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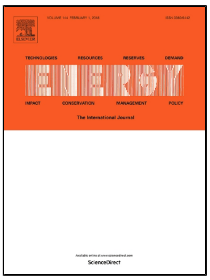

The combustion characteristics and performance evaluation of DME (dimethyl ether) as an alternative fuel in a two-section porous burner for domestic cooking application

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The combustion characteristics and performance evaluation of DME (dimethyl ether) as an alternative fuel in a two-section porous burner for domestic cooking application

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ABSTRACT

Towards enhancing the thermal performance and fuel flexibility of existing domestic cooking stoves, the present work employs the heat recirculation mechanism of the porous medium (PM) combustion to these burners offering greater fuel compatibility for both liquefied petroleum gas (LPG) and renewable fuel dimethyl ether (DME). To establish the advantages of DME combustion than that of LPG within the stove, experimental measurements and numerical modeling are performed in a two-layer PM burner. The numerical model is used to investigate the dynamics of DME flame in the PM through reaction path analyses. Both experiment measurements and numerical predictions show lower CO emissions for DME flame than that of LPG flame inside the PM stove. With the use of DME instead of LPG, following the guideline of World Health Organization, the maximum allowable equivalence ratio can be extended from 0.4 to 0.5 and the thermal load from 4.0 kW to 5.0 kW. Moreover, the total heat generation rate, the gas- and solid-phase temperatures and radiant efficiencies of the burner with DME flame are higher than that with LPG flame at the same input conditions. However, the stability ranges of DME flame are found to be less than that of LPG flame.

Keywords: Combustion, Porous medium burner, DME/LPG cooking stove; Lattice Boltzmann method, Finite difference method

Nomenclature

A_c	cross-sectional area (m^2)
C	specific heat (J/kg·K)
d_p	pore diameter (m)

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