Biohydrogen production from kitchen based vegetable waste: Effect of pyrolysis temperature and time on catalysed and non-catalysed operation

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High temperature favors high H2 yield in vegetable waste pyrolysis. The catalyst presence reduced the CO2 percentage in the bio-gas. Presence of sand as catalyst increases the methane yield considerably. Presence of silica based catalyst improves the calorific value of bio-gas.

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ABSTRACT
Pyrolysis of kitchen based vegetable waste (KVW) was studied in a designed packed bed reactor. The effect of process parameters like temperature, time and catalyst on bio-gas yield and its composition was studied. The total bio-gas yield was found to be maximum with non-catalysed operation (260 ml/g) at 1073 K (180 min). Higher hydrogen (H2) yield with non-catalysed operation (32.68%) was observed at 1073 K (180 min) while with catalysed operation the requisite temperature (873 K) and time (120 min) reduced with both silica gel (33.34%) and sand (41.82%) thus, saving energy input. Methane (CH4) yield was found to be highest (4.44 times than non-catalysed and 1.42 with silica gel) in presence of sand (71.485 ml/g) at medium temperature (873 K) and time (60 min). The catalyst operation reduced the carbon dioxide (CO2) share from 47.29% to 41.30% (silica gel catalysed) and 21.91% (sand catalysed) at 873 K.

1. Introduction

Rapid urbanization, industrialization and population growth have led to severe waste management problems in several cities of developing or under developed worlds. Due to uninterrupted relocation from rural and semi-urban areas to towns and cities the share of urban population has increased from 10.84% (1901) to 30.24% (March, 2012) in India (CPHEEO, 2000; MoSPI, 2012). The per capita waste generation rate depends on the size of the city (0.2–0.87 kg/d) (MoF, 2009). Municipal solid waste (MSW) has long posed threats to environmental quality and human health. Thus, the utilization of MSW for energy generation would suggest a solution of this problem (Singh et al., 2011). In India, most of the MSW is constituted of biomass (about 45–50%) waste generated in kitchens, agriculture, gardening, etc.

Hydrogen (H2) is currently produced from natural gas, liquid hydrocarbons and coal by various chemical process like steam...