MULTIMODE HEAT TRANSFER IN CYCLIC FLOW REVERSAL COMBUSTION IN A POROUS MEDIUM

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Experimental and numerical studies of combustion and multimode heat transfer in a porous medium, with and without a cyclic flow reversal of a mixture through a porous medium, were performed. Parametric studies were done in order to understand combustion characteristics such as maximum flame temperature and radiative heat flux using a one-dimensional conduction, convection, radiation and premixed flame model. The porous medium was assumed to emit and absorb radiant energy, while scattering is ignored. Non-local thermodynamic equilibrium between the solid and gas is taken into account b introducing separate energy equations for the gas and the solid phase. As a preliminary strdy, the combustion regime was described by a one-step global mechanism with an internal heat source uniformly distributed along the reaction zone. The effects of the flame position, cyclic flow reversal, period of the cyclic flow reversal, the optical thickness and the flow velocity on the burner performance were clarified by a rigorous radiation analysis. The model was validated by compaaring the theoretical results with the experiments. It was shown thaat, for maximizing the flame temperature and the net radiative heat flux feedback, the flame should be stabilized near the centre of the porous medium with a cyclic flow reversal, the period of whtich should be as small as possible. A high optical thickness produced a high flame temperature and a high net radiative feed back. Also, a high flow velocity at low period of the cyclic flow reversal of mixture yielded a high value of both the flame temperature and the net radiarive feedback. Thermal structure predictions in terms of the gas-phase and the solid-phase temperature distributions along the axis of the combustor show good agreement with the experimental ones.