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Design and Performance Evaluation of Plasma Spouted Bed Reactor for Converting Waste Plastic into Green Hydrogen

Authors : Palash Kumar Mollick, Leire Olazar, Laura Santamaria, Pablo Comendador, Gartzen Lopez, Martin Olazar

Abstract : Average calorific value of a mixure of waste plastic is approximately 38 MJ/kg. Present work aims to extract maximum possible energy from a mixure of waste plastic using a DC thermal plasma in a spouted bed reactor. Plasma pyrolysis and steam reforming process has shown a potential to generate hydrogen from plastic with much below of legal limit of producing dioxins and furans as the carcinogenic gases. A spouted bed pyrolysis rector can continuously process plastic beads to produce organic volatiles, which later react with steam in presence of catalyst to results in syngas. lasma being the fourth state of matter, can carry high impact electrons to favour the activation energy of any chemical reactions. Computational Fluid Dynamic (CFD) simulation using COMSOL Multiphysics software has been performed to evaluate performance of a plasma spouted bed reactor in producing contamination free hydrogen as a green energy from waste plastic beads. The simulation results will showcase a design of a plasma spouted bed reactor for converting plastic waste into green hydrogen in a single step process. The high temperature hydrodynamics of spouted bed with plastic beads and the corresponding temperature distribution inside the reaction chamber will be critically examined for it's near future installation of demonstration plant.

Keywords : green hydrogen, plastic waste, synthetic gas, pyrolysis, steam reforming, spouted bed, reactor design, plasma, dc palsma, cfd simulation
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