Improving engine performance and fuel efficiency

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A study conducted in part at the Canadian Light Source (CLS) at the University of Saskatchewan suggests reformulating lubricating oils for internal combustion engines could significantly improve not only the life

of the oil but the life of the engine too.

Dr. Pranesh Aswath with the Department of Materials Science and Engineering at the University of Texas at Arlington and his research colleagues focused on the role soot plays in engine wear, and its effect on the stability of engine oil.

He described the research as "one piece of a broader story we're trying to write" about how the reformulation of engine oils can reduce emissions, decrease wear and increase the longevity of engines.

Soot is a carbon-based material that results from incomplete combustion of fuel in an internal combustion engine, he explained. The soot ends up in crankcase oil where it is trapped by additives, but that leads to reduced engine efficiency and a breakdown of lubricating oil.

Using three beamlines at the CLS—VLS-PGM, SXRMB, and SGM—the researchers looked at how elements like calcium, sulphur and phosphorous become incorporated into the soot chemistry and then interact with the additives in lubricating oil. "The CLS has the best low-energy beamlines out there," said Aswath.

What the study identified was the involvement of a common calcium-based dispersant that is added to oil to keep wear debris and other contaminants from forming a sludge. Aswath said the interaction of the dispersant with the soot creates calcium phosphate which makes the soot particles very abrasive. That abrasive quality removes the protective film from moving engine parts and leads to excessive wear. The solution, he said, is to consider alternative additives.

"Calcium is a cheap and readily available dispersant, and when it comes to making engine oil, it's a matter of saving pennies," he said, "but there may be other possibilities you could use without sacrificing either cost or

performance."

Reducing engine wear and extending oil life have wide-spread implications, he said. In the trucking industry, for example, "having to change your oil frequently means it costs you $50 to change the oil but you also might lose $400 in productivity so there are all kinds of other surrounding issues."

Engine manufacturers are also interested in Aswath's research as the science may affect warranties on their products.

Issues with soot have also been identified in some gasoline engines, he added, increasing the need for "a new generation of additive chemistry."

More information: Kimaya Vyavhare et al. Impact of Diesel Engine Oil Additives–Soot Interactions on Physiochemical, Oxidation, and Wear Characteristics of Soot, *Energy & Fuels* (2019). DOI: 10.1021/acs.energyfuels.8b03841

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