World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Combustion and Emissions Performance of Syngas Fuels Derived from Palm Kernel Shell and Polyethylene (PE) Waste via Catalytic Steam Gasification

Authors : Chaouki Ghenai

Abstract : Computational fluid dynamics analysis of the burning of syngas fuels derived from biomass and plastic solid waste mixture through gasification process is presented in this paper. The syngas fuel is burned in gas turbine can combustor. Gas turbine can combustor with swirl is designed to burn the fuel efficiently and reduce the emissions. The main objective is to test the impact of the alternative syngas fuel compositions and lower heating value on the combustion performance and emissions. The syngas fuel is produced by blending Palm Kernel Shell (PKS) with Polyethylene (PE) waste via catalytic steam gasification (fluidized bed reactor). High hydrogen content syngas fuel was obtained by mixing 30% PE waste with PKS. The syngas composition obtained through the gasification process is 76.2% H2, 8.53% CO, 4.39% CO2 and 10.90% CH4. The lower heating value of the syngas fuel is LHV = 15.98 MJ/m3. Three fuels were tested in this study natural gas (100%CH4), syngas fuel and pure hydrogen (100% H2). The power from the combustor was kept constant for all the fuels tested in this study. The effect of syngas fuel composition and lower heating value on the flame shape, gas temperature, mass of carbon dioxide (CO2) and nitrogen oxides (NOX) per unit of energy generation is presented in this paper. The results show an increase of the peak flame temperature and NO mass fractions for the syngas and hydrogen fuels compared to natural gas fuel combustion. Lower average CO2 emissions at the exit of the combustor are obtained for the syngas compared to the natural gas fuel.

Keywords : CFD, combustion, emissions, gas turbine combustor, gasification, solid waste, syngas, waste to energy
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020