
# Task 34 Pyrolysis Combined Business Meeting Minutes and Site Visit Notes
# 22-25 May, 2018
# Netherlands and Germany
# BTG and KIT

**Attendees**

***National Team Leaders (NTL):***
Ben Bronson (BB) - CanmetENERGY, Canada (for Fernando)
Nicolaus Dahmen (ND) – KIT, Germany [Host Dld]
Bert van de Beld (BvB) – BTG, Netherlands [Host NL]
Ferran de Miguel Mercader (FM) – Scion, New Zealand
Linda Sandström (LS) – RISE-SP-ETC, Sweden (for Magnus)
Alan Zacher (AZ) – PNNL, USA, Lead

**Observers**
Robbie Venderbosch (RHV) – BTG (at BTG & FrieslandCampina)
Hans Heeres (HH) – BTG (at BTG & FrieslandCampina)
Evert Leijenhorst – BTG (at FrieslandCampina)
Gerhard Muggen – BTG Bioliquids (at BTG)
Ruud Meulenbroek – BTG Bioliquids (at BTG & Empyro)
Hans Leibold (HL) – KIT, Germany (at KIT)
Marco Tomasi Margano (at KIT)
Roy Hermanns, (OWI, at KIT)
Cornelius Pfitzer, Andreas Niebel (bioliq FP plant engineers, at KIT)

Note that due to the number of active DTL applications and research groups in Netherlands and Germany, the Task 34 Meeting was interleaved with site visits to make efficient use of the time. This report represents both the Task Meeting minutes as well as summary notes from the Site Visits.

## Tuesday 22 May, 2018 (Task Meeting)

Participants: ND, FM, LS, BR, BvB, AZ, GM, RHV, HH

Introductions: FP welcomed everyone to the meeting and ran through the agenda for the day.

Country Reports: Reports were given by the US, Germany, New Zealand, Sweden, Canada, and Netherlands. Highlights included the recent changes in national research priorities due to changes in government or national strategy, progress of government and academic institutions, and identification of important reports, theses, and outputs that may have international research or policy implications.

Proposal for Extension of Task 34 and Discussion of Remaining Activities from Current Triennium. Discussion of plans for the rest of the triennium and round robin activities.

US: Continued changes in research priorities among government sponsors. Applications of bio-oils in heating (along with Canada) and in coprocessing have generated continued, quiet news.
DE: Progress of research organizations reported. Will also allow additional details to be provided by site visits.
SE: Research reports on continued progress in research, and successes and challenges for industrial bio-energy applications.
CA: Progress is encouraging in Canada with focus on biomass and energy use. Reported needs are in legacy biomass as well as remote communities. News on continued expansion of bio-oil for heating.
NZ: Increased focus on biomass due to new government. Future ban on oil and gas exploration. New Zealand roadmap (is both technical analyses and an education for stakeholders.
NE: Brief update, with additional details to be provided during site visits.

Outputs from CR:

1) Need a working group on materials compatibility. Both for pump seals and for metal equipment (chloride is one issue.) This is to enable research but also to avoid surprises for adoption or industry when pumps or items fail that normally work for other materials.
2) Need a discussion on pumping bio-oils and bio-crudes to share experiences among Task members.
3) Need to consider other opportunities to share research difficulties and successes to help others leverage their research. Much of this information is not in the journals, and NTLs have historically shared this kind of guidance and advice. Question on how to collect and disseminate it.
4) ND requested formal approval to be the liaison between ProcessNet and Task 34, to co-report between working groups.
5) PhD thesis on scCO2 should be out in DE.

## Tuesday 22 May, 2018 (Reports and Site Visits)

BtG: Following the Task meeting in Enschede, the Netherlands, Hans Heeres and Robbie Venderbosch Discussed the current results progress of FPBO fractionation including considerations for biobased products from biomass fast pyrolysis. Included were discussions around techniques for enabling and performing the upgrading of FPBO to biofuels as well as considerations for co-refining for the production of fuels.

Along with this was a visit to the BtG research facilities. Systems included pyrolysis, bio-oil fractionation, upgrading, and modified diesel engine testing of bio-oils. Of particular note were the good safety practices, separations of systems and working areas, and considerations for long term operation of test stands including the diesel engine testing.

Empyro: Traveling over to Hengelo, the Netherlands, and the team took a visit with Gerhard Muggen and Ruud Meulenbroek to the Empyro production plant where bio-oils were produced for delivery as well as the coproduction of steam to a neighboring plant. Discussions centered on the progress towards operation of a commercial feedstock, increasing uptime of the plant.

Of particular note were the good communication and coordination between the plant and the client with the steam offtake agreement, as well as good coordination and communication between the plant and the bio-oil consumer. It was highlighted that there were successes of the knowledge gained in implementation by having technical staff well integrated with the research staff. Also, of particular note was that the Empyro system was a model facility for housekeeping and cleanliness. It was good to see that a production facility for bio-oil can be maintained in excellent condition despite the challenges that bio-oil has at a research scale. We observed a truck being loaded that was on its way to the FrieslandCampina facility in Borculo.

## Wendesday 23 May, 2018 (Reports and Site Visits)

FrieslandCampina: The team travelled from Enschede to Borculo, the Netherlands, to meet up with Johan van den Abbeele and others at the FrieslandCampina facility. The facility is undergoing construction and expansion indicating the heath of the current industry. The group was able to visit the steam production facility where bio-oil from Empyro is delivered, stored, and consumed for production of steam for use within the facility including use for drying of milk for the production of powder.

The team was able to witness part of the bio-oil delivery logistics of a truck that had arrived from the Empyro plant and was in the process of unloading material to the holding tanks at the Borculo facility. Noted that the transfer area was tidy, indicating good procedures and equipment for successful bio-oil transfers. The existing transfer system connects the headspaces of the truck and receiving tank such that the displaced volume from the receiving tank is transferred to the truck which minimizes the odor of bio-oil.

The facility representative took the team through the steam generators that were used to provide steam for the facility. Co-located with the bio-oil boiler was a bio-gas boiler. The bio-oil boiler used some amount of natural gas as a co-feed. The facility uses the multiple boilers to provide steam as needed and can ratio among them depending on maintenance schedules, availability, and demand. The facility is also generating needed data on bio-oil steam generator performance, uptime, and maintenance. The representative explained the process of change-out of routine maintenance items such as the bio-oil injector nozzle. It was good to see the process of liquefied biomass utilization from start to finish as well as gain an appreciation for the partnerships that have formed in order to make it work.

Fraunhofer Institute UMSICHT: Following this, the team traveled to Oberhausen, Germany to visit with with Stefan Conrad of the Fraunhofer Institute. He explained the recent projects in collaborative research of fast pyrolysis using the well-known, spinning-disk ablative pyrolysis system designed and built by Pytec. This was followed by a visit to the laboratory to discuss the system, the research, and the modifications and adjustments that have been made on the system. This provided an opportunity for the task members to ask questions about the effort, but also served as an opportunity for information exchange where the task members were able to provide wisdom back to the researchers in exchange for this opportunity.

The day adjourned with a Task dinner.

## Thursday 24 May, 2018 (Reports and Site Visits)

Pyreg, Dörth: The team traveled to Dörth, Germany to speak with Kevin Friedrich and Marcel Rensmann of Pyreg. The site was the demonstration facility and construction facility for slow pyrolysis systems for the production of bio-char and other solid biomass products. As a biomass related process and as the bio-char industry can be a side product of some liquefaction technologies, it was of interest to investigate the commercialization activities of Pyreg and meet with principals to learn from the challenges of biomass commercialization.

The Pyreg team provided an interesting case and plan for deployment of modular systems for the use of biomass in slow pyrolysis for a variety of applications. Much of the discussion centered around their approach for transferring the technology to owner-operators in order for the client to solve their specific biomass related need and output. What was of primary interests were the modular design and construction of the biomass system. The system was designed for scale-up in numbers, by constructing many of the components in a way to allow up to 4 systems to be integrated to share many components, including feed and product handling system. This also potentially allowed for maintenance and adjustments to throughput by bringing modules off- and on-line.

There were some interesting discussions around ideas for safe char handling which can also be applicable to DTL processes that generate side-product char. The tour took the group to the bench scale system used for screening client feeds and generating initial design numbers. Finally, the task members visited the construction floor where systems were being produced for external clients. It was good to see related technologies that were solving biomass needs in different ways.

KIT in Karlsruhe: The task traveled next to Karlsruhe, Germany to meet with Roy Hermanns, Hans Leibold, Marco Tomasi Morgano, Cornelius Pfitzer, and Andreas Niebel. The team had the opportunity to listen to the current research efforts in pyrolysis and product utilization from the active teams at KIT. This was followed by a tour of the pyrolysis oil research unit and related biomass processing systems.

It was noted the need to follow up with R2H which is now in its second year of research. The oil production work is being performed by BtG and VTT, while the research on the oil is being done at KIT, CNR, etc. OWI work is around the burner. CNR is modelling the combustion of FPBO.

One of the repeated themes was the reminder that oil pumps in normal residential heating are not compatible with FPBO and there is value in looking for team experience that can be leveraged by equipment manufacturers.

Another significant challenge was around being able to set quantifiable criteria around homogeneity of FPBO. While an ASTM specification for FPBO may call out homogeneity as a required characteristic, there may not exist a clear definition or criteria upon which to define it clearly. It was discussed that this has been examined by a number of Task members. This should be considered a future priority of the task to help craft metrics around homogeneity.

Following this was a tour of the intermediate pyrolysis system and an opportunity to learn about the interesting methodology around the sampling and product collection techniques on the system. This included discussion around the product library demonstrating the products produced from a wide history of biomass and biomass-related feedstocks that have been evaluated over the year. The system is a screw pyrolysis technology with intermediate pyrolysis including hot gas filtration for high ash content biomass and waste. Products have included various biomass, ag residue, sewage sludge, plastic waste with a focus on char product.

The team then proceeded to the demonstration plant for the BIOLIQ pilot plant. This was an excellent opportunity to view the process from large biomass handling through the fast pyrolysis and gasification processes for the production of fuels and chemicals. The team had the opportunity to ask questions and learn about many of the biomass and intermediate handling challenges that appear at scale, as well as the maintenance and flexibility around this system. Of particular note was the intrinsic value of this demonstration plant as a university teaching tool. It was large enough that classes have used the facility for the opportunity for engineers in training to experience the challenges of comparing process and engineering diagrams to fully constructed plants for the purposes of locating subsystems, reading control and instrumentation, and locating subsystems for simulated maintenance. The tour culminated with the view from the top of the plant to overlook the integrated grid testing systems where various electrical supply and demand systems were used to understand the impact of renewable energy in a simulated demand framework.

| Friday 25 May, 2018 (Task Meeting) | |
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Task Meeting, Karlsruhe: Final day was used to wrap up task business, plans for the current triennium, and discuss the plans for a proposed future triennium within IEA Bioenergy.

Technical Expertise Series: Discussion began over the need for collecting the combined experience of Task members with regards to research equipment. This was a consensus based on discussions on Tuesday on pumps and materials compatibility, discussions on Thursday at KIT around the gap between existing home heating oil handling equipment and the needs of bio-oil, as well as observing the vast array of research and startups having to answer these questions. As this data has been shared informally among NTLs in the past, formalizing it could allow OEMs and researchers to avoid common pitfalls and get to their research, particularly as there is not enough of this guidance in the literature. This was agreed that it could be valuable such that IP would not be disclosed and that it may be wise not to name specific manufacturers to avoid endorsements. The series could include individual topics such as pumps, materials compatibility, handling expertise, quench?, etc. AZ was given the action to start this process by putting together experience on pumps and forward to the group.

Round Robin Update: FM: All oils are assembled, need to update the dropbox to reflect the oil and duplicates (AZ action). Labs were shown, 17 potential. BvB suggests we should seek out labs with chlorine experience. Need to contact Axel to see if he has lab contribution. IFP France may also have chlorine analysis. It was suggested for analyses (particularly N) it may be good to recommend analyses or let them have the freedom to choose their own. So long as the lab details which method they used. As far as acknowledgements, it was decided that it was currently best not to mention oil producers. The labs will be listed (but not referencing their number and also offer option to exclude their name. All data will be randomized.

PyNe Newsletter Articles:

US: Steeper, Mariefel, Writeup on Doug. [Talk to Norway and UK for input.]

NZ: Pretreatment, Roadmap

NL: Robbie (electrochemistry), consultancy LCA (considering), Allucia "finds it interesting"

DE: Roy (yes), Axel is preparing something,

SE: Update on slurry phase plans?

FI: Ask Kristin (Refinery) ask about any contributions.

CA: none yet (may be interesting to hear from Ontario regulatory, or others from workshop.)

(Thunen HTL? Other?]

Also: May needs to complete a new form for use of picture. Use of this should be done for IEA. Alan needs to find out what do we do with the mailing list?

Alan: Go back to prior ExCo Task reports to quick harvest the website analytics for comparison of last few years.

ND: Provide input for the webpage first, so we can finish it. And then start up again for the brochure. Need to use the text from Tony from the prior triennium.

Next Years' Triennium

Questions around getting feedback from ExCo81 and how to proceed from the next year.

TEA: Should this be part of our efforts? Have we been doing this much from the task? Is there a value proposition for this enough to include it? Is the task the right people to be working on this? There is a similar activity on the Eurpoean energy alliance that may be working on this. Task may be better off looking over that and monitoring that for. The report on this could be analyzing the results of other TEA (Robbie is doing this) to put in a meta study of TEA.

For TEA: A meta study on TEA may be great, but some countries may not be able to make recommendations. It may be best to investigate what is there, report on it, and maybe contract someone to write it up. Workshop along with TEA.

Website update: Need to commission work this year to updating the website in the current triennium. Look for getting reimbursements for commissioned work for the Task to deal with the unspent funds.

Analytical techniques: Should work on advanced analytical.

Dissemination: Has been challenged on softening it and hardening it in some cases. Support for development of standardization methods.

Next Meeting

November 5-8:  ABLC in SF

Options:  Oct 30 to Nov 1 in Richland, WA at PNNL

Need to discuss if holding part of the meeting over the weekend is necessary or optimal in order to minimize travel time.  Action to report back on team availability for meting availability in Richland. Need to determine if there are any good hotel options in SF.

Meeting was adjourned.