Engine Downsizing

Engine downsizing is the use of a smaller engine, which is boosted with a turbocharger, replacing a larger naturally-aspirated engine. For example, a turbocharged four-cylinder engine can replace a naturally-aspirated V6 engine. Downsized engines operate at higher load to achieve the same vehicle torque and power, reducing throttling losses and the effect of engine friction. This leads directly to improved vehicle fuel economy. Downsizing also allows modular engine families to be developed, with different boosting levels and therefore power densities meeting the requirements of different vehicles. This is beneficial for OEMs in terms of product portfolio cost and complexity.

As we expect the uptake of GDI technology to increase, so will boosting systems to enable engine downsizing. Direct injection combines very well with engine downsizing, as it allows compression ratios to be maintained in the downsized engine, and excessive enrichment to be avoided.

As downsizing retains performance whilst reducing the size of the engine, it increases the power density. This means that the engine has to deliver higher power more of the time, leading to more heat being produced. As a result, fuel injectors and combustion chamber are subjected to higher temperatures more often. This places the fuel under higher thermal stress, which leads to a risk of more deposits forming. Fuel additives can play a role in minimizing and preventing deposit formation, protecting the engine.

Downsized engines are also at risk of low-speed pre-ignition – also known as LSPI. This is an event that occurs in gasoline vehicle engines when there is a premature ignition in the combustion chamber. Deposits inside the engine can lead to LSPI in 2 ways; either by the auto-ignition of droplets of fuel and oil combined together due to poor spray quality. Or deposits from the combustion chamber or injectors flaking off and acting as an ignition source. This abnormal combustion creates spikes in engine pressure and can ultimately cause internal damage. Therefore, good fuel with optimised detergents are necessary to minimise deposits within the engine and prevent LSPI.