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HYDROTHERMAL CARBONIZATION OF DIGESTATE: SEMI-CONTINUOUS ANALYSIS OF LIQUID COMPOUNDS

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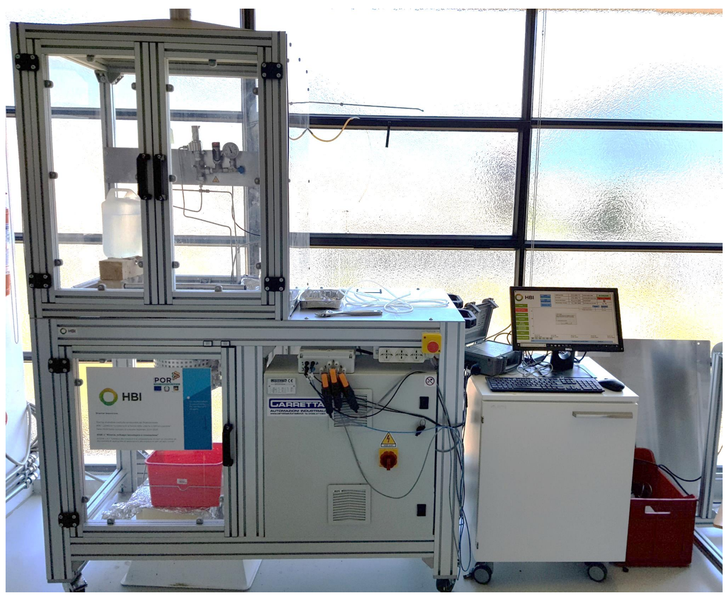
Introduction

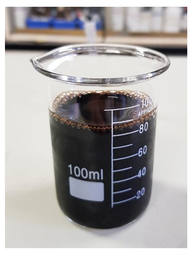
In this work, a **semi-continuous sampling method** is applied to the **hydrothermal carbonization (HTC)** process of digestate to study the composition of its liquid phase, the **aqueous HTC liquids (AHLs)**. While previous studies presented data on AHLs sampled after the quenching of the reactor after several runs at different conditions, the approach here proposed relies on the **spillage of small liquid samples during the process** (at high T and P). This **reduces the number of HTC runs** required to obtain a significant number of samples and **avoids the uncertainty due to the reactor quenching.** This provides a reliable procedure for the study and thus the valorization of AHL, as of today seen as a problematic byproduct.

HTC reactor

- **Feedstock**: digestate from cow-manure and agricultural residues
- Stainless steel batch reactor
- **Semi-continuous liquid sampling**
- V = 4 L
- T = 180 – 220 – 250 °C
- t = 3 h



AHLs



Hydrochar

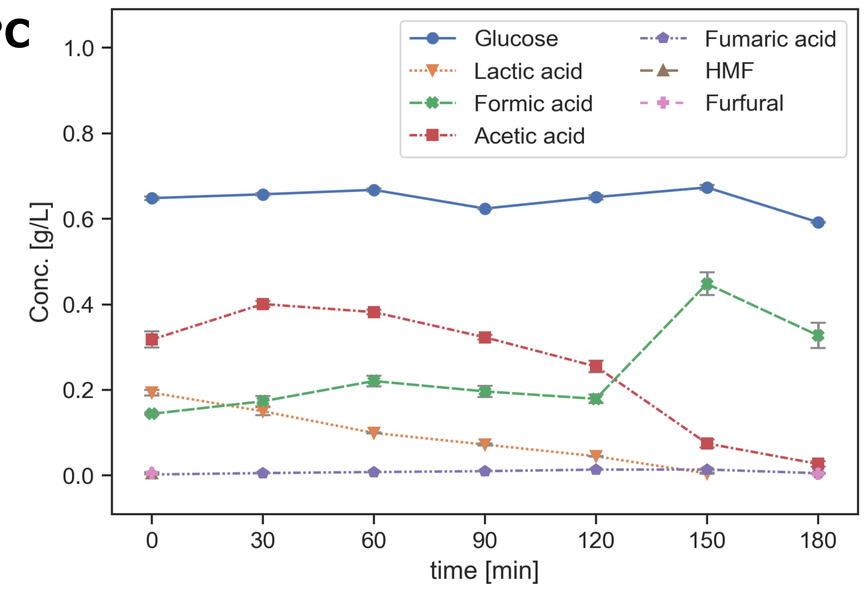
AHLs

The liquid phase was sampled **every 30 minutes**, starting from the moment the set temperature was reached.
The compound analysis was performed using High Performance Liquid Chromatography (**HPLC**) equipped with a cation exchange column Aminex 87-H column (300 × 7.8 mm, 9 µm, Bio-Rad), and an isocratic elution with 10 mM H_2SO_4 as carrier solution at a flow rate of 0.6 mL/min.
Results show the variation in the concentration of:

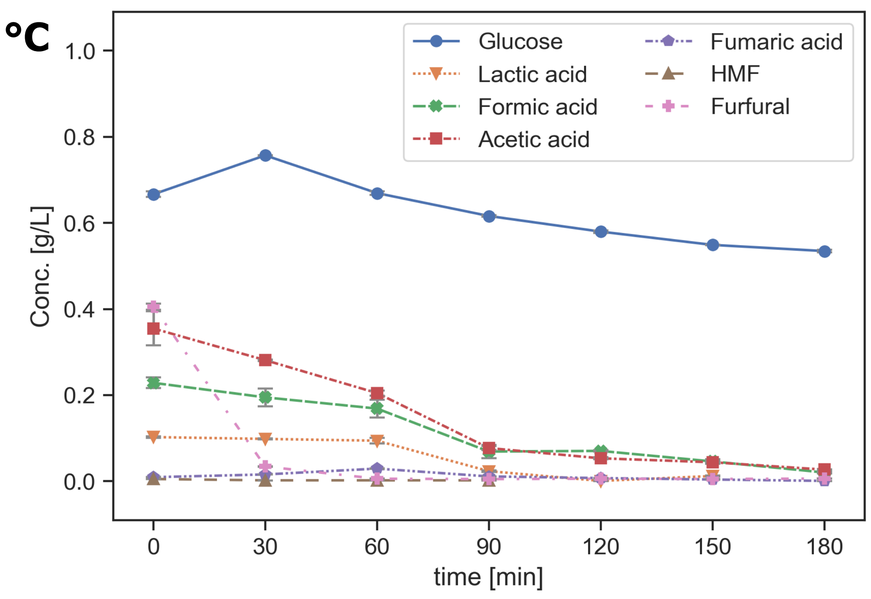
- Glucose
- Lactic acid
- Acetic acid
- Formic acid
- Fumaric acid
- Hydroxymethylfurfural (HMF)
- Furfural

Results

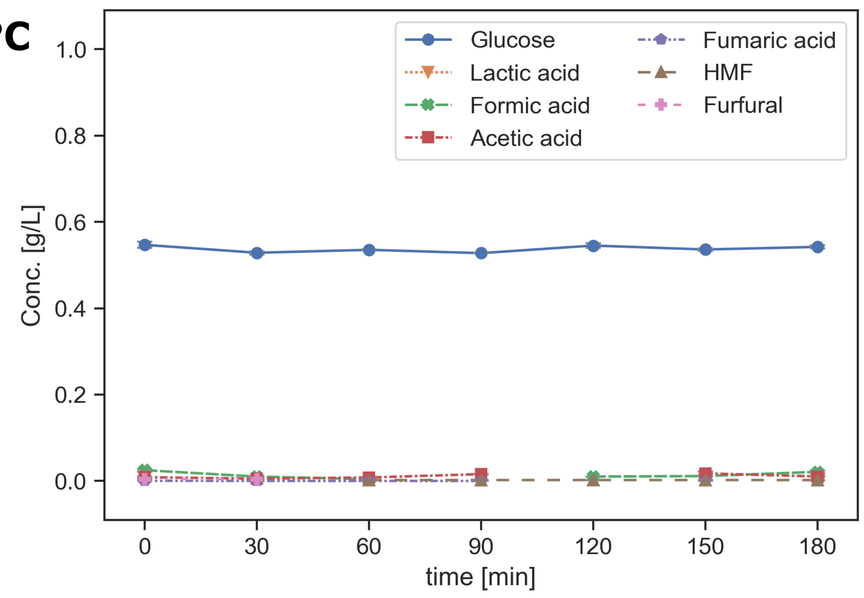
180 °C



220 °C



250 °C



Conclusions

Compounds' concentration decreases as a function of increased temperature and residence time. This is due to an increase of the reaction rate of hydrolyzation and dehydration that become the governing reactions of the process. Especially sugars, HMF and furfurals are less stable at high temperature and residence time and therefore degrade more easily. Moreover, polymerization and the formation of secondary char could be responsible of the decrease of the final concentration of these less stable compounds.

Acknowledgements

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