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Batch and continuous thermophilic hydrogen fermentation of sucrose using anaerobic sludge from palm oil mill effluent via immobilisation technique

Abstract

This study aimed to investigate the feasibility to use immobilised cells on granular activated carbon (GAC) operated in fifteen cycles of repeated batch mode for enhancement of biohydrogen production under thermophilic conditions. The effects of the initial pH (5.0-6.5), sucrose concentration (13-43 mM) and repeated batch cultivation on biohydrogen production from sucrose were investigated using anaerobic sludge from a palm oil mill effluent treatment plant. The cumulative hydrogen production results were fitted into a modified Gompertz equation in order to find the optimum operational conditions. The optimal hydrogen yield (2.8 molH2/molhexose) was obtained at an initial pH of 5.5 and sucrose concentration of 13 mM after fifteen cycles of repeated batch. Enriched granular activated carbon (GAC)-immobilised cells from the repeated batch cultivation were used as the immobilised seed culture for anaerobic fermentation of sucrose into hydrogen in continuous operation using a fluidised-bed column reactor (FBCR). The maximum hydrogen production rate (HPR) was found to be 2.7 mmolH2/L/h and the hydrogen yield peaked at 2.8 molH2/molhexose-consumed after a hydraulic retention time of 12 h. The main soluble metabolites were identified as acetic acid, butyric acid and ethanol. The hydrogen content ranged from 48 to 50% of the total biogas.

Keywords

Activated carbon; Biohydrogen; Immobilisation; Repeated batch; Thermophilic