

Optical Study of tumble, Spray and Combustion

This is an optical study of a tumble inducing system for a direct injected gasoline engine. The tumble flap is a system that blocks part of the intake. It has the purpose to promote mixing of fuel and give more stable and faster combustion. These wanted behaviours could be seen in the study.

The Master's thesis was a study of the gas movement inside a direct injected gasoline engine. The study was made with an optical engine. The aim of the study was to evaluate a so called tumble flap system and how the system interacts with the injected fuel and affects the combustion. The engine had a glass piston and a cylinder wall made of glass. The combustion and also the fuel spray was studied by filming the combustion chamber through the glass. Variations of certain parameters such as tumble flap position, engine speed and fuel pressure were made to investigate the system in an effort to understand how the tumble flap system works for different conditions. Some really interesting results were seen in the investigation, such as more rapid combustion which is better for the engine efficiency due to less time for heat transfer to between the combustion chamber and walls, but also results that indicates the need for more investigation to understand the system completely. From the spray study some very interesting results were collected. The spray was affected in such a way that the stronger so called tumble motion could be observed clearly. The study was made at Volvo Cars Corporation with their optical engine.

The system as such has the possibility to improve fuel consumption and emissions of a petrol engine. It is important to understand the fuel/air interaction when designing the combustion system. The current trouble with this type of engine is that the fuel consumption too high to meet coming laws in emissions in terms of for example CO₂ and soot. CO₂ have negative effect on climate and soot is a health issue. For this reason it is important to decrease the fuel consumption of the DISI engines and as mentioned before the purpose of a tumble flap system is to achieve lower fuel consumption.

The knowledge learned and the observed behaviours can be very useful when the tumble flap system is tried on a full metal engine or so called real engine. This is due to observed behaviours in the optical engine that can explain what happens in the full metal engine. It can also be used as input for the development of the engines. It can be important to be able to see the connection between what happens in the metal engine to what was seen in the optical engine study. The causes of problems can be directly seen in the optical engine. In a metal engine you only have the results of what happened and can not see the direct link between the problem and cause. The study can also be used to understand calculations and simulations for the tested system. It can also give possible input to the simulations. One very interesting observed with the tumble flap system was the possibility of moving the ignition closer to top dead center due to the faster combustion. It will give the possibility to take out more power in the expansion stroke.

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Master Thesis in Combustion technology

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