SUCCESS STORY

RC-LowCAP
Research Center for Low Carbon Special Powertrain

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Project

Type of project: **F-TRANS**, 1.12.2019-30.11.2022, multi-firm & **X-FUEL**, 1.12.2019-30.11.2022, strategic, multi-firm

CI COMBUSTION SYSTEM 2030+

TAPING THE FULL POTENTIAL OF FUTURE RENEWABLE FUEL BLENDS WITH TAILORED COMBUSTION SYSTEMS

In compression ignition (CI) engines the design of the combustion system is intrinsically tied to the properties of the fuel. Individually optimizing the one or the other may bring some benefits, but optimizing both together will bring significant benefits. The latter is one of the major targets of the RC-LowCAP project.

The most important target values of CI combustion development are efficiency, nitrogen oxide (NO_x) and smoke. They are interlinked by various trade-offs that emerge from the processes of mixture formation, ignition, combustion and emission formation.

The mutual optimization of fuel and combustion system was done on a single cylinder research engine because it is easy to handle and highly accurate. A set of different pistons, fuels and injectors defined the basic variation space. Other parameters are swirl, injection strategy and charge condition. The selection of the test fuels is based on literature research and existing results. The investigations were conducted within the projects F-TRANS and X-FUEL.

The plot below gives an explanatory example of the very interesting results by means of an EGR swing. Baseline is a configuration with standard fossil diesel fuel and a standard combustion configuration (*'Std/Std'*). The efficiency can be found around 42,5 % and the NO_x-Soot trade off in an usual range.

Increasing the compression ratio while staying at standard fuel (*'Std/Adv'*) improves the efficiency by 1,5 $\%_{pts}$, but soot rises to unacceptable figures, three times higher than the baseline. This increase is caused by a shortened ignition delay and bad jet penetration. Hence, this compression ratio is not feasible with conventional fuel.

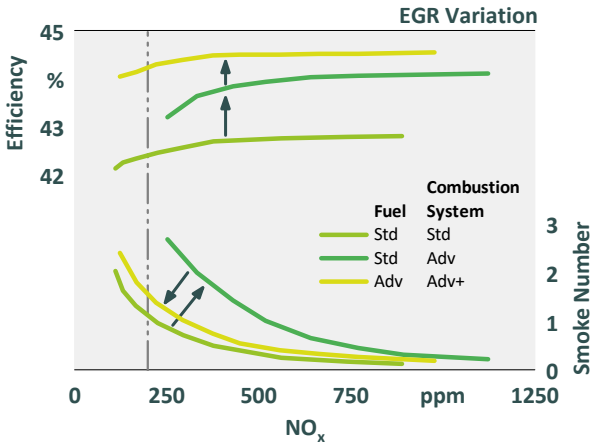
Fuels with high oxygen content are assumed to have less tendency to soot formation, what was confirmed during these measurements. Using a high-oxygen fuel

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Federal Ministry
Republic of Austria
Digital and Economic Affairs

Version 01/2020

with the above combustion system let the soot drop to the original level again. The efficiency, on the other hand, remains high and can be even increased by an injector with higher mass flow rate (*'Adv/Adv+'*). It ranges above 44 %.



This example reflects one of the most impressive results of the combined combustion and fuel optimization investigation and demonstrates the great potential of this approach. However, during the investigations an extensive database within the variation space of fuels, hardware and operating parameters was established. This database enables a prediction of combustion properties of different renewable fuels and their sensitivity to hardware adaptions. Industry partners AVL and OMV use the results for engine development and fuel development respectively.

Project coordination
Dr. Stephan Schmidt
General Management

T +43 (0) 316 873 – 30153
schmidt@ivt-tugraz.at

RC-LowCAP
Inst. For Internal Combustion Engines
and Thermodynamic, Graz University of Technology
Inffeldgasse 25
8010 Graz
T +43 (0) 316 873-30001
office@ivt.tugraz.at

Project partner

- Inst. f. Internal Combustion Engines & Thermodynamic, TU-Graz, Austria
- Inst. f. Chemistry, University Graz
- OMV Refining & Marketing GmbH, Austria
- AVL List GmbH, Austria

This success story was provided by the consortium leader and by the mentioned project partners for the purpose of being published on the FFG website. RC-LowCAP is a COMET Project within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, Province of Styria and Province of Upper Austria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet