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Research group: GREiA (UDL)

Research topic and interests

My research focuses on the development of bio-based phase change materials (PCMs) for thermal energy storage through the valorisation of non-edible animal fat waste (cow, chicken, lamb, pig).

I combine process design and intensification with material characterization and the assessment of their potential to replace fossil-based compounds, aiming to contribute to sustainable energy solutions.



Circular economy



Waste valorisation

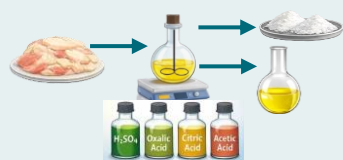


Thermal energy storage

Key areas of expertise

Process engineering:

- Extraction and fractionation of fatty acids
- Synthesis and purification
- PCM development

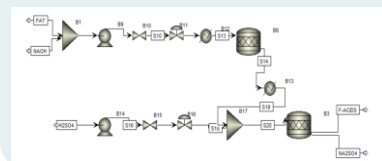


Chemical and thermal characterization:

- DSC
- TGA(thermogravimetric analysis)
- Nuclear magnetic resonance (NMR)
- Gas chromatography (GC)
- Thermal cycling

Process modelling and simulation:

- Aspen plus (simulation of the basic hydrolysis process followed by acidification)
- Design and analysis of continuous processes
- Optimization of operating conditions



Process development and intensification:

- Extraction and hydrolysis of inedible fats
- Continuous processes
- Laboratory-scale scale-up and optimization



Current work

- Development and characterization of bio-based PCMs (derived from agro-industrial waste and by-products).
- Simulation and analysis of continuous hydrolysis and subsequent acidification processes using Aspen plus.
- Evaluation of replacing fossil-based acids with organic acids.
- Process intensification and scale-up of continuous laboratory-scale processes.
- Characterization of PCMs via differential scanning calorimetry (DSC) analysis.
- Integration of PCMs into thermal energy storage systems.



Non- edible animal fat



Fatty acids



PCM



Thermal energy storage applications

Results

- Production of fatty acids with an extraction efficiency of up to 87% and development of bio-based PCMs.
- Production of materials with PCM temperatures in the 48–61°C range.
- Development and validation of an Aspen plus-PFR model for the continuous production of fatty acids, with an R^2 of 0.98 and conversions approaching 92%.
- Evaluation of replacing H_2SO_4 with organic acids, yielding predictive models with R^2 values of 0.91–0.99 and demonstrating their viability for maintaining optimal yield.

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