Abstract

This research presents a theoretical and analytical model for evaporation of hydrocarbon fuel droplet. This model assumes that there is a moving hydrocarbon fuel droplet in quasisteady environmental air. Four types of fuel (n-heptane, n-hexan, n-decan, and light Diesel) are used for analysis at standard atmospheric pressure and ambient temperatures from about 300 to 1500 K. The initial droplet size used is 100 μm for a Reynolds number ranging from 0.1 to 1800.

Two models were analyzed and they are the classical model and the extended model or film theory. The fundamental equations for these two models are arranged and derived for evaluation the required parameters for four types of fuel used through investigation. n-heptane fuel was used for comparison between the two models. The used elevated temperatures are (300-1500) K.

A computer program was constructed for each model employing (Matlab-7) for evaluation the required characteristic parameters such as droplet lifetime, flame standoff ratio mass fraction, mass evaporation rate, flame temperature, and Damköhler number.

From the obtained results, it is found that the mass evaporation rate from the extended model is greater by (0.13 %) than that obtained from the classical model due to the heat gain to the drop.

A comparison between the classical models and with previous works stated in available literature was done and shows to give a reasonable agreement with a maximum deviation between results of about (4.3%).

A useful relation was obtained for determination the mass evaporation rate of extended model from the classical theory depending on the temperature and type of fuel used Curve Expert 1.3v Microsoft and the other relation was obtained for determination the mass evaporation rate of extended model from the classical theory depending on the different Reynold's number and type of fuel.