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Electron flow of biological H_2 production by sludge under simple thermal treatment: Kinetic study (Article)

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Abstract

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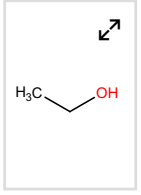
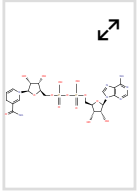
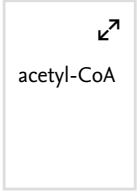
Mixed culture sludge has been widely used as a microbial consortium for biohydrogen production. Simple thermal treatment of sludge is usually required in order to eliminate any H_2-consuming bacteria that would reduce H_2 production. In this study, thermal treatment of sludge was carried out at various temperatures. Electron flow model was then applied in order to assess community structure in the sludge upon thermal treatment for biohydrogen production. Results show that the dominant electron sink was acetate (150–217 e^- meq/mol glucose). The electron equivalent (e^- eq) balances were within 0.8–18% for all experiments. Treatment at 100 °C attained the highest H_2 yield of 3.44 mol H_2/mol glucose from the stoichiometric reaction. As the treatment temperature increased from 80 to 100 °C, the computed acetyl-CoA and reduced form of ferredoxin (Fd_{red}) concentrations increased from 13.01 to 17.34 e^- eq (1.63–2.17 mol) and 1.34 to 4.18 e^- eq (0.67–2.09 mol), respectively. The $NADH_2$ balance error varied from 3 to 10% and the term $e^-(Fd \leftrightarrow NADH_2)$ (m) in the $NADH_2$ balance was $NADH_2$ consumption (m = –1). The H_2 production was mainly via the Fd:hydrogenase system and this is supported with a good $NADH_2$ balance. Using the modified Gompertz model, the highest maximum H_2 production potential was 1194 mL whereas the maximum rate of H_2 production was 357 mL/h recorded at 100 °C of treatment.

Chemistry database information

Substances







Author keywords

Biohydrogen | Electron flow model | H_2 yield | Kinetic model | Stoichiometry

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