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Press release

Fiber-optic combustion analysis to optimize combustion engines

Measurement technology from the Kistler Group now deployed for pre-chamber spark plugs

Winterthur, July 2020

The Kistler Group has now added pre-chamber spark plugs to the range of applications for its fiber-optic combustion analysis. This advance gives development engineers more options to press ahead with in-depth research on engines with pre-chamber spark plugs. The objective of this development: to make engines more efficient by improving their fuel consumption and reducing CO_2 emissions.

Pressure to drive the development of combustion engines ahead is growing in step with demands to cut fuel consumption and emissions. In 2021, the EU will introduce legal regulations to limit CO_2 emissions from passenger cars to 95 grams of CO_2 per kilometer. Any automobile manufacturers who exceed this value will be subject to heavy fines. The new limits can be met by combining an electric motor with a combustion engine, so hybrid designs are leading the way to the future. But at the same time, more efforts are needed to exploit the potential of the combustion engine. One way of achieving this is to deploy pre-chamber spark plugs to boost the efficiency of spark ignition engines. This ignition principle already has a long track record of success in large engines and motor sport – and now, it is set to make inroads into mass production.

Visualizing the effects of combustion

Fiber-optic analysis involves placing small viewing windows in the outer wall of the pre-chamber to capture a detailed record of processes in the engine so that optimization potential can be identified. The new design developed by Kistler allows analysis of more complex processes, taking account of different fuel mixes: until now, this measurement technology was only available for commonly used spark plugs.

Optical analyses provide spatial and time-based visualization of processes in the combustion chamber – such as knocking or pre-ignition – so researchers can understand them in detail. "To optimize fuel consumption and emissions in the engines of the future, we need a precise understanding of pre-chamber ignition processes. Until now, this was impossible with such a level of detail. Our sensors make the effects of combustion visible, so we can work on eliminating the

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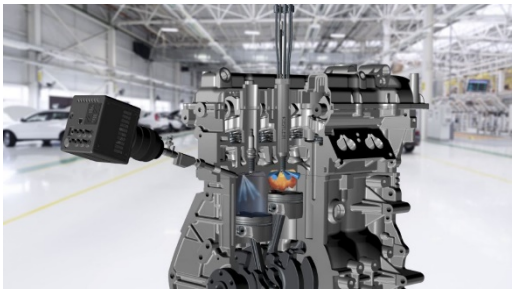
disruptive factors that reduce efficiency," according to Dr. Frank Wytrykus, Kistler's expert on optical technologies.

The challenge: dimensioning the pre-chamber

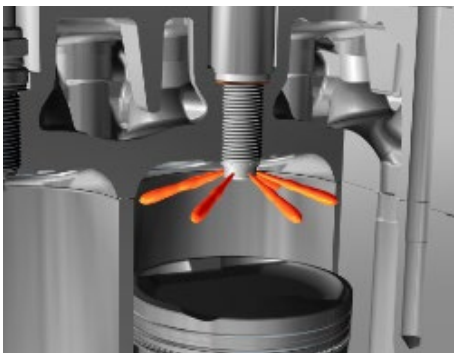
These special spark plugs ignite the fuel-air mix in a pre-chamber – hence their name. The expansion shoots the flame through small bore holes into the combustion chamber to trigger the main combustion over a large area. As the result, the main combustion is initiated at several points in the chamber: this makes it more likely that combustion will be uniform. Correct dimensioning of the pre-chamber is the challenge here: even small changes to the design have a major impact on combustion. For example, engines with a pre-chamber spark plug are more susceptible to knocking. But to optimize engine efficiency and emission levels, it is essential to prevent uncontrolled combustion processes such as knocking or pre-ignition, and to avoid any formation of soot.

By introducing this new technology for pre-chamber spark plugs, Kistler is supporting automobile manufacturers with in-engine process optimization, and is also helping to advance research into alternative combustion processes: needs that must be met if the EU emission targets for 2021 are to be achieved.

Image material (please name the Kistler Group as picture source)



Fiber-optic combustion analysis provides spatial and time-based visualization of processes in the combustion chamber such as knocking or pre-ignition, so researchers can understand them in detail.



An engine with a pre-chamber spark plug: the pre-chamber spark plug initiates the main combustion simultaneously at multiple points in the combustion chamber, thus increasing the likelihood of uniform combustion.

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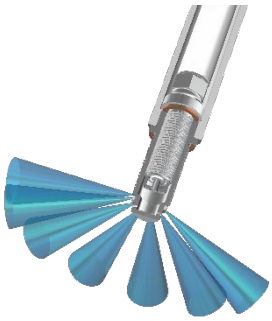

Cross-section through the pre-chamber and the "visibility cones" for optical combustion analysis: processes in the engine are captured through small viewing windows in the outer wall of the pre-chamber, providing pointers to optimization potential.

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About the Kistler Group

Kistler is the global market leader for dynamic pressure, force, torque and acceleration measurement technology. Cutting-edge technologies provide the basis for Kistler's modular solutions. Customers in industry and scientific research benefit from Kistler's experience as a development partner, enabling them to optimize their products and processes so as to secure sustainable competitive edge. Unique sensor technology from this owner-managed Swiss corporation helps to shape future innovations not only in automotive development and industrial automation but also in many newly emerging sectors. Drawing on our extensive application expertise, and always with an absolute commitment to quality, Kistler plays a key part in the ongoing development of the latest megatrends. The focus is on issues such as electrified drive technology, autonomous driving, emission reduction and Industry 4.0. Some 2,200 employees at more than 60 facilities across the globe are dedicated to the development of new solutions, and they offer application-specific services at the local level. Ever since it was founded in 1959, the Kistler Group has grown hand-in-hand with its customers and in 2019, it posted sales of CHF 466 million. About 7% of this figure is reinvested in research and technology – with the aim of delivering better results for every customer.