Optisk studie av bränslespray och antändningsposition för PPC*

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Project details

• Programme: KCFP, Kompetenscentrum Förbränningsprocesser
• Project name: PPC HD
• Programme period: 2014-2017
• Main support recipient: Lund University
• Support: 11.340kSEK, with inkind 19.864kSEK
Optical engine
### Experimental setup - Operating conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Speed</td>
<td>1200 rpm</td>
</tr>
<tr>
<td>Intake pressure</td>
<td>1.5 bar</td>
</tr>
<tr>
<td>Intake $O_2$</td>
<td>21%</td>
</tr>
<tr>
<td>Injection strategy</td>
<td>Single injection</td>
</tr>
<tr>
<td>Common rail pressure</td>
<td>800 bar</td>
</tr>
<tr>
<td>Injection duration</td>
<td>900 µs</td>
</tr>
<tr>
<td>CA50</td>
<td>~3° aTDC</td>
</tr>
<tr>
<td>Inlet temp</td>
<td>Adjusted based on CA50</td>
</tr>
<tr>
<td>SOI</td>
<td>Sweep from -73 CAD to -17 CAD</td>
</tr>
</tbody>
</table>
Background

Reference: Li et al., SAE 2016-01-0767
Shen et al., SAE 2015-01-1790
Definitions

- **Injector**
- **Cylinder head**
- **Piston bowl edge**
- **Squish height**
- **Squish region**
- **Piston bowl**
Results - Spray images

SOI-40 CAD

SOI-46 CAD

SOI-63 CAD
Results - Spray regimes

1. Piston bowl regime (SOI -17 CAD to SOI -40 CAD)
   All the fuel is injected into the piston bowl

2. Intermediate regime (SOI -46 CAD to SOI -54 CAD)
   Fuel is divided between the squish region and the piston bowl

3. Squish regime (SOI -57 CAD to SOI -73 CAD)
   Most of the fuel is going into the squish region
Results - Piston bowl regime

1. Piston bowl regime
2. Intermediate regime
3. Squish regime
Results - Piston bowl regime

- 3 CAD  -2 CAD  0 CAD  3 CAD
Results - Intermediate regime

1 Piston bowl regime
2 Intermediate regime
3 Squish regime
Results - Intermediate regime

<table>
<thead>
<tr>
<th>Time (CAD)</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>![Image]</td>
</tr>
<tr>
<td>-3</td>
<td>![Image]</td>
</tr>
<tr>
<td>-2</td>
<td>![Image]</td>
</tr>
<tr>
<td>0</td>
<td>![Image]</td>
</tr>
<tr>
<td>3</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

SOI -40
Results - Squish regime

1. Piston bowl regime
2. Intermediate regime
3. Squish regime
Results - Squish regime

SOI -60 CAD

SOI -70 CAD
Results - Initial combustion location

1. Piston bowl regime
2. Intermediate regime
3. Squish regime
Summary (1 of 3) – Bowl regime

• Based on analysis of the spray and combustion images, we assume that richer mixtures are more reactive.
• All the fuel is injected into the piston bowl
• Rich local mixtures
• Lower inlet temperature

1 Piston bowl regime
2 Intermediate regime
3 Squish regime
Summary (2 of 3) – Intermediate regime

- The fuel is divided between the piston bowl and the squish region
- Leaner local mixtures in the piston bowl
- Higher inlet temperature required compared to the piston bowl regime

1. Piston bowl regime
2. Intermediate regime
3. Squish regime
Summary (3 of 3) – Squish regime

- SOI -57 CAD to SOI -66 CAD
  - Heating by piston?
  - Somewhat lower intake temperature

- SOI -70 CAD and SOI -73 CAD
  - Longer mixing time
  - Higher temperature
Ongoing and future work

- Quantitative fuel-LIF measurements
  - Correlate local $\phi$ (and estimated $T$) with ignition sites
  - Is our assumption correct?

- CFD simulations
  - Complementary analysis
  - Optimize predictive capability of models
  - Aim: use CFD to understand what an optimal combustion system looks like
Acknowledgements
• Thank you for your attention!