

EFFECT OF D-LIMONENE ON PRODUCTION OF METHANE FROM STARCH AND XYLAN USING MEMBRANE BIOREACTOR

ABSTRACT

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Methane is a potential renewable energy source which can be produced through the anaerobic digestion of biomass such as food waste. However, the presence of active compounds like D-limonene in food waste may inhibit methane production. In this work, configuration of PVDF MBR (*polyvinylidene fluoride membrane bioreactor*) in which preheated free cells and encapsulated unheated cells work simultaneously in a single reactor, was tested for methane production from starch, xylan, and citrus peel in a batch operation. The unheated thermophilic cells (3 g) were encased and sealed in 3 × 6 cm polyvinylidene fluoride (PVDF) membranes with a pore size of 0.1µm, and were then placed in batch reactors containing basal medium and starch or xylan (with and without D-limonene) or citrus peel as a carbon source. Methane yields, hydrogen yields and pH values were measured. The MBR enhanced the cell tolerance against 5 g/L of the inhibitor D-limonene in the starch medium (the methane yield was 802.03x10⁻³ Nm³/g VS). However in the xylan medium containing 5 g/L of D-limonene, the methane yield of the MBR was statistically the same as the free cell system (methane yield was 727.10x10⁻³ Nm³/g VS). Although membrane encasement of cells can protect the cells from D-limonene, nutrient mass transfer is crucial in the application of an MBR. The MBR provided a higher methane yield from citrus peel waste with substrate to inoculum ratios of both 1:2 (methane yield 24.98x10⁻³ Nm³/g VS) and 1:4 (methane yield 82.53x10⁻³ Nm³/g VS) compared with the free cell system.

Keywords: Anaerobic digestion, methane, biogas, synthetic membrane, cell containment, limonene