Experimental Study of combustion syngas released from gasification of agriculture waste in a downdraft gasifier

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The main objective of this research is to investigate the combustion and emission characteristics of syngas by using an atmospherics flame burner. The syngas produced by gasification of olive waste particles in a small pilot scale 5 kWth downdraft fixed bed gasifier, where the oxidizing agent is a air, was combusted in a combustor through a burner. The gasifier has an inner diameter of 0.190 m lined with refractory cement and a height of 0.682 m. The throat diameter is 0.047 m. The gasifier are burner are made of stainless steel. The nozzle exit inner burner diameter is 25 mm. The fuel nozzle consists of a center body fuel injector, a radial air swirler, and a mixing area. Thermocouples type-K were used for recording temperature profiles at different parts of the gasifier and at different sections of air/syngas flame. Air flow at the inlet of the gasifier is regulated via mass flow controller while the syngas is regulated by high temperature vortex flow meter. For syngas and exhaust analysis, gas chromatograph and exhaust gas analyzer were used, respectively. Syngas combustion emissions measured include NO, CO, O_2 and CO_2. In this work, we compared the performance of olive waste and wood pellet as fuels for downdraft gasification to reveals the influences of the operating parameters such as reactor temperature and equivalence ratio on the hydrogen rich-syngas composition. The composition of syngas and gasification performance for olive waste and wood pellet were analyzed comparatively. Physicochemical characterization were checked through ultimate and proximate analyses as well as energy content measurement. Ultimate analysis was carried out to determine carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and Sulphur (S) weight fractions. Proximate analysis was done using a thermogravimetric analyzer (DTG-60). A calorimetric bomb (Parr 2100) was used to measure the high heating value (HHV). The purpose of the present work is to report results on syngas compositions (H_2, CO, CO_2, CH_4, N_2) and CO/H_2 molar ratio effect on air/syngas flame structures and combustion emissions.

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