Upgrading of pyrolysis oil for application in standard refineries

Tcbiomass 2009, September 18, Chicago

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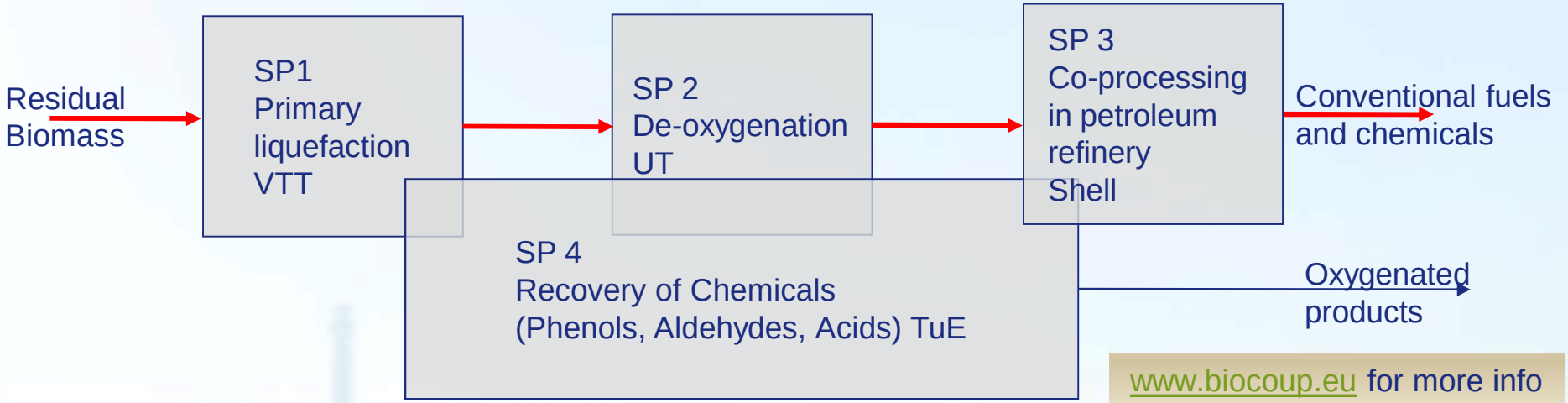
A European Project supported within the sixth Framework Programme for Research and Technological Development

BIOCOUP



www.biocoup.eu for more info on scope and other SP's

Goal SP2:

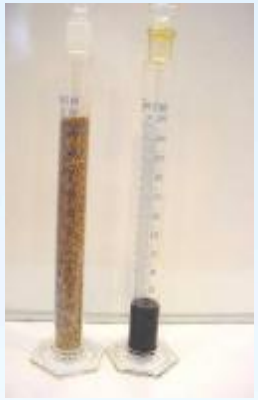
Development of de-oxygenation technology for pyrolysis oil (derived) liquids

- Catalyst development (BIC), screening (RUG, TKK), support testing (Albemarle)
- Product research (RUG, UT)
- Reactor development (UT, BTG)
- Process development (BTG, UT)
- Analysis feed stock and products (VTT, vTI, RUG)
- Oil production and demonstration at PDU scale (BTG, UT)

Upgrading and Technologies

Advantages of pyrolysis oil:

- low ash content
- 'high' energy density (biomass)



Left wood;
Right pyrolysis oil
Both 1 MJ

(Photo BTG)

Why upgrading: negative sides of pyrolysis oil

- high acidity/reactivity pyrolysis oil
- tendency of considerable char formation (blocking, catalyst poisoning)
- high oxygen and water content
- miscibility problems conventional feeds

Technologies studied in SP2- BIOCOUP

HPTT: High Pressure Thermal Treatment 200-400 ^{o}C; 1-20 minutes; 50-200 bar

DCO: Catalytic Decarboxylation = HPTT + catalyst

HDO: Hydrodeoxygenation = DCO + Hydrogen 15 min-4 hours !

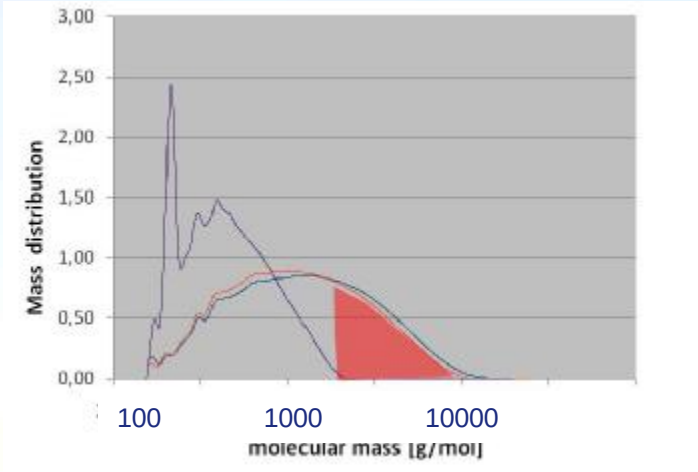
HPTT and DCO

+ Phase separation: oil, aqueous, gas
+ Deoxygenation to ~ 25wt% O (dry oil basis) possible
+ Substantial energy densification (up to a factor of 2)

rapid! Increase Mw

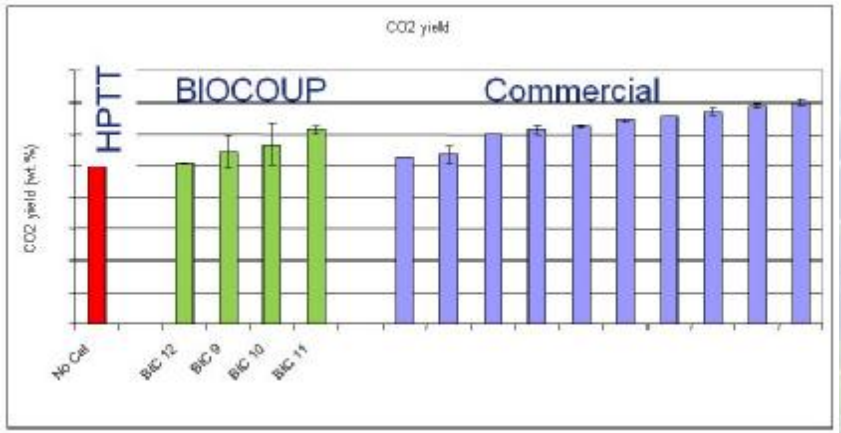
Likely cause: Polymerization of 'sugars' in pyrolysis oil

This will complicate hydrodeoxygenation/co-processing



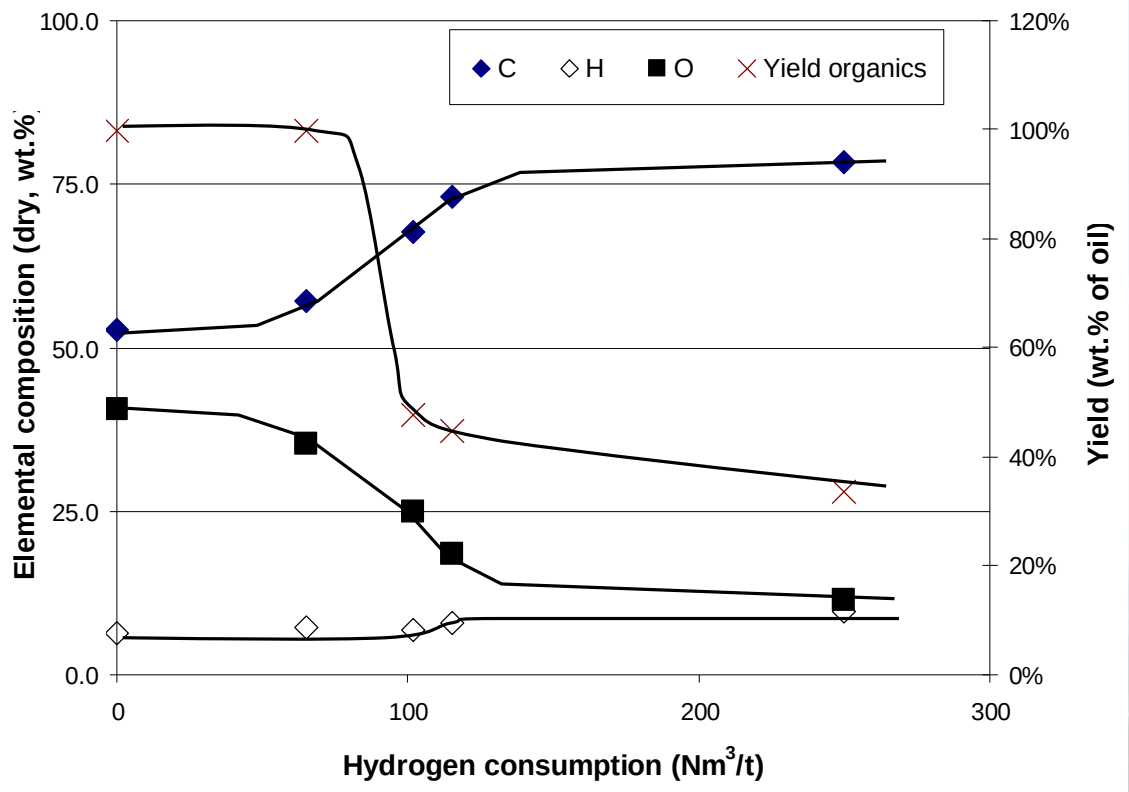
High Molecular Mass formed during HPTT (minimum)

Increase of molecular weight: more so with severity



DCO similar to HPTT with respect to decarboxylation and polymerization

HDO results



Data BTG/RUG (packed bed)

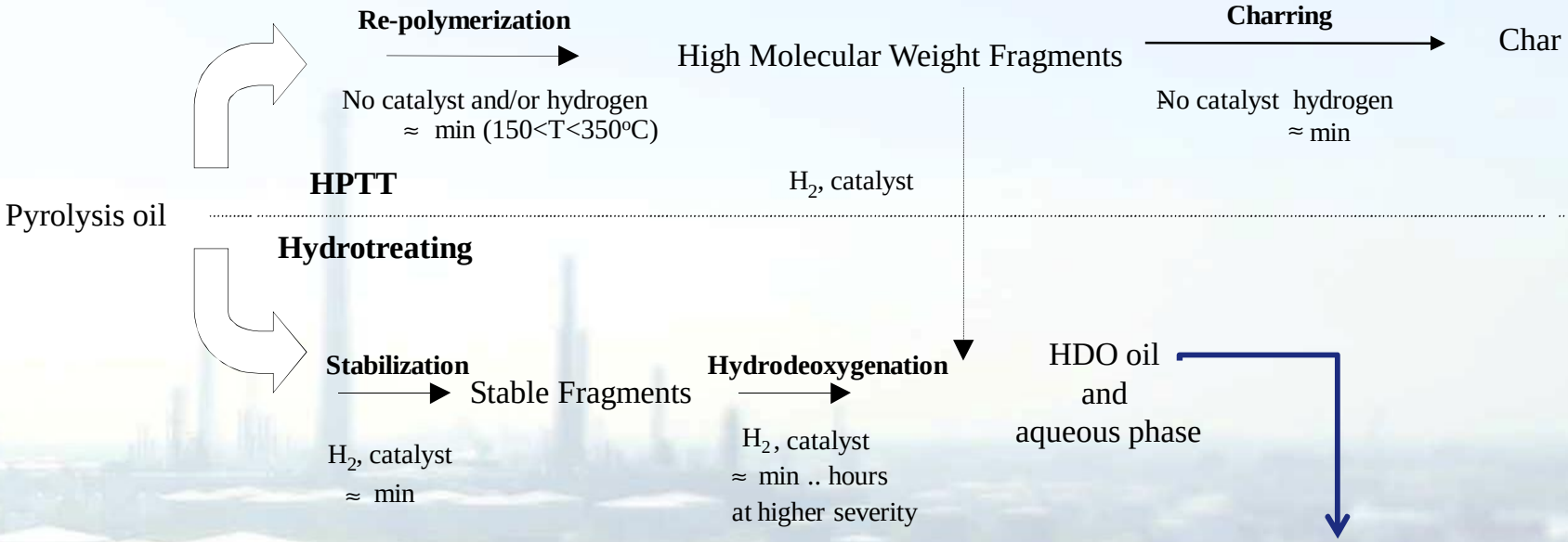
Increasing severity (T, τ):

- Higher H_2 consumption (150-800 NL/kg feed)
- Higher deoxygenation (<10-40wt% O in dry remaining)
- HDO oil yield ~ 40wt%, decreases with severity
- No (substantial) increase in Mw

Remaining aqueous phase can be used for chemicals extraction (acids: SP4) or hydrogen production

HDO process insight

Parallel HDO vs Repolymerization reactions



Adapted figure from BTG/RUG

Tested in lab scale refinery units (SP3)
Feed back to SP2

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