomass



High lignin biomass

fast pyrolysis



Light gases, bio-oil, char

catalytic upgrading

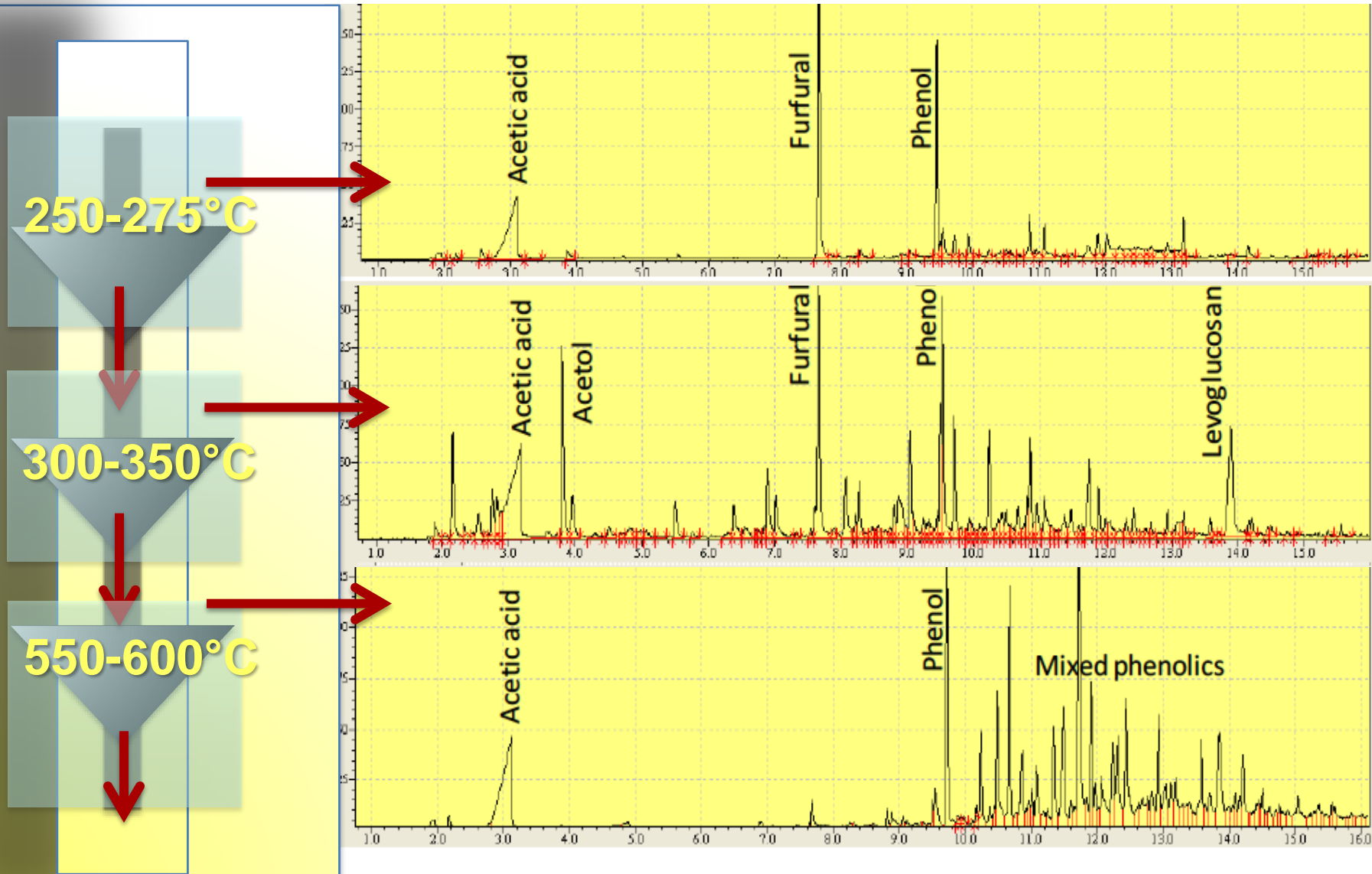


Drop-in fuels,
boiler fuel



Energy, soil
amendment

Multi-stage pyrolysis



Biomass conversion processes



Waste fats and oils



High cellulose/hemicellulose biomass



High lignin biomass

fast pyrolysis

thermal fractionation, solvolysis, hydrolysis

Light gases, bio-oil, char

Light oxygenates

Sugar-derived compounds

Phenolics

catalytic upgrading

condensation, ketonization, isomerization

deoxygenation

transalkylation, deoxygenation

Drop-in fuels, boiler fuel

Energy, soil amendment

Aromatics, monomers, fuel cmpds, solvents

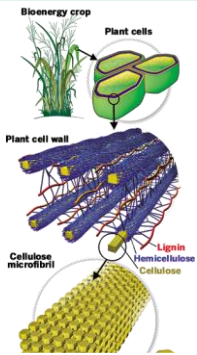
Specialty chemicals, monomers, fuel cmpds

Specialty chemicals (aromatics, solvents, monomers), fuel cmpds

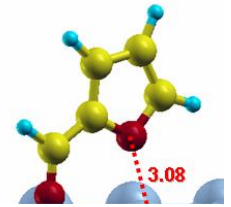
Enabling technology: Interfacial Reaction Engineering



Other: inorganic membranes, ionic liquids, reactive distillation



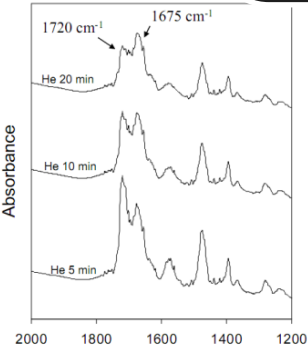
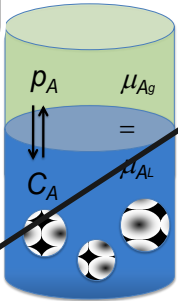
Biomass identification, modification



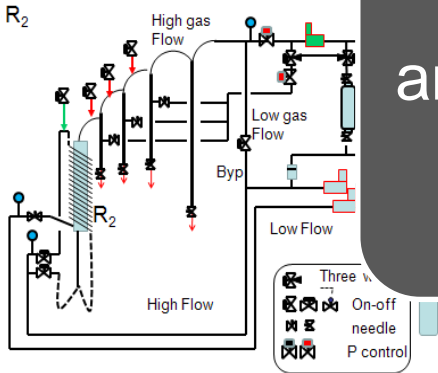
Novel catalytic strategies

Advanced separations

Biomass



Liquid production strategies



Techno-economic and life cycle analysis (economics, sustainability, synergy with Oklahoma energy industry)

Research capabilities and needs

- **Thermochemical conversion and upgrading:**
Crossley, Jentoft, Lobban, Mallinson, Resasco, Striolo, Chem/biochem
- **Catalyst synthesis and characterization:**
Crossley, Jentoft, Resasco
- **Biomass properties:** Bartley, OSU, Noble
- **Techno-economics and life cycle analysis:**
Mallinson, OSU, Noble
- **Advanced separations** (ionic liquids, membranes, reactive distillation): ?