

Converting biogenic urban liquid fuels for road transport by means of Hydrothermal Liquefaction (HTL)

Newsletter

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1. Webinar Series

Webinar #1 - Radically changing the way we think about wastewater management

The first webinar in the final year webinar series got off to a flying start, with the successful delivery of 'Radically changing the way we think about wastewater management', presented by Irantzu Alegría (CENER), Thomas Helmer Pedersen (AAU), Joscha Zimmermann (KIT). The presentation was recorded and is available on the NGRF YouTube channel to watch again here:



In this first webinar we heard from Thomas with an overview of the research concept, which is now in the final 10 months of this four year project, as such the achievements to date and key findings were presented, such as aqueous phase valorization and upgrading of biocrudes. Following on, we heard from Irantzu who gave us an overview of the composition of sewage sludge and how it differs depending on the source location and country. To conclude Joscha presented his research about improving the quality of the biocrude.

Join us for the following upcoming webinars:

Webinar #2 - Cost analysis of biofuels produced from HTL of urban waste

This webinar will present the econominc feasibility of producing biofuels by HTL of urban waste, and will be presented by Gonzalo del Alamo Serrano (SINTEF), on 15th March 2022.

Webinar #3 - Membrane technology – looking for an adequate solution for treatment of hydrothermal liquefaction wastewater (HTL-WW)

This webinar will be presented by Ali Sayegh (KIT), on 5th April 2022, focusing on his research into membrane technology in terms of finding a solution for the treatment of HTL wastewater.



Upcoming events Webinar #2 - 15th March 2022 Webinar #3 - 5th April 2022



2. NextGenRoadFuels - Achievements to date

2.1 75% N-removal

Urban waste contains a high nitrogen composition, but nitrogen for fuel is not valuable, therefore research into extraction and reuse during the pretreatment step has been conducted. By analysing and evaluating protein extraction pathways more than 75% N-removal can be achieved in the pre-treatment step.

2.2 Pilot unit success

After pretreatment, the outcome is the biomass, from which bio-crude is produced after HTL is performed. A pilot unit, constructed at Aalborg University in partnership with Steeper Energy, demonstrated processing of more than 8 tons of slurry to make the valuable product of bio-crude.



Figure 1: Steeper Pilot Unit - Photo credits Steeper Energy ApS, DK

The bio-crude requires further upgrading to remove or recover minerals, oxygen, nitrogen, and sulfur, to produce fully finished transportation fuels.

Now the main research of NGRF is the stage between bio-crude and upgrading, in other words; what it actually takes to make the bio-crude ready to be fed into full scale equipment.

Development on HTL product separation during this project has obtained more than 100 kg of high quality upgradable biocrude and nutrients recovery, simultaneously, with pleasing parameters:

- Low mineral and water content
- Low Micro Carbon Residue
- Low viscosity
- Easily run in a fix bed hydrotreater for several hundred hours

2.3 Valorising the whole process

The research objective is to valorise the whole package. Not just the carbon that is required to turn into fuels, but also the other minerals, such as phosphorus. During the research phosphorus recovery for more than 95 % has been realised as a solid byproduct.

However, the recovery of minerals is not the only thing that will change the economy of the process but it is key in circular thinking of waste management and this value proposition is a key enabler for Legislative requirements for phosphorus recovery urban waste utilization (EC – INMAP in 2021).



Figure 2: Biocrude - Photo credits Steeper Energy ApS, DK

2.4 HTL destroying micro-pollutants

Urban waste is full of micropollutants, in particular micro-plastics. The high temperatures of HTL destroy the pharmaceuticals in urban waste up to nearly 100%. NGRF has been able to create a method to quantify microplastics that are found in the sludge, and determine its type and size. Most of the mirco-plastics found in sludge are prone to degrade at high temp, the 1% remaining that cannot be degraded belong to the resistant fractions, but the important thing is that this end fraction is dealt with on-site and will not return back to farmers field in a solid form with phosphorus.

High temperatures of HTL destroy up to nearly 100% of mirco-plastics found in urban waste.





Figure 3: Microplastic particles in urban waste - photo credits Aalborg University

fuels we already have on the market. The next few months research will be focusing on these questions, and how it can be mixed and blended, and what are the emission profiles when combusted. Two different approaches for distillation will be explored, finally to result in engine testing.

These results are going to be presented in Webinars and certainly at the project's final event, to be held at Aalborg University, in October 2022.





2.5 Aqueous phase

Sludge is a wet feedstock, as such the water needs to be removed and then disposed of. However, the waste water from HTL has concentrations of minerals several orders of magnitude higher than those in a wastewater treatment plant (WWTP), therefore it can not be discharged to nature or returned to WWTP, it must be dealt with on site. Research has discovered that thermal distillation of the waste water, can turn carbon and nitrogen into a concentrate that can be recirculated into the process, resulting in 85% of the energy recovery.

Furthermore the research conducted by Ali Sayegh, at KIT university, has proven with the use of certain membranes the aqueous phase can be valorised and purified even further. This will be the subject of the third webinar, to be presented on 5th April.



Figure 4: Aqueous phase (AP) purification - photo credits Aalborg University

2.6 Finishing the value chain

The last year of NGRF is going to finish off the value chain by using the finished fuels that are produced by the hydro-processing of biocrude and experimenting further, as to how these fuels can be distilled into market products, such as gasoline diesel and jet fuel. The final question remains at this point is how can it be brought to market? Can it be combusted in an engine on it's own, or does it need to be mixed with other

3) EUBCE 2022 - NGRF presentations

This year's 30th edition of the EUBCE, May 9th - 12th, will host three presentations from the NGRF project. They will be presented by researchers from Aalborg University and KIT, with the following titles;

- Catalytic Hydrotreating of Bio-Crude Obtained from Hydrothermal Liquefaction of Biopulp: Effect of Aqueous Phase Recirculation on the Final Upgraded Oil.
- What It Takes to Continuously Hydroprocess Different Hydrothermal Liquefaction Biocrudes: Challenges, Prospects, Achievements, and Drop-in Fuel Potential.
- Influence of Lipid, Protein, Cellulose Interaction on the Evolution of N-Heteroatom Compounds During Hydrothermal Liquefaction.

All three will be presented as part of topic 5.2, Hydrothermal Processing. The full programme of events can be found at <u>https://www.eubce.com/</u>.

Two different approaches for distillation will be explored, finally to result in engine testing.





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