## Research theme: valorization

## Research subtheme: Sustainability and the circular economy

# Enhancing Hydrothermal Co-Liquefaction of Insect and Brewer's Spent Grains Biomass: A Synergistic and Parametric Optimization Study

The hydrothermal liquefaction (HTL) technology facilitates the direct conversion of wet biomass into biocrude while circumventing the need for a preliminary drying operation. Biocrude constitutes the main product of the HTL process and can be used as a fuel or a source of biochemicals[1] due to its favorable higher heating value (>30 MJ/kg)[2, 3] and its content of high value compounds (e.g. esters, aromatics, alkanes etc.), respectively. The HTL process exploits water's ability to alter its thermodynamic properties as its critical condition ($T_c$ = 373.95 °C, $P_c$ = 22.064 MPa)[1, 4] is attained, with the polarity of water transitioning from polar to less polar. Due to the potential of utilizing HTL for value extraction from biomass waste, this project will seek to incorporate synergistic effects via co-liquefaction and parametric optimization approaches in an attempt to further enhance the overall process efficiency. In this regard, highly polluting waste streams of insect biomass (ISB) and brewer's spent grains (BSG) will be assessed as promising HTL feedstocks. The project hypothesizes that by combining ISB and BSG, it may be possible to enhance the overall process efficiency of a low temperature (200 $^{o}$C <$x$<300 $^{o}$C)[1] HTL process. During the course of the project, separate parametric optimization studies of ISB and BSG will be undertaken and the optimal conditions for enhanced biocrude production for the different biomasses determined. The compositional assessments of the optimally produced biocrude products will also be undertaken. Different blending mass ratios (1:0, 3:1, 1:1, 1:3, 0:1) of ISB and BSG will then be prepared and subsequently subjected to Hydrothermal Co-Liquefaction (HTcL) while imposing the determined conditions for optimal HTL for ISB and BSG. The resulting synergistic or antagonistic effects of the blending process on biocrude yields will then be determined. In addition to quantitative effects of blending ISB and BSG on the HTcL process, the effect on the biocrude composition and quality will also be assessed. It is anticipated that this holistic study will inspire innovation in the field of HTcL and further promote the transition towards a more sustainable and resource-efficient Belgium.

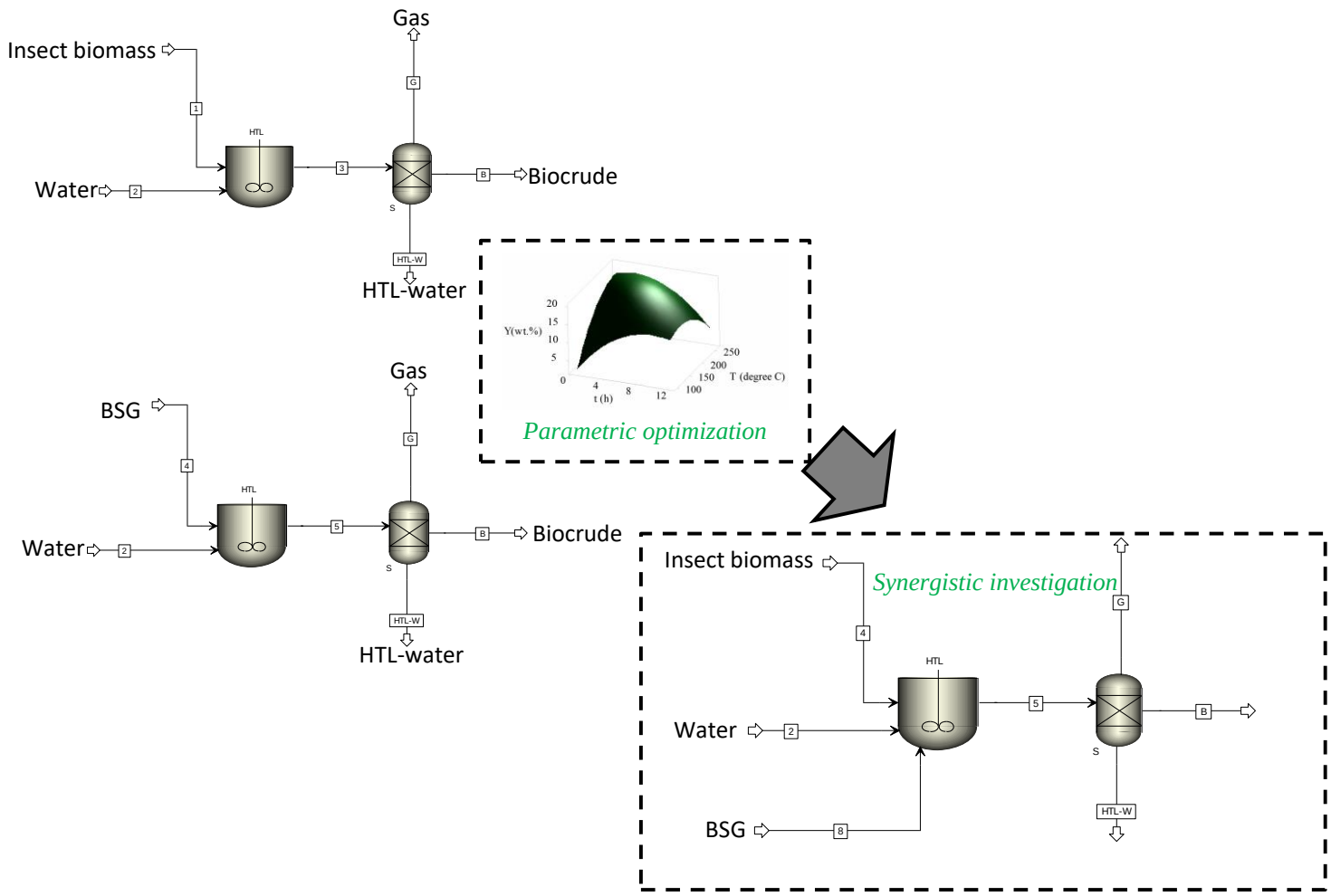
Keywords: *hydrothermal liquefaction; brewer's spent grains; insect biomass; optimization; synergizing effects; sustainability*

## Requirements

1. The candidate should have an excellent academic background preferably a BSc (or BEng.) degree Chemical/Process/Biomaterial Engineering with a minimum of a 2.1 graduating grade point.
2. The candidate should be motivated and have a strong desire to learn and improve.

## References


1. Okoro, O. V.; Sun, Z.; Birch, J., Meat processing waste as a potential feedstock for biochemicals and biofuels – A review of possible conversion technologies. *Journal of Cleaner Production* **2017,** *142*, 1583-1608.
2. Okoro, O. V.; Sun, Z., The characterisation of biochar and biocrude products of the hydrothermal liquefaction of raw digestate biomass. *Biomass Conversion and Biorefinery* **2021,** *11* (6), 2947-2961.
3. Ellersdorfer, M., Hydrothermal co-liquefaction of chlorella vulgaris with food processing residues, green waste and sewage sludge. *Biomass Bioenergy* **2020,** *142*, 105796.
4. Okoro, O. V.; Sun, Z.; Birch, J., Prognostic Assessment of the Viability of Hydrothermal Liquefaction as a Post-Resource Recovery Step after Enhanced Biomethane Generation Using Co-Digestion Technologies. **2018,** *8* (11), 2290.




Graphical abstract