Circular Economy in Food Industry Waste Management (BIVALIA Workshop2 - 2026)

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Evaluation of food waste hydrothermal carbonisation through process simulation and environmental life cycle assessment

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Oral Presentations #16

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Hydrothermal carbonisation (HTC) has been widely investigated as a potential route for the valorisation of wet organic residues, since it enables the conversion of high-moisture feedstocks into hydrochar. In the case of food waste, previous studies have shown that HTC can support energy and nutrient recovery, but its environmental performance depends on process conditions, energy requirements, hydrochar use, and the management of the liquid phase [1,2]. These aspects make HTC a process in which experimental data, process simulation, and life cycle assessment need to be consistently integrated. Brewer's spent grain is particularly relevant in this context because it is generated as a wet by-product of beer production, typically with a moisture content of around 70 – 80 % [3]. In this context, Spanish beer production reached approximately 41.3 million hectolitres in 2024, with an estimated generation of 0.83 Mt of wet brewer's spent grain annually.

In order to advance towards a circular economy in Spain, this work presents a combined process simulation and environmental life cycle assessment of HTC of brewer's spent grain. The simulation model was developed to represent the main mass and energy flows of the system, including HTC, solid–liquid separation, and energy integration. The resulting life cycle inventory was incorporated into an environmental assessment to estimate the potential impacts associated with the process and to identify the main contributors to its environmental profile. Furthermore, the analysis studies the influence of process yields, energy demand, and hydrochar and liquid phase valorisation. In this regard, potential extension of the system to include fermentation of the liquid phase is explored. Overall, the study shows that the environmental suitability of the system is highly conditioned by the specific process design, e.g. in terms of the involved energy and end-of-life strategies.

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