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NUMERICAL MODELING OF FILTRATION GAS COMBUSTION IN A CYLINDRICAL RADIATION BURNER WITH AXIAL GAS FLOW*

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The filtrational gas combustion in a chemically inert porous media allows create an intensive radiative heat fluxes compared with radiation from free flame. Other advantages of filtrational gas combustion burners over combustion systems with free flame are the higher burning rates, increased power dynamic range, extension of the lean flammability limits, and the low emissions of pollutants. The reviews on this interesting topic one can find in [1-8]. Extensive experimental and numerical works were carried out and are still underway, to explore the feasibility of porous burners with filtrational gas combustion for energy production and others applications. Porous radiation burners are promising for creating sources of thermal radiation with controlled power, spectrum and distribution of radiation density for contactless heating of workpieces or materials in industrial processes. The porous radiant burners potentially can be applied in those technical processes where electrical heat sources are used. It can significantly increase production efficiency due to the absence of the electricity generation stage from energy produced by combustion and the transmission electricity losses. Another advantage of porous radiant burners is the insensitivity to the electromagnetic interference and the absence of open flames, reduction of accidents when using lean mixtures, as well as stability of operation and protection from external influences, which is ensured by the gas combustion occurring inside the burner's porous body.

Combustion in a porous cylindrical tube with axial injection of combustible mixture was studied. This configuration can be potentially used as new type of heater for the contactless heating of materials in industrial processes. The material under treatment is placed inside the cylindrical porous tube and is heating by radiative flux from the cylindrical tube wall. The calculation of combustion in a porous cylindrical burner is carried out within the framework of a two-temperature thermo-diffusion model [1,3] taking into account the gas filtration effects described by Darcy's law. We represent combustion in a porous medium with a two-dimensional model that includes one-step Arrhenius type chemistry, radiative heat losses from the inner surface of hollow cylindrical burner, separate gas and solid energy equations and the transport of fuel concentration of the combustible lean mixture. Numerical modeling allowed to estimate the range of gas flow rates at which stable combustion regimes exist, to find the temperature distribution in the gas and the porous body, and to evaluate the radiation fluxes inside the reactor. It was shown that stable combustion can take place in a certain range of pressure drops and radiation heat losses on the inner surface. High levels of radiative heat fluxes and wide range of operation condition with stable combustion shown feasibility application of this type of porous burner for contactless treatment of different materials.

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