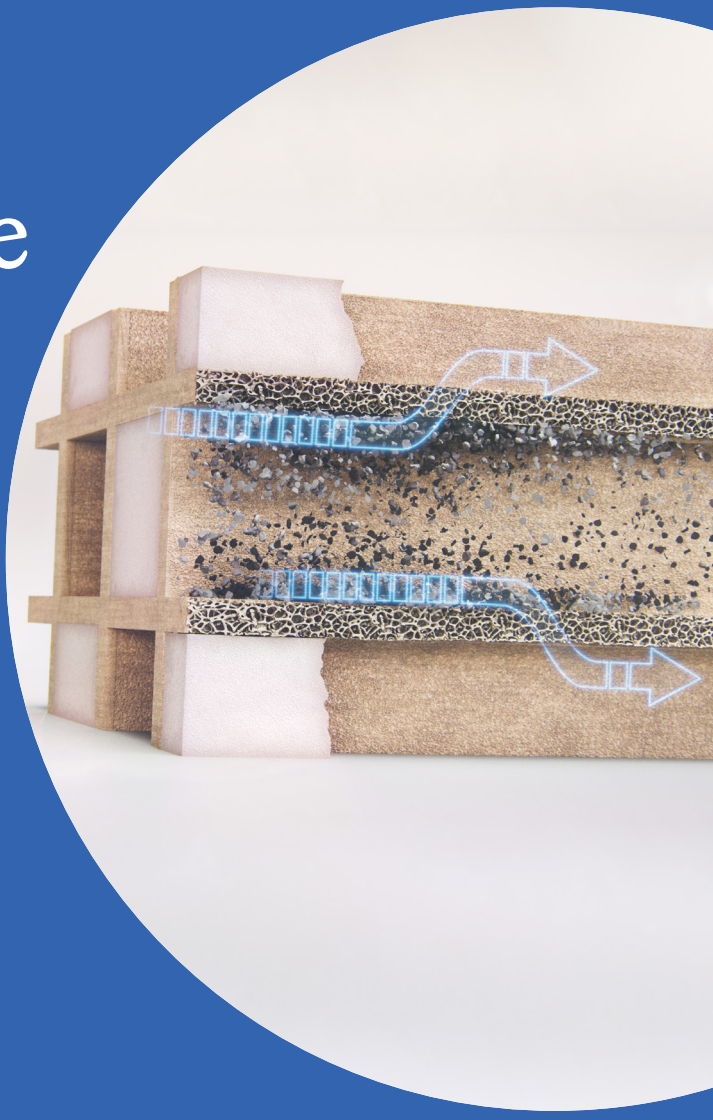
diamond

Automotive

CASE STUDY

Enabling cleaner air through novel engine oil formulations

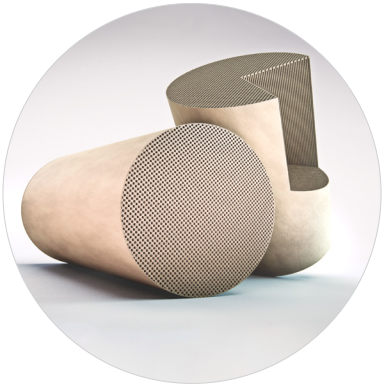


Poor air quality and reduced greenhouse gas emissions are at the forefront of public discussion, as well as being high on the agenda of worldwide policy makers. Many industries are embracing rapid changes in response, as is especially visible in the automotive sector, with the introduction of technologies such as gasoline particulate filters (GPFs). GPFs are positioned in a vehicle's exhaust system and filter fine particulate matter (PM) produced by the engine. Recent legislation in places such as China, India and Europe will drive the adoption of GPFs on the majority of new gasoline, and hybrid electric, vehicles.

Whilst GPFs benefit public health and the environment by filtering out PM, they can also become gradually blocked by collected material. Captured carbonaceous particles (e.g. soot) can routinely oxidize away; however, inorganic PM (e.g. ash) typically remains in the filter for life, slowly blocking it and potentially reducing the fuel economy and power of the vehicle. Inorganic PM is predominantly derived from engine oil additive chemistry, which plays an important role in improving fuel economy, performance, and engine lifetime.

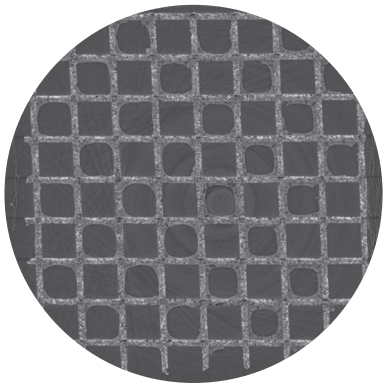
Lubrizol CORNING

The Challenge



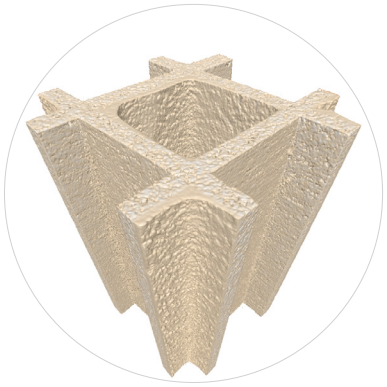
In a collaborative project, Lubrizol and Corning Environmental Technologies conducted an extensive field trial, examining the effect of engine oil additive chemistry on GPF performance. The formulations trialled included different additive chemistries and loadings, with the aim of investigating the effects of these on ash collection, and subsequent GPF and vehicle performance. A key aspect of the study was to understand the location, morphology and relative concentrations of ash within the intricate GPF structures, requiring a non-destructive method to probe internal GPF features without disturbing or damaging collected ash.

The Solution



In collaboration with Novitom advanced 3D imaging, and using I12 at Diamond, samples were studied using non-destructive X-ray tomography (XRT) to examine captured ash inside of the filters. Upon completion of the field trial, GPF hardware was removed from vehicles utilizing the different engine oil additive chemistries, and the intricate filter channels examined using XRT. The synchrotron source allowed multiple GPF channels to be examined at high-resolution along the entire channel lengths, ensuring robust and justified conclusions could be drawn. Using this approach, the research teams were able to clearly correlate the amount and location of ash collected within the GPFs with exhaust backpressure (caused by filter blocking) and fuel economy, subsequently linking this directly to engine oil additive chemistry.

The Benefits



X-ray imaging at Diamond offered researchers a rapid, non-invasive and quantifiable method to study a range of GPF samples. Using these results, the teams were able to assess the impact of different engine oil formulations on ash collection in GPF-fitted vehicles. The findings from this work will guide Lubrizol's future engine oil formulating efforts, directly impacting the advanced additive chemistry that goes into engine oils and enabling the world to move cleaner.

"The high-resolution XRT data collected at Diamond's leading facilities have allowed Lubrizol to build further understanding into the role of our additive chemistry on GPF performance and durability. Whilst directly contributing to increased vehicle efficiency through our additive chemistries, this data also ensures we will continue to enable the world to move cleaner through effective advanced aftertreatment systems." **Dr Paul Kirkman, Lubrizol Ltd.**

For further information

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