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Analysis of Spectral Radiative Entropy Generation in a Non-Gray Participating Medium with Heat Source (Furnaces)

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Abstract : In the present study, spectral radiative entropy generation is analyzed in a furnace filled with a mixture of H_2O, CO_2 and soot at radiative equilibrium. For the angular and spatial discretization of the radiative transfer equation and radiative entropy generation equations, the discrete ordinates method and the finite volume method are used, respectively. Spectral radiative properties are obtained using the correlated-k (CK) non-gray model with updated parameters based on the HITEMP2010 high-resolution database. In order to evaluate the effects of the location of the heat source, boundary condition and wall emissivity on radiative entropy generation, five cases are considered with different conditions. The spectral and total radiative entropy generation in the system are calculated for all cases and the effects of mentioned parameters on radiative entropy generation are attentively analyzed and finally, the optimum condition is especially presented. The most important results can be stated as follows: Results demonstrate that the wall emissivity has a considerable effect on the radiative entropy generation. Also, irreversible radiative transfer at the wall with lower temperatures is the main source of radiative entropy generation in the furnaces. In addition, the effect of the location of the heat source on total radiative entropy generation is less than other factors. Eventually, it can be said that characterizing the effective parameters of radiative entropy generation provides an approach to minimizing the radiative entropy generation and enhancing the furnace's performance practicality.

Keywords : spectral radiative entropy generation, non-gray medium, correlated k(CK) model, heat source
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