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Cyclic Flow Reversal Combustion in Porous Media

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Abstract

An experimental study of combustion in a porous medium, with a without a cyclic flow reversal of a mixture through the porous medium, was performed. The thermal structure, in terms of axial temperature distribution, of two systems (with and without cyclic flow reversal of the mixture) is compared so as to elucidate the performance of the two systems. The effect of dominating parameters, i.e., half-period, equivalence ratio and flow velocity of the gas mixture on the axial temperature distribution is reported. It is shown that the transient behavior of the thermal capacity of the porous medium, induced by a cyclic flow reversal of the mixture, plays a vital role in yielding a higher quality combustion flame than without a cyclic flow reversal system or a one-way flow combustion system. The half-period of the cyclic flow reversal of the mixture has a moderate effect on the maximum flame temperature. Equivalence ratio and flow velocity have a similar effect on the thermal structure with respect to an increase in the maximum temperature and in the time averaged exhaust temperature, leading to an increase in heat losses. In this study, the minimum heat content of the mixture that would be able to burn by the CFRC system is 140 kj/kg at the minimum equivalence ratio of $\mathbf{0}$ = 0.046, a flow velocity of about 0.2 m/s and a half period of 30 seconds. The corresponding adiabatic flame temperature of the equivalence ratio of $\mathbf{0}$ = 0.046 is 177 ^{o}C.