SINAN DEMIR, HAYRI SEZER, TORLI BUSH and V'YACHESLAV AKKERMAN, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV, 26506. Effect of Non-Uniform Coal Dust Distribution in a Gaseous-Dusty Premixed Environment on Flame Acceleration due to Wall Friction.

While a premixed flame front would consume an unburnt matter with a constant speed S_L, such a flame occurs extremely seldom in the reality, where flames are curved and characterized by another velocity, S_w, and it is oftentimes conventionally assumed that the ratio S_w/S_L is proportional to the corrugated flame surface area scaled by the planar one. However, the thermal-chemical parameter S_L may experience spatial and temporal variations; in particular, due to the combustible (coal) dust impurities. The present study initiates a systematic investigation of the influence of local variations of the thermal-chemical flame properties on the global flame dynamics. This particular work focuses on the effects of S_L-variations on flame acceleration due to wall friction in a gaseous-dusty premixture. Specifically, we performed the computational simulations of the reacting flow equations, with compressible hydrodynamics and combustible coal dust particles incorporated into the original (gaseous) computational platform by replacing an "effective fluid" with the locally-modified, dust-induced flow and flame parameters. Keeping in mind a coalmine passage, we employed a channel with a large aspect ratio. Various spatial distributions of the coal dust concentration are studied, namely: homogenous, linear, cubic and parabolic. As a result, the similarity and differences in the evolutions of the flame shape and velocity have been identified for each distribution. It is shown that the non-uniform distributions may result in an extra distortion or a local stabilization of the flame front, which promotes or reduces the flame surface area, thereby facilitating or moderating flame acceleration due to wall friction.

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