Numerical Analysis of Diesel Injector Hole Geometry Influence on Spray Characteristics

**MOTIVATION & OBJECTIVES**

Scania Euro 6 is a drastic downward step in emission levels compared to Euro 5. This Master Thesis aim is to have a better understanding of the effects of injector nozzle hole shapes on sprays in combustion chamber which is a key point to decrease emission levels. Eulerian-Lagrangian multiphase flow simulations are performed for five nozzle hole geometries. Lagrangian-Eulerian multiphase spray simulations are then performed for the 5 geometries by using the properties obtained at the nozzle exits with a coupling file. Internal nozzle flows and corresponding sprays are analysed and compared in order to see how the holes parameters are affecting the spray properties. Full load engine-like boundaries are used in both types of simulations.

**DATA EXTRACTED**

**Spray Analysis**

The Spray Penetration Depth is calculated by taking the mean distance of the farthest droplets on the spray axis representing 1% of the total mass of the spray. Clear differences can be observed between the different injectors. Hybrid Inlet and Large Inlet have the largest penetration depth. The Expanding Nozzle hole shows a larger penetration depth than Baseline due to the larger nozzle exit diameter (0.22 mm vs 0.2 mm).

The Spray Half Cone Angle is calculated by taking the mean angle of the radial farthest droplets from the spray axis representing 1% of the total mass of the spray. The injectors with vapor reaching the nozzle exit have a larger half cone angle. A bump can be observed just after the vapor reaches the nozzle exit. Large Inlet presents also an increase of the half cone angle but it is due to the tip of the spray hitting the piston bowl (largest Spray Penetration Depth).

The Droplet Size Distribution is calculated for 5 zones in the piston bowl. Each zone corresponds to a distance from the center of the bowl. Zone 1 is from 0 to 1 cm Zone 2 from 1 to 2 cm, etc. For each zone the total mass of droplets observed in the region during the entire injection time is calculated. Then the total mass of different droplets categories are calculated from 0-200 microns every 5 microns which means 40 categories. To obtain the mass fraction, each category total mass is divided by the overall total mass.

**SPRAY ANALYSIS**

![Diagram: Coupling from Eulerian to Lagrangian](image_url)

**Sprays analysis**

**5 Geometries Tested**

<table>
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<tr>
<th>Geometry</th>
<th>D_{in}</th>
<th>D_{tot}</th>
<th>T_{in}</th>
<th>T_{down}</th>
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</tbody>
</table>

**Spray Penetration Depth**

**Spray Half Cone Angle**

**Droplet size mass fraction distribution**

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