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Fuels production from liquids after hydrothermal carbonization of kitchen waste – methane fermentation step

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In recent years, due to the rapid increase in fuels costs, there has been a growing interest in the production of biofuels. One of the most common ways of the biofuel generation is the methane fermentation. However, there are still a lot of investigations conducted on the optimization of this process. One of the current trends is the production of hydrogen and methane from the substrate using two-step fermentation. Our earlier investigations showed that in two-step fermentation of kitchen waste produced more methane was than single-step fermentation – even though the gases produced in the first step were removed from the system [1].

In this study, kitchen waste (KW) was subjected to 0.5 h of hydrothermal carbonization at different temperatures – 180, 215 and 250°C. The liquids produced during this process were used as a substrate for the dark fermentation process. The remaining digestate was used as a substrate for the methane fermentation process, which was carried out in a static, periodic mode, under mesophilic conditions (37°C), using fermented sludge from the Wastewater Treatment Plant (WWTP) in Lodz as an inoculum. The volume of the biogas produced was measured by the displacement method, while the composition of biogas was measured by means of 8610C gas chromatography (SRI Instruments).

The obtained results showed that the hydrothermal carbonization temperature had a significant influence on the methane production from the generated liquids. The highest value of the Biochemical Methane Potential (BMP) was observed for the liquids generated in 180°C – 144±4 $mlCH_4/g_{TVSKW}$. It was 33% higher than for the liquids obtained in 25°C – 108±3 $mlCH_4/g_{TVSKW}$ but 47% lower than for the kitchen waste after the dark fermentation only (272±20 $mlCH_4/g_{TVSKW}$). Further increase of the temperature (to 215 and 250°C) resulted in a rapid decrease of the BMP value – to 44±3 $mlCH_4/g_{TVSKW}$ and 38±2 $mlCH_4/g_{TVSKW}$, respectively. As it can be seen, the use of hydrothermal carbonization as a hydrolysis step is not the most efficient method for increasing methane production. Moreover, the higher the hydrothermal carbonization temperature, the lower the BMP values.

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[1] Paździor K. et al., Kitchen waste valorisation–biofuels production, European Congress on Biotechnology 2024 – Book of abstracts, 160.