# ENHANCEMENT OF MICROALGAE ENERGY RECOVERY BY HYDROTHERMAL CARBONIZATION

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## INTRODUCTION

Microalgae is known nowadays as advantageous approach to remove organic pollutants from wastewater and convert them into biomass. Anaerobic digestion has been used for microalgal biomass (MB) valorization to boost the sustainability of wastewater microalgae-based treatment. However, methane yields obtained are low due the rigid cell envelope of microalgae, which limits the biological degradation. Hence, cell envelope disruption is needed to improve energy recovery.

The HTC upgrades the wet biomass into hydrochar and a liquid fraction (LF) using mildest temperatures of 180 to 280 ºC. Obtained hydrochar can be used as solid fuel while the LF has ideal characteristic for anaerobic digestion (AD) such as high COD and nutrients. Currently, few studies on the potential to produce methane from LF of HTC are limited (Villamil et al., 2018). This study compared the energy recovery from AD of microalgal biomass with that from HTC (at 180, 210 and 240 ºC) of microalgal biomass (hydrochar + $CH_4$ by AD of LFHTC).

## MATERIALS AND METHODS

### Hydrothermal carbonization

**Microalgal Biomass:**
46.3 gVS /L, xx gTCOD/L

**HTC process:**
180, 210, 240 ºC. 1h

Hydrochar

Liquid fraction (LFHTC)

### HTC PRODUCTS

Characteristics of hydrochar at different T

| T (ºC) | 180 | 210 | 240 |
|---|---|---|---|
| VS (%) | 45.9 | 40.4 | 34 |
| Fixed C (%) | 10.9 | 12 | 13.4 |
| Ash (%) | 34.7 | 39.5 | 45.7 |
| H heating V (MJ/kg) | 18 | 18.6 | 16.7 |

Characteristics of LFHTC at different T

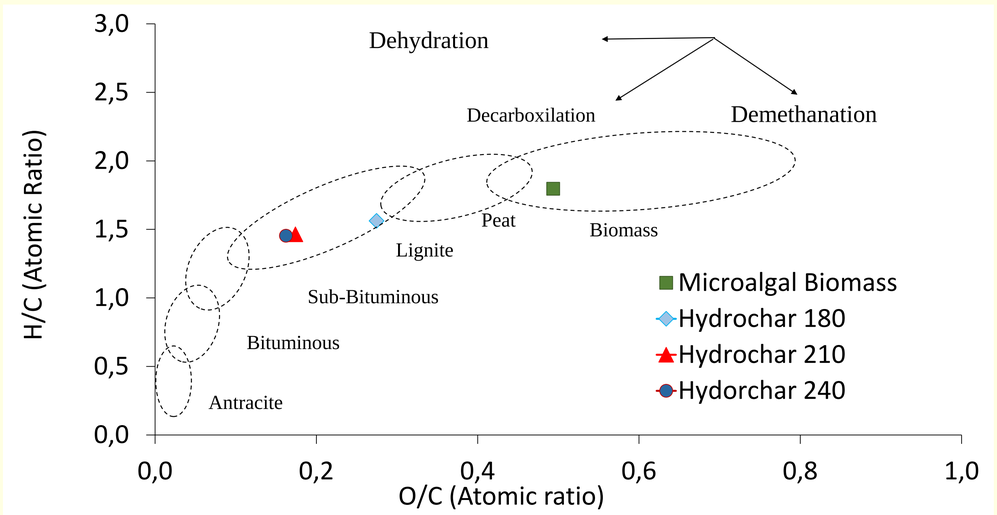
| T (ºC) | 180 | 210 | 240 |
|---|---|---|---|
| VS (g/L) | 57.9 | 33.8 | 24.5 |
| COD (g/L) | 26.8 | 22.3 | 22.8 |

### AD batch experiment

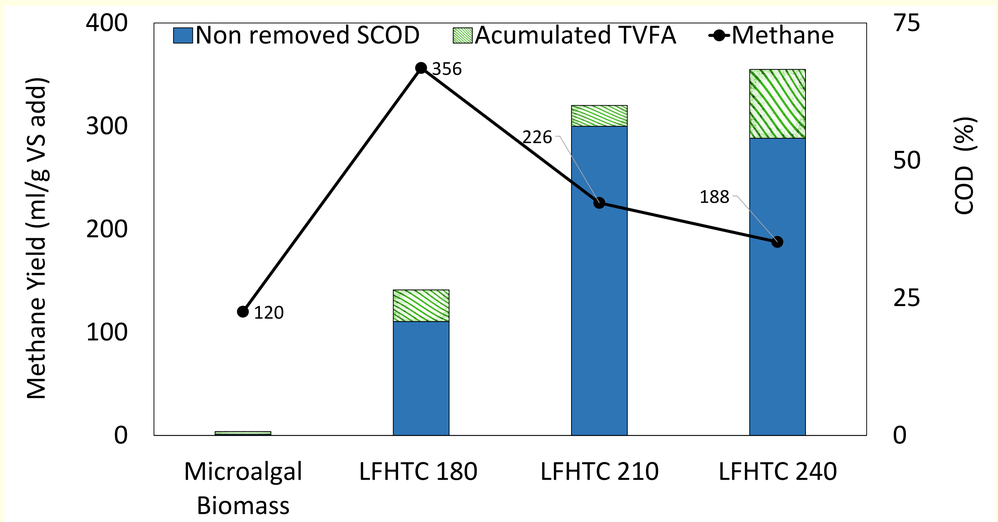
**AD experiment**
Inoculum: 15 gVS /L
ISR: 2. Temperature: 35ºC

## RESULTS AND DISCUSSION

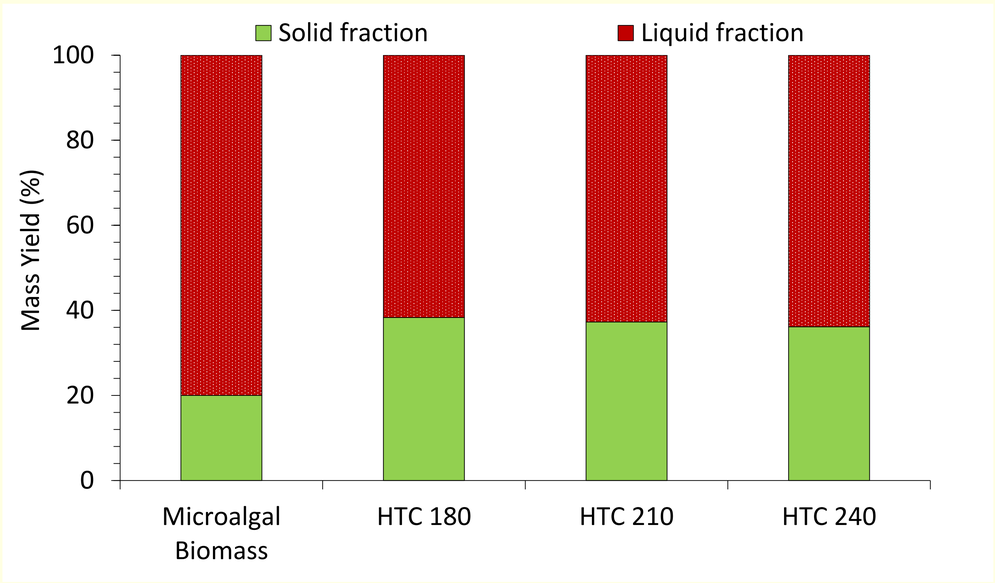
### HYDROCHAR FUEL PROPERTIES. VAN KREVELEN DIAGRAM

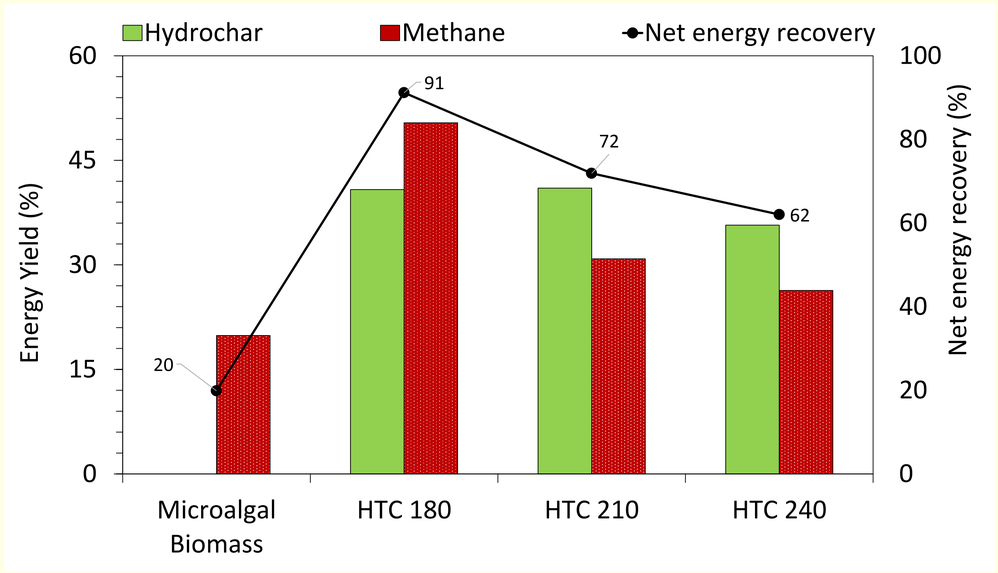



### LFHTC BIODEGRADABILITY: METHANE YIELD AND COD REMOVAL




### HTC PRODUCT YIELDS AND ENERGY RECOVERY




## CONCLUSSIONS

- The mildest HTC condition of 180 ºC is recommended to obtained a hydrochar with fuel characteristics of lignite and a LFHTC with high anaerobic biodegradability.
- Añadir conclusion sobre DQO VFA y METANO
- Microalgae energy recovery was widely improved by hydrothermal carbonization (HTC). The net energy recovery of 20% obtained by AD of microalgal biomass, increases up to 4-fold after HTC treatment.
- Increase in HTC temperature over 210 ºC reduced higher heating values (HHV) in hydrochars by carbon loss. Likewise, LFHTC obtained over 210 ºC showed refractory compounds inhibiting the energy recovery by AD.

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