Synthetic options for the diesel engine

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Professor Christian Beidl with the world's first oxymethylene ether powered research vehicle. Credit: Katrin Binner

Synthetic fuels, such as oxymethylene ether, could prepare Diesel vehicles to play a major role in the drive train mix of tomorrow. Scientists at the TU Darmstadt are carrying out research into the practical viability of alternative fuels.

Professor Christian Beidl, Head of the Institute for Internal Combustion Engines and Powertrain Systems at the TU Darmstadt, does not consider the current debate on internal combustion engines and electric motors as competing drive train systems to be particularly expedient. Instead, the expert favours an open contest between technologies, which considers the system as a whole, because, he believes, the Diesel engine will continue to play a crucial role in the drive scenarios of tomorrow – particularly in long-distance transport.

"It is not the engines as energy converters that are the problem", Beidl emphasises, "but rather the fuels". For many years, his team has been conducting research into new non-fossil-based fuels for Diesel engines, designed not only to reduce nitrogen oxide and particulate matter pollution levels, but also as a sustainable solution to the CO2 problem. The main challenge that this entails is to resolve a conflict that is typical for Diesel engines, namely that engines with a high degree of efficiency tend to generate high temperatures which, in turn, results in a high nitrogen oxide output. The established way to reduce temperature peaks within the combustion chambers is to include a return feed of virtually anoxic exhaust gases. However, the lower the oxygen levels, the more

soot particles are formed there. "Therefore", Beidl explains, "to resolve this conundrum we need to inhibit the formation of soot." Experiments conducted on industrial drive system and car engines as well as on a single-cylinder research engine have already shown that the use of oxymethylene ether is the ideal way to achieve this objective. The researchers have performed basic experiments and carried out realistic driving simulations for various operating modes and driver profiles under differing environmental conditions, in the course of which they focused on emissions, process controls and various exhaust gas aftertreatment concepts. They have been able to demonstrate that oxymethylene ether enables soot-free combustion whilst increasing the efficiency level of the motor, but that it also reduces energy density due to its high oxygen content.

Outstanding Properties

Thus, the optimum adaptation of Diesel engines to this synthetic fuel, according to Beidl, will require more in-depth research in combination with technological progress. However, the basic engine technology will not change. "We now know that oxymethylene ether fuels have some outstanding properties", says Beidl, who is also excited about the technical process chain involved in the production of the new fuel. As oxymethylene ether consists, among other things, of hydrogen, which can be synthesised from surplus electrical energy, one can imagine possible solutions which would both absorb peak loads and help to improve the distribution and storage of electricity from regenerative power sources.

In terms of introducing oxymethylene ether, Beidl currently imagines two possible scenarios. In one scenario, the oxymethylene ether would be deployed as a fuel supplement – comparable with ethanol – such that it would penetrate the entire market via existing infrastructure. Another scenario would involve its niche application in ships, locomotives and

agricultural vehicles. However, for a long time to come, crude-oil-based fuels and their production is likely to remain significantly more cost effective than synthetic fuels, which are currently only available at the laboratory scale. Yet, Beidl views attempts to resolve the CO2 issue by means of electric drive systems alone as short sighted: "We want to show that oxymethylene ether represents a socially relevant parallel development path."

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