Unraveling the Obscurities of Soot Reductions by Post-Injections
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Motivation
A post-injection, i.e. a relatively short injection pulse after the main injection, has been reported to reduce engine-out soot in several studies [1]. However, fundamental understanding of the effects of a post-injection is still lacking. In the current work research on a heavy-duty metal test engine is combined with efforts on an optically-accessible engine to get a better insight in the effects of a post-injection.

Metal Engine Approach
For tests on the metal engine, Design of Experiments (DOE) is applied, which has some specific advantages:

- Map the effect of multiple operating parameters, e.g. boost pressure, rail pressure, Start of Actuation (SOA) and EGR
- Map interaction effects of operating parameters
- Relatively small amount of test runs

Preliminary results in Figure 1 show a clear reduction of engine-out soot for specific dwell and split and elevated boost pressure. Results with elevated boost pressure and without post-injection yield an FSN value of around 0.07. Here, dwell is defined as the period between end of main injection and start of post-injection in ° CA and split as fraction of total fuel injected in post-injection in %. For lower boost pressure the reduction is much less significant, which could indicate that a post-injection is more efficient in reducing soot if enough oxygen is present in the cylinder.

Optical Approach
Laser-Induced Incandescence (LII) is commonly used for soot visualization. Collected signal is strongly temperature dependent and therefore, a combination of two-color pyrometry and natural luminosity/laser-induced incandescence is applied for temperature determination. Preliminary natural luminosity results can be seen in Figure 2.

Outlook
Currently, the application of two color high-speed LII is investigated to reduce line-of-sight and chemiluminescence effects that influence temperature calculations [2]. Current findings on the metal engine need to be verified and further tests will be performed for different engine speed and load.

References