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Numerical Investigation on the Effect of Aluminium Nanoparticles on Characteristic Velocity of Kerosene-Oxygen Combustion

Authors : Al Ameen H., Rakesh P.

Abstract : To improve the combustion efficiency of fuels and to reduce the emissions of pollutants as well as to improve heat transfer characteristics of fuels, both non-metallic and metallic nanoparticles can be added into it. By varying the concentration and size of nano particles added into the fuels, behaviour of droplet combustion and hence heat generated can be altered. In case of solid or liquid fuels, surface area of the fuel in contact with oxidizer(gaseous) is small because of higher density compared to gases. If the surface area of fuel exposed to the oxidizer is very small, then the combustion will not occur, because the combustion rate is proportional to the surface area of fuel droplet. To avoid such instance there is a way to increase the exposed surface area. To increase the specific surface area available for reaction, the particle size can be reduced. If the additives are solid then by reducing the particles size the specific surface area of liquid fuel can be increased. For the liquid fuels the exposed surface area available for combustion can be increased by suspending nanoparticles. Addition of non-metallic and metallic nanoparticles in fuels improves its combustion efficiency by enhancing the thermo-physical properties. The burn rate constants and temperatures of Kerosene-Oxygen combustion for fuel droplet sizes of 50μm, 75μm, 100μm and 125μm under varying concentrations of 25%, 50%, 75% and 100% are studied numerically and its characteristic velocities are determined. Later the burn rate constants of fuel with concentrations of 0.5%, 1.0% and 2.0% by weight of aluminium nanoparticles are added. The spray combustion characteristics of such nano-fuel has improved the combustion temperature by the addition of aluminium nanoparticles. Thus, aluminium nanoparticles have improved burn rate and characteristic velocity of Kerosene-Oxygen combustion. An increase of 40% in characteristic velocity is observed.

Keywords : burn rate, characteristic velocity, combustion, thermo-physical properties
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