Notes for the Spray H (baseline n-heptane) condition with 0% ambient oxygen

Overview

This non-reacting spray dataset was obtained using an injector made by Diesel Technologies Corporation as described in:
http://www.sandia.gov/ecn/cvdata/sandiaCV/injectorCharacterization-1997.php

Experiments for this particular condition were performed from 2005 to 2006. A major goal of this research was to quantify fuel-ambient mixing for this condition and link this to other measurements of ignition, lift-off length, and soot formation. Pertinent references for this effort include:

1. Idicheria, C.A. and Pickett, L.M., "Soot formation in diesel combustion under high-EGR conditions," SAE Transactions 114:1559-1574, 2005-01-3834.

2. Idicheria, C.A. and Pickett, L.M., "Formaldehyde visualization near lift-off location in a diesel jet," SAE Transactions 115:683-695, 2006-01-3434.

3. Idicheria, C.A. and Pickett, L.M., "Effect of EGR on diesel premixed-burn equivalence ratio," Proc.Combust.Inst. 31:2931-2938, 2007.

4. Idicheria, C.A. and Pickett, L.M., "Quantitative mixing measurements in a vaporizing diesel spray by Rayleigh imaging," SAE Paper 2007-01-0647, 2007.

5. Idicheria, C.A. and Pickett, L.M., "Ignition, soot formation, and end-of-combustion transients in diesel combustion under high-EGR conditions," International Journal of Engine Research 12:376-392, 2011.

6. Musculus, M.P.B., Lachaux, T., Pickett, L.M., and Idicheria, C.A., "End-of-injection over-mixing and unburned hydrocarbon emissions in low-temperature-combustion diesel engines," SAE Paper 2007-01-0907, pp. 515-541, 2007.

7. Pickett, L.M., Manin, J., Genzale, C.L., Siebers, D.L., Musculus, M.P.B., and Idicheria, C.A., "Relationship between diesel fuel spray vapor penetration/dispersion and local fuel mixture fraction," SAE International Journal of Engines 4:764-799, 2011.

8. Pickett, L.M., Kook, S., and Williams, T.C., "Visualization of diesel spray penetration, cool-flame, ignition, high-temperature combustion, and soot formation using high-speed imaging," SAE Paper 2009-01-0658, 2009.

Experimental diagnostics

1. Rate of injection and flow coefficients:
    a. Methodology is described at http://www.sandia.gov/ecn/cvdata/sandiaCV/SprayHroi.php and http://www.sandia.gov/ecn/cvdata/sandiaCV/injectorCharacterization.php.

   b. Table shows measured flow coefficients: http://www.sandia.gov/ecn/cvdata/sandiaCV/injectorCharacterization-1997.php. Note that measurements were performed with room temperature fuel and the derived Cd and Ca assume a nominal diameter of 0.100 mm for exit orifice.
2. Internal nozzle geometry:
   a. Drawings of the internal geometry are available under the variable "nozGeom". The design is for a sharp-edged orifice with no convergence (K = (d_inlet – d_outlet)/10 [use μm] = 0. Silicone molds were made in an attempt to derive the actual shape analysis of the molds is also available under "nozGeom". See siliconeMoldAnalysis.pptx and the created "sacVolumeDimensions.pdf".
3. Needle movement:
   a. Measurements were made but the needle lift sensor was far from the orifice. Flex and needle compression needs to be considered. Work in progress is documented at "C:\pickett\ECN\baseline\bicdgnl\needleMovementBicdgnl.pptx" and posted online under "needlePos".
4. Liquid length and transient liquid penetration:
   a. Time-averaged mie-scattering, following the method of Siebers (threshold = 3% of maximum intensity) was used to determine the mean liquid length. See liquid length information.
   b. Processing of high-speed mie-scatter images was performed to return the mean liquid penetration vs time. (See C:\pickett\ECN\baseline\bicdgnl\shadowVaporPen.m). Data were acquired on 3/24/2006. 6 injections were analyzed. Optical setup is lens f=105 mm with 2x tele, f2.8, 50 kHz with 17 microsec exposure, IDT camera. Note that the injection duration for these runs was 6 ms, an exception to what is reported for this case online.
5. Schlieren visualization:
   a. Optical setup was as Pickett, 2009-01-0658. Vapor penetration processed as described in jet penetration information.
   b. Processing of 5 injections was performed to give the mean vapor penetration rate. (See C:\pickett\ECN\baseline\bicdgnl\shadowVaporPen.m). Schlieren movie shown in high-speed movie is the difference method, correcting for background ambient disturbances. See Pickett, 2009-01-0658. Boundaries shown as a green line are available in Matlab format in the additional files.
   c. Example of vapor boundary plot from Matlab format, where i is certain image time index: plot(JB{i,2},JB{i,1},'g','LineWidth',2.5);
6. Rayleigh scattering:
   a. See references and explanation under the "mixing" field
7.
8.