INVESTIGATION OF LIGHT LOAD HCCI COMBUSTION BASED ON MEASURED TEMPERATURE AND OH CONCENTRATIONS

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Conclusions

- Gaseous diluents with different specific heats confirm that the low-load limit is a temperature constraint.
- Time-resolved concentration measurements show that OH forms during the second stage of heat release.
- Measured [OH] was found to decrease monotonically with fuel mass.
- Disappearance of OH corresponds to loss of the second-stage ignition and a rise in CO emission.
- Peak temperatures were measured via H$_2$O spectroscopy, OH equilibrium, and ideal gas with fairly good agreement.
- H$_2$O temperature data shows that when the peak temperature drops below approximately 1550 K, unacceptable CO emissions occur.

Method

- OH Concentration: T, H$_2$O Concentration: Sample OH Measured Spectra:

Spectral Results

Sample OH Measured Spectra:

Sample H$_2$O Measured Spectra:

- Measured water vapor spectra were compared with a library of known water vapor spectra to determine temperature and water mole fraction.

Results Overview

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Intake Diluents:

- Argon and CO$_2$ have specific heats lower than, and higher than air, respectively.
- If we replace part of the intake air with either of these gases the temperature history of the mixture will change – T increases with Ar diluent and T decreases with CO$_2$ diluent.
- As should reach the critical acceptable peak temperature at a lower fuel mass than 100% air.
- CO should reach the critical acceptable peak temperature at a higher fuel mass than 100% air.
- We can show that the cutoff for marginally complete combustion is a temperature limit, not an equivalence ratio limit.

Spectral Results

Sample OH Measured Spectra:

Sample H$_2$O Measured Spectra:

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