

Task 34

Direct Thermochemical Liquefaction of Biomass

2nd Task 34 Meeting Triennium 2022-24
January 30th, 2023 at HPGRDC in Bengaluru/ India; hybrid)
09:00-19:00 (IST)

Recognition of Meeting Participants

Alex Böhm	(AB)	Task Assistant
Axel Funke	(AF)	Task Lead/ NTL Germany (Minutes)
Bert van de Beld	(BvB)	NTL The Netherlands
Daniele Castello	(DC)	Alternate NTL Denmark (online)
Francois Collard	(FC)	NTL New Zealand (online)
Lavanya Meesala	(LM)	Alternate NTL India
Mike Thorson	(MT)	NTL U.S. (online)
Pramod Kumar	(PK)	NTL India

Country reports

U.S.

MT presents an overview of liquefaction projects, a lot of which are gasification projects with subsequent synthesis, based on capacity over investment cost. He stretches the importance of income by integrating CCS strategies/ technologies into biofuel production. The focus of US DOE will be sustainable transportation fuels (light duty vehicles, trucks, rail, marine, aviation). MT sees a huge support for biofuels, especially a push towards SAF.

PNNL has very good results for diesel fuels from hydrotreated HTL biocrude. For SAF, denitrification is still a challenge. HYPOWERS is planning a 3 tpd sewage sludge HTL system, construction pending funding authorization. Metro Vancouver applies Genifuel process from PNNL; co-processing of produced biocrude at Parkland.

MicroBio 12,500 GGE algae biofuels production looking at applying HTL for algae conversion and SCWO for the aqueous phase). There is also a demonstration unit taking the next step towards commercialization of HTC, including chemicals (chloromethyl furfural, levulinic acid, furfural) as byproducts, from Origin Materials.

NREL continues work with thermal and catalytic pyrolysis, including investment conducted by ExxonMobil. Research Triangle Institute corn stover in a 1 tpd unit with reactive catalytic fast pyrolysis followed by hydroprocessing to produce SAF. No update from Iowa State University autothermal pyrolysis activities available. The Biogas Energy is operational (12 tpd feedstock capacity). Alder fuels has a concept that focusses on LLE extraction of FPBO to produce SAF and feed for HEFA co-processing.

New Zealand

Policies: coal boilers to be replaced by 2037; biofuels obligation with wholesaler reduction targets increasing to 9% by 2035. Separate policies for marine and aviation fuels to be developed. Accompanied by programs to stimulate biomass production.

No commercial activities in the field of DTL. R&D activities at Scion (SAF and marine fuels via catalytic pyrolysis), Cetogenix (HTO to produce feed for fermentation) University of Canterbury (catalytic pyrolysis and steam reforming of bio-oil for H₂ production), and Nufuels (co-pyrolysis of biomass and plastic waste)

India

India plans to increase RE from 9 to 38-50 EJ by 2050; strong policies to push 1G/2G ethanol and biogas (compressed biogas) as fuels. There is a strong strategic focus on agricultural residues/ surplus crop residues.

HPGRDC runs a fast pyrolysis and catalytic pyrolysis unit, also for upgrading the produced bio-oil.

RCAT works on HTL of algae to produce a biocrude in a demonstration unit for co-processing in refineries. Reliance Industries demonstrated algae biomass and their conversion to biocrude with HTL.

Shell operates a 5 tpd plant for their IH₂ technology (hydro-pyrolysis in a fluidized bed reactor). TERI is working on producing bio-oil with slow pyrolysis, also involved in upgrading. MASH also follows slow pyrolysis to produce bio-oil for mixing with furnace oil (up to 5%) and electricity via char combustion. Intermediate pyrolysis for bio-oil production is investigated by IIT Ropar (pyroformer technology from EBRI).

There are many initiatives to produce SAF, but primarily based on ethanol and used cooking oil.

The Netherlands

Difficult situation in The Netherlands for bioenergy since new plants are not allowed to emit any nitrogen compounds, which is hardly reasonable to achieve for biomass based systems.

Empyro fast pyrolysis unit had to stop operation due to the special circumstances of the current energy crisis in Europe (too high feedstock cost, fixed product price). BTG Bioliquids is continuing working on new fast pyrolysis initiatives.

Research involves Torwash for pretreatment (demineralization) of biomass prior to fast pyrolysis (Residue4Industries). There are many European R&D projects ongoing with BTG as partner (use of FPBO and fractionated/ upgraded FPBO), also at University of Groning/ Prof Heeres who also focus on aromatics and University of Twente (Gerrit Brem/ EnCat)). TNO follows up pyrolysis with their PYRENA technology; also bioased aromatics.

1-cylinder engine operation on FPBO achieved >1,000h, investigated as part of SmartCHP. BTG further follows up on FPBO extraction and upgrading R&D.

Denmark

Aalborg University operates HTL with focus on upgrading, Aarhus University HTL with focus on co-processing. DTU is investigating hydrolysis. They have a new Horizon Europe project for negative CO₂ emission SAF via HTL (Circularair).

Steeper Energy licensed their supercritical Hydrofaction[®] process in the meantime; Circlia Nordic is also still commercially active in the field of DTL. There is also commercial activity in the field of solvolysis by KVASIR (biomass liquefaction in ethanol).

Germany

The German government has initiated work on a 'National Biomass Strategy' to align biomass resources and applications with highest possible impact. These applications will be most likely in the hard to abate sectors biofuels, high temperature process heat, flexible power supply (via CHP) and carbon dioxide removal technologies. It is also foreseeable that there will be a strong focus on agricultural residues.

There are no updates regarding commercial activities. Fraunhofer UMSICHT has finalized their Syn2Fuel project. KIT has wrapped up their bioliq[®] project by proving the process chain from wheat straw to transportation fuels, including tests in engines and cars. There is a restructuring and the research will be now conducted as part of the newly installed 'Carbon Cycle Lab'. As part of these changes, a new process development unit for fast pyrolysis is planned and at the same time the demonstration unit will be decommissioned.

Work Package Discussion

WP 1.2: Production of chemicals and materials from HTL and FP oil (MT)

MT will send around latest version of the report, BvB will check what they can contribute until end of March 2023. However, focus should be on finalizing the REACH report first to not let that be delayed. AF is able to contribute to the FP part starting from March.

WP 3.1: Round Robin (BB)

AF explained that Phil Bulsink will be conducting the Round Robin and that AB/AF will replace Ben Bronson (i.e. doing the preliminary planning) because he will not be able to commit any resources. The scope of the Round Robin was discussed and AF explained he would like to follow the strategy developed by Ben Bronson earlier last triennium, i.e. start with a study on subsampling issues. This should include a limited amount of standard analyses (CHN, solids, water) but also one less well studied such as elemental analysis by ICP.

It was concluded that 2-3 different methods for sampling have to be established and that care should be taken to exclude a potential bias arising from lab personnel being aware that these methods will be evaluated. Also, these sampling methods should be tested before applying to Round Robin sampling for sending out to labs (for their sub-sampling). AF will check with Canmet whether it is possible to analyse all samples sent out to labs to avoid a bias through sampling at Canmet.

All NTL's are asked to send potential laboratories to AB, preferably with contact details.

BvB can supply FPBO from wood and pyrolytic lignin; AF will check whether they have wheat straw based FPBO from bioliq left. MT can supply algae and check whether sludge HTL biocrude is realistic; DC will check with Steeper Energy whether they are willing to provide a sample. Alternatively, Aalborg University could produce samples.

Webinar(s)/ increasing visibility

AF outlines the need to organize a webinar to increase visibility of Task 34. After discussing different tentative topics, it was decided to follow two topics and develop an outline for a webinar (speakers, scope):

- WP 1.1 Transportation fuels from HTL and FPBO (PK)
- The use of non-woody material in DTL technologies (AF)

Webinars could potentially take place early 2024.

Other potential topics raised were:

- WP 1.2 Production of chemicals and materials from HTL and FP oil
- The role of DTL in a climate neutral society/ in IEA Scenarios
- Merge findings of 1.1-2.3 and 3.3 for a review article/ contribution to EOT conference?!

Definition of stable and hydrotreated FPBO

The issue of a missing definition was thoroughly discussed and concluded, that it would be at least challenging – if not impossible – to come with a reliable definition any soon. However, it was also clear that there are many different definitions out there. It was decided that AF sums up the content of the discussion and comes up with a draft structure for a Technical Note to elucidate this field.

Next physical task meetings

The next Task 34 meeting will be in the U.S. end 2023. MT proposal to try organising this meeting at NREL was received very positive. It should be checked whether it is then also possible to have a workshop to get in touch with the stakeholders of commercial DTL activities.

The Task meeting end of 2024 will not be aligned with the IEA Bioenergy EOT conference due to little positive feedback from NTL's; instead Task 34 will follow the original schedule with a meeting in The Netherlands.