日本機械学会中国四国支部

国際技術講演会

日時：（1）2021 年 8 月 17 日（火）10：30～12：00

（2）2021 年 8 月 24 日（火）10：30～12：00

場所：Zoom によるオンライン講演室

題目：（1）Diesel Spray Imaging in Spray Chamber

（2）The Path towards a Fossil-Free Transportation System in Sweden

講師：Prof. Mats ANDERSSON, Chalmers University of Technology, Sweden

Prof. Mats ANDERSSON は 7 月 1 日－8 月 31 日，広島大学教員として雇用され（クロスアポイントメント制度を利用），これまではスウェーデンでのリモート勤務でしたが，来日後の 2 週間隔離を経て 8 月 2 日に東広島市に到着され，3 日から広島大学での勤務となりました．Chalmers University of Technology で長くエンジン燃料噴霧のレーザー・画像計測研究をされ，世界的に知られた研究者です．広島大学で燃料噴霧内の混合気濃度分布の高速度画像計測に関する共同研究を行います．

講演概要：次ページの Abstract をご参照ください．

参加費：無料

定員：？？（Zoom の容量）

申込方法： 氏名・所属・連絡先（住所・電話番号・E-mail アドレス）等を記載の上，下記お申込み先までお申込みください。Zoom のリンク先をお知らせします。

（お申込み人数によっては先着順となる場合があります。ご了承ください）

申込締切：（1）2021 年 8 月 16 日（月）17 時

（2）2021 年 8 月 23 日（月）17 時

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Abstract

(1) Diesel Spray Imaging in Spray Chamber

In Diesel engines the fuel is injected into the cylinder towards the end of the compression stroke when the air pressure and temperature is high. The quality of the spray process, breaking up the liquid fuel jet into droplets, entrainment of air leading to evaporation and ignition determines the combustion efficiency and emission formation. Thus, to improve and optimize the Diesel engine combustion process it is important to be able to characterize and understand the fuel injection and spray process. Using a spray chamber in which temperature and pressure can be controlled and kept constant at conditions similar to those of an engine, the fuel spray can be investigated in great detail using various optical diagnostics.

Sprays from single-hole nozzles with different geometry have been characterized at various fuel injection pressures and gas conditions, using high-speed video imaging techniques. Evaporating sprays were imaged with the light absorption and scattering (LAS) technique, in which the spatially and time resolved extinction of visible (VIS) and ultraviolet (UV) light is recorded. The extinction of visible light is due to light scattering by fuel drops and, thus, the VIS images show the contours of the liquid phase spray, whereas the UV light is absorbed also by the vapor phase fuel, whose penetration and density can be measured. The spray flames were characterized by imaging OH* chemilumi-nescence light at 308 nm and soot luminescence at visible wavelengths, in addition to soot extinction measurements using monochromatic light at 532 nm for background illumination.

At evaporating conditions, sprays from straight cylindrical nozzle holes were compared with sprays from convergent conical nozzle holes. It is assumed that there is a higher degree of cavitation in the straight holes, and wider sprays close to the nozzle was observed from the straight nozzle. The liquid penetration length was comparable for the same mass flow rates of the two nozzles showing that air entrainment was at least as efficient for the conical nozzle. The abundance and location of OH and soot in the spray flames was investigated for different nozzle diameters and fuel injection pressures. The amount of soot formation and the width of the sooting zone was found to correlate with the estimated equivalence ratio at lift off. Furthermore, the width of the outer zone with strong OH* chemiluminescence varied inversely with the width of the central sooting zone. In addition to measuring the soot concentration with conventional Diesel fuel, measurements were performed with various renewable fuels such as alcohols, RME, HVO and blends between them. Lower soot concentration was measured for oxygen-containing fuels.

In the engine, the spray and jet flame impinge on the surface of the piston, leading to a deflection of the jet flame followed by flame-flame collisions. In order to investigate these processes in the spray chamber a piston dummy was mounted in the chamber in a geometry where two sprays impinged on a curved wall. The flame impingement and flame-flame collision were imaged by capturing the OH* and soot chemiluminescence with video cameras. In particular, the effect of placing a protrusion on the piston wall was investigated, and it was found that the protrusion facilitated late mixing and soot oxidation.

Abstract

(2) The Path towards a Fossil-Free Transportation System in Sweden

The scientific evidence is points at an accelerating global warming with increasingly negative impact on ecosystems and society, including sea level rise and more extreme weather conditions. The emission of carbon dioxide and other greenhouse gases from human activities is the main driver of the global warming, where the use of fossil fuels is the biggest source of emissions. There is a growing awareness that the emission of greenhouse gases needs to be curbed drastically and that the reductions need to be implemented without delay.
In this presentation the measures to reduce CO_2 emissions planned in Sweden will be described with a background of the Swedish energy system. Sweden is in a better position than many countries to remove fossil fuels from the energy system, since the share of fossil energy is lower than in many other countries and there is, in relative terms, a higher share of bioenergy and renewable electricity. Still a transition to a fossil-free future will not be without significant challenges.

The focus of the presentation will be on achieving fossil-independent transportation. Government policies (present and proposed) will be reviewed, initiatives by energy and vehicle companies will be described, and my perspective as a researcher in combustion engine and vehicle propulsion technology will be given. There is not a single solution but a range of measures that need to be undertaken. Overall, the demand for transportation need to be reduced and transport efficiency need to be increased. Electrification will play a major role for road transport. In applications where batteries are not suitable, hydrogen is expected to be a preferred energy carrier combined with a fuel cell or a combustion engine. Still there are applications in which liquid fuel is difficult to replace and biofuels and electrofuels can be the solution if available in sufficient quantities. The advantages and limitations of different technologies will be discussed.