HYDROTHERMAL LIQUEFACTION PROCESS OF FOOD WASTE IN BATCH AND CONTINUOUS LAB SCALE REACTORS

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Due to the energy burden that represents the drying step, wet biomass is often underexploited for energy purpose. Indeed, this step represents one of the most energy consuming step in a thermochemical process and is often economically prohibitive. During hydrothermal liquefaction, conversion of biomass takes place at temperatures between 250 and 374 °C and at pressures above the saturation pressure to ensure that water remains in the liquid phase, typically above 100 bars, avoiding enthalpy energy penalties [1]. To avoid competitive use of land for food supply and excessive cost of entrance biomass, blackcurrant pomace and brewery's spent grains have been selected and tested on liquefaction as food residues. Experiments have been carried out in a 600 mL batch reactor (PARR), allowing maximum temperature of 320°C and maximum pressure of 130 bars. Effects of operating parameters such as temperature and holding time, biomass pretreatment and reactor configuration are investigated on mass yields, aqueous phase composition and energy balance. Results obtained in the batch reactor constitute the reference of this study, in the comprehension of the mechanism of the liquefaction of food residues. Also, these results form the basis for a model to scale up the process, and are confronted to the results on a continuous lab scale plant.

Yield of hydrothermal liquefaction of raw blackcurrant pomace was reported by Déniel et al.[2]. In comparison, experimental results show that grinding improves the bio oil yield, compared to liquefaction of raw biomass. Temperature strongly influences mass yields, especially above 15 minutes holding time. This underlines the combined effect of temperature and holding time (Figure 1).

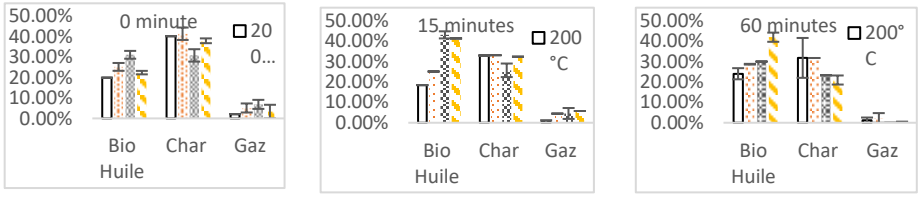

Figure 1 : Evolution of the products yields from the liquefaction of blackcurrant pomace with temperature and holding time

Further experiments were carried out in a continuous lab scale plant with a capacity of 2 kg/h, to understand the role of the reactor configuration in the liquefaction mechanism. The injection system and heating rate are main parameters likely to explain the much of the differences observed. Results on the first experiment in the continuous pilot plant will be presented here on ground black currant pomace.

References

[1] M. Déniel, G. Haarlemmer, A. Roubaud, E. Weiss-Hortala, et J. Fages, « Optimisation of bio-oil production by hydrothermal liquefaction of agro-industrial residues: Blackcurrant pomace (Ribes nigrum L.) as an example », *Biomass and Bioenergy*, vol. 95, p. 273-285, déc. 2016.
[2] M. Déniel, « Etude de la production de bio-huile par liquéfaction hydrothermale de résidus agroalimentaires et de leurs molécules modèles », PhD Thesis, Ecole des Mines d'Albi-Carmaux, 2016.