Hydrothermal liquefaction of food wastes for biofuel production: batch versus continuous

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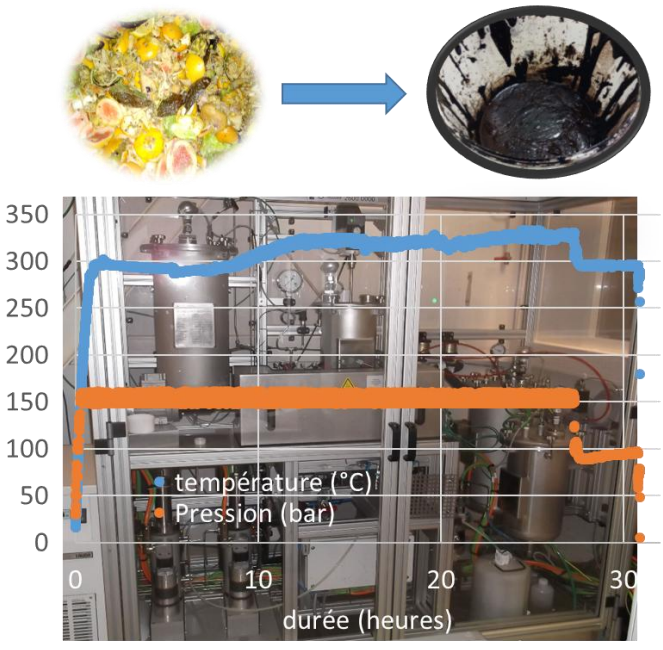
WASTE2ROAD European project aims to develop a new generation of cost-effective biofuels from a selected range of low cost and abundant biogenic residues and waste fractions. The established consortium covers the full value chain, from waste management, the technological process of transforming waste to advanced biofuels to the assessment of the end-use compatibility of the obtained biofuels. This will be achieved through transformation of a diverse range of wastes (and fractions thereof) into intermediate bio-liquids, deploying both fast pyrolysis ('pyrolysis') and hydrothermal liquefaction ('HTL').
Our previous work on HTL of agro-industrial residues has shown that the biochemical composition of the initial matter is the major parameter influencing conversion efficiency and quality of the product [1]. Main quality criteria for biofuel production is to minimize O, N content of the product and correspondingly to have a high energetic content (HHV) but also reduce solid fraction of biocrudes.
Different types of resources have been considered for HTL conversion in the WASTE2ROAD project. For this presentation we will focus on the conversion of food wastes. First screening of conversion conditions and yields was done in a batch reactor. Mass and carbon balances were carefully done and the products were characterized after separation. Continuous experiments were performed with the same resources on our 2.5 L/h test bench, in similar temperature conditions. The first aim of the continuous conversion was the production of a satisfying quantity of biocrude, for further upgrading studies at SINTEF.

9 Kg were produced and the longest running time was 30 hours (see figure below as illustration).



Picture of the Hydroliq installation and pressure/temperature recordings during conversion of food wastes

A study on aqueous phase recycling in batch and in continuous tests was made to see the impact on biocrudes characteristics and yields.
Food wastes are an interesting resource with lipids in it coming from meat residues and cooking oils. The obtained biocrude has an oil/char ratio up to 5 and a HHV of 30 MJ/Kg with a mass yield above 40%.
Aqueous phase coming out of the continuous experiments have a higher carbon content than the batch ones with the same initial resource even if the identified species by GCMS are similar. Recycling of the process water increase the final carbon concentration in aqueous phase but at the same time increase the biocrude yield (up to 47 %w) so that recycling of the HTL aqueous process water seems a good way to spare water resource and increase the efficiency of the process.

[1] Deniel, M., et al., Hydrothermal liquefaction of blackcurrant pomace and model molecules: understanding of reaction mechanisms. Sustainable Energy & Fuels, 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818120.