THE SURFACE COMBUSTOR-HEATER WITH CYCLIC FLOW REVERSAL COMBUSTION

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A new surface combustor-heater (SCH) equipped with a concept of cyclic flow reversal combustion (CFRC) was examined. Existing designs of the SCH have typically relied on a one-way flow combustion (OWFC) in which the flow direction of the mixture is fixed. The new SCH, which is capable of working as both the CFRC and the OWFC, was built. It had an insulated combustion section that was 45 x 75 mm^2 and consisted of several 15 mm thick honeycomb ceramic plates of magnesia-stabilized zirconia with a single tube of cooling water embedded. Liquefied petroleum gas (LPG) diluted with air was supplied to the combustor in such a way that the flow direction was either fixed (OWFC) or periodically changed at a regular time interval (CFRC). Comparison of performance between the new SCH and the conventional OWFC was performed by measuring the axial temperature distributions, thermal efficiencies and emission characteristics. Results showed that hot zone location has a significant effect on the performance of the two systems. Under the same equivalence ratio and flow velocity, the two systems yielded different hot zone locations in relation to a fixed water tube and thus a difference in thermal efficiencies and emission characteristics. With the same hot zone location the CFRC yielded a preferable high thermal efficiency in a much leaner mixture than the OWFC. As the equivalence ratio decreased, thermal efficiency of the CFRC significantly increased, whereas that of the OWFC rapidly decreased. The half-period is directly proportional to the thermal efficiency through the hot zone location, which depends on the half-period. Too long half-period yields asymptotic value of the thermal efficiency with an increase in CO emission. The CFRC is very suitable for working at relatively high flow velocity with preferable high thermal efficiency, reduction in CO with low NO_x emission.