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Bio-process optimization for biohydrogen and methane generation in an anaerobic co-digestion of kitchen waste with sewage treatment plant sludge

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The biomethanisation process alone for solid waste management becomes less energy efficient with high residual waste generation and less calorific value for methane (42 kJ/gm) than the Hydrogen (122 kJ/gm). Therefore, the anaerobic sequential production of hydrogen followed by methane maximizes the energy recovery with an intensive bioprocess optimization. One such approach of potential importance is the production of hydrogen and methane from sewage sludge co-digested with kitchen waste. This paper focuses on generation of hydrogen and methane through bio-process optimization using different pH, and oxidation reduction potential (ORP). The sewage sludge sample mixed with minced kitchen waste was optimized using different pH between 4.5 and 7.5. The optimized pH was further regulated with ORP between -100 mV to -400 mV. The maxima hydrogen production was occurred at a pH of 5.5 and the ORP of -380 mV, whereas the methane maxima was noticed in the pH of 6.8 and the ORP of -210 mV. This was consistent with predominant rods shaped microorganisms in hydrogen maxima while the cocci shaped organisms at methane maxima correlated with the results reported elsewhere. The study demonstrated the specific hydrogen yield potential of 0.3 Nm.L/g of VS removed (VSr) and the specific methane yield potential of 0.6 Nm.L/gm of VSr against the control specific hydrogen and methane yield potential of 0.05 Nm.L/gm VSr and 0.3 Nm.L/gm VSr. Hence, the study demonstrated that the minced kitchen waste co-digested with STP sludge becomes an energy efficient solid waste management option as a sequential production of hydrogen and methane using two stage hydrogeniser followed by methaniser ameliorating the existing two stage anaerobic hydrolyser followed by methaniser.

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Tailor-made fuels from biomass: The fuel design process on the example of 1-octanol

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Alternative fuels have become great importance for sustainable individual transportation since the emissions of greenhouse gases from the transport sector represent a great threat for the environment. Furthermore, the harmful emissions from combustion engines, like soot and nitrous oxides (NO_x), are strongly regulated. Therefore, the Cluster of Excellence "Tailor-made Fuels from Biomass" (TMFB) was established at RWTH Aachen University. The goal of TMFB is to establish the fuel design process for modern combustion development of engines. The establishment of this fuel design process is a loop, beginning with the development of different methods to identify promising fuel candidates, derived from lignocellulosic biomass. Afterwards the production pathways of these fuel candidates are developed and their efficiency is assessed. To close the loop, the most promising fuel candidates are passed to intensive fuel screening and investigations in combustion engines and the results are fed back into the model development. In this paper, the fuel design process is explained by taking the example of 1-octanol, which is a promising fuel candidate for compression ignition (CI) engines. The starting point of the synthesis of 1-octanol are platform chemicals, namely furfural and acetone, which can be obtained using D-xylose, obtained from lignocellulosic biomass, together with sulfuric acid. 1-Octanol is then derived from these platform chemicals using a bifunctional catalyst, developed within the TMFB, with yields of 60%. Due to this promising production route, 1-octanol is investigated in a CI engine. The engine results proved a very drastical reduction of engine-out soot and NO_x emissions when compared to conventional EN590 Diesel fuel.