SHOCK TUBE STUDIES OF CYCLOPENTANE AND CYCLOHEXANE IGNITION AT HIGH PRESSURES

by

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ABSTRACT

Ignition delay times for mixtures of cyclopentane and synthetic air (pure N_2/O_2 at a molar ratio of 3.76:1) and cyclohexane and synthetic air at three different equivalence ratios (of Φ = 0.25, 0.5, and 1.0) have been measured in a shock tube, at pressures ranging from 11 to 61 atm, and at temperatures ranging from 847 to 1379 K. Ignition times were determined using electronically excited OH radical emission collected through the shock tube endwall. For both fuels, the ignition time data exhibited overall activation energies that were found to be independent of temperature, pressure, and equivalence ratio, as no negative temperature coefficient behavior was observed. The dependency of ignition time on pressure, temperature, and equivalence ratio was quantified and correlations for the ignition time data have been formulated.

Comparisons have been made to the previous shock tube data of Sirjean et al. [1] and rapid compression machine (RCM) data of Lemaire et al. [15]. Significant differences were found between the current experimental data and that of Sirjean et al., apparently due to the considerable differences between mixtures and conditions studied. On the other hand, the data of Lemaire et al. showed good agreement with the experimental data near 900 K.

Comparison of the data was also made to the results of kinetic mechanisms proposed by Sirjean et al. [1] for both fuels, and by Silke et al. [2] for cyclohexane. It was found that both of these mechanisms are in poor agreement with the current data. Significant improvements to these kinetic mechanisms are needed before they can be used for quantitative combustion modeling.