Assessing the effect of phenolic hydrochars in the anaerobic co - digestion of waste activated sludge and cheese whey wastewater

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Introduction

Lesvos island has a well-developed food industry, and as a result several wastewater streams need to be valorized and properly disposed. The main sources of wastewater come from the food industries are the olive mills, the wineries, and the diary processing facilities.

Production of biogas from food industry wastewater (FIWW) can be a significant source of energy and a first steps towards the green energy transition of the island. In the framework of Circular Economy FIWW was treated by means of hydrothermal carbonization for the production of hydrochar, which was added to BMP experiments of said FIWW.

Methods

OMWW and wine sludge were treated in a 4570A Parr hydrothermal reactor for a residence time of 2 hours, temperature of 250 °C and pressure of 55 bars. Wheaton bottles (25 ml volume) with septum seals were utilized for the anaerobic co-digestion of locally sampled cheese whey wastewater with added hydrochar in mesophilic conditions. In all experiments 5 ml of CWWW was treated (1:2 ratio with sludge) along with different added hydrochar percentages, i.e., 50 g, 100 g and 250 g respectively. This study presents the results from hydrothermal carbonization of OMWW and wine sludge with a focus on the quality of the produced hydrochar. The biomethane potential of the co-digestion was assessed by BMP tests, and the final digestate was assessed for the content in VFAs by means of an Agilent GC with a DB-WAX column. Analysis also included the TS/ VS content, COD and Total Phenolic Content of the digestate (Folin – Ciocalteu method).

Results and Discussion

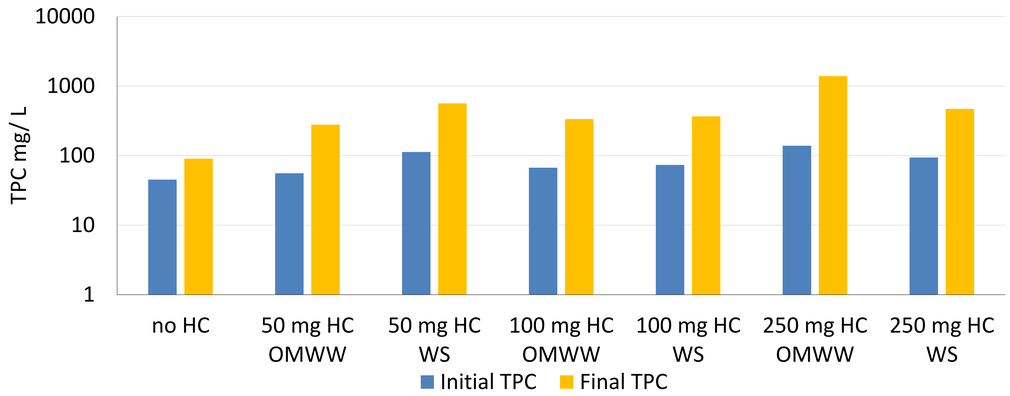

Fig.1. Total phenolic content (initial and final). HC: hydrochar, WS: wine sludge, OMWW: olive mill wastewater

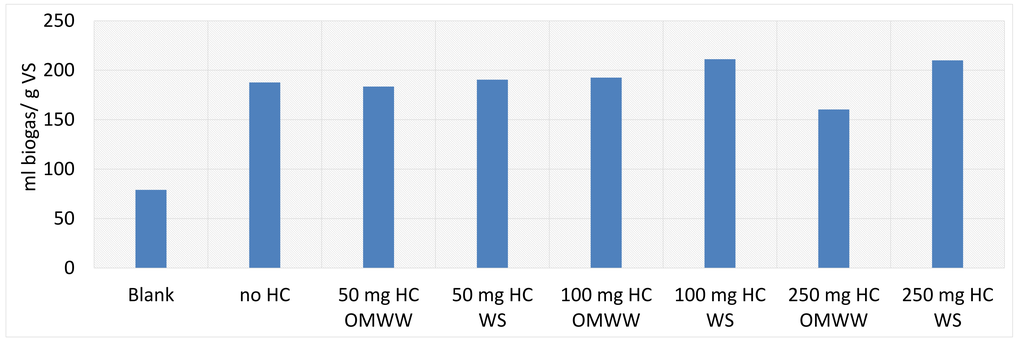

Fig.2. Biogas potential. HC: hydrochar, WS: wine sludge, OMWW: olive mill wastewater

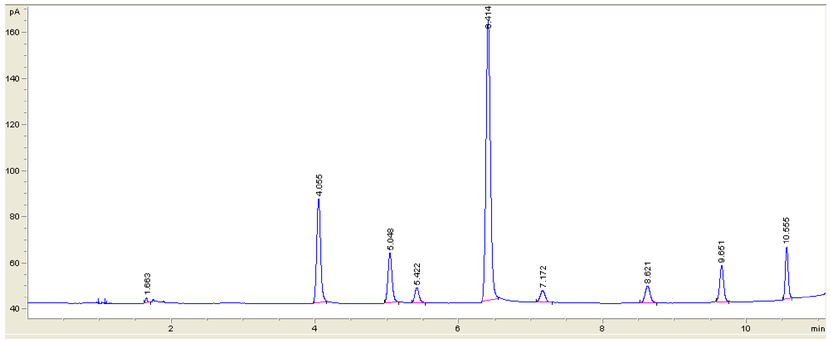

Fig.3. GC graph of VFAs from sample with 250 mg hydrochar from wine sludge

- Overall, 8 samples underwent BMP test. All of them contained 5 ml of cheese whey wastewater (CWWW) and 10 ml of substrate (waste activated sludge).
- Hydrochar (HC) was produced from phenolic wastewater sources, i.e., olive mill wastewater (OMWW) and wine sludge (WS). HC from WS had a heating value of 28.05 MJ/ kg, while HC from OMWW had a slightly lower heating value of 26.55 MJ/ kg.
- Biogas was measured in respect to the g VS of CWWW, and in this case the VS content was 5.5%.
- The highest biogas production was observed for the samples with 100 and 250 mg of WS HC. The sample with 100 mg of HC from OMWW performed also well but the addition of HC from 100 to 250 mg had a mitigating effect on biogas production.
- The final Total Phenolic Content of the digestates from the BMP tests were increased and further studies will analyze the “produced amount” vs the “transferred amount from hydrochars”
- In respect of the VFAs concentration, butyric acid was the predominant one followed by acetic acid for all cases and samples. The presence of hydrochar did not significantly alter the concentration or the types of produced VFAs from AD.

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