Evolution of soot in a heavy-duty diesel engine

Giovanni Ferraro[1*], Emiliano Fratini[1], Riccardo Rausa[2], Paolo Fiaschi[2] and Piero Baglioni[1]

[1] *Department of Chemistry "Ugo Schiff" and CSGI, University of Florence, Sesto Fiorentino, Italy*
[2] *Eni R&M, San Donato Milanese, Italy*

**giovanni.ferraro@unifi.it*

In the last decades, industrial research on lubricant oils has grown to develop more efficient formulations. One of the main factor reducing the engine lifetime, is the formation of carbonaceous particles (soot) which induce an increase in lubricant viscosity as time passes. The comprehension of the mechanism of both soot formation and growth [1] is of fundamental importance to design better performing lubricants. Up to now, information on the evolution of soot in terms of dimensions and morphology at different aging times during a real application are still limited.
In this work, we report on a multi-technique investigation of soot-in-oil samples drawn from the oil sump of a heavy-duty diesel engine at increasing working times up to 300h. Exhaust oil viscosities correlate well with the amount of soot particulate in the oil. SEM and DLS reveal a primary unit of 24 nm and this unit forms quite open clusters with an average diameter of about 200 nm. The mean dimension of both primary particles and aggregates remains constant during engine work up to 300h. As time passes SAXS curves show an increase in the low-q scattering as a result of the conversion of primary units into clusters. In conclusion, the growth of the particulate inside a lubricant oil under work is characterized by a dimensional cut-off of both primary particles and aggregates and that there is no growth of clusters or primary particles over this cut-off dimension.

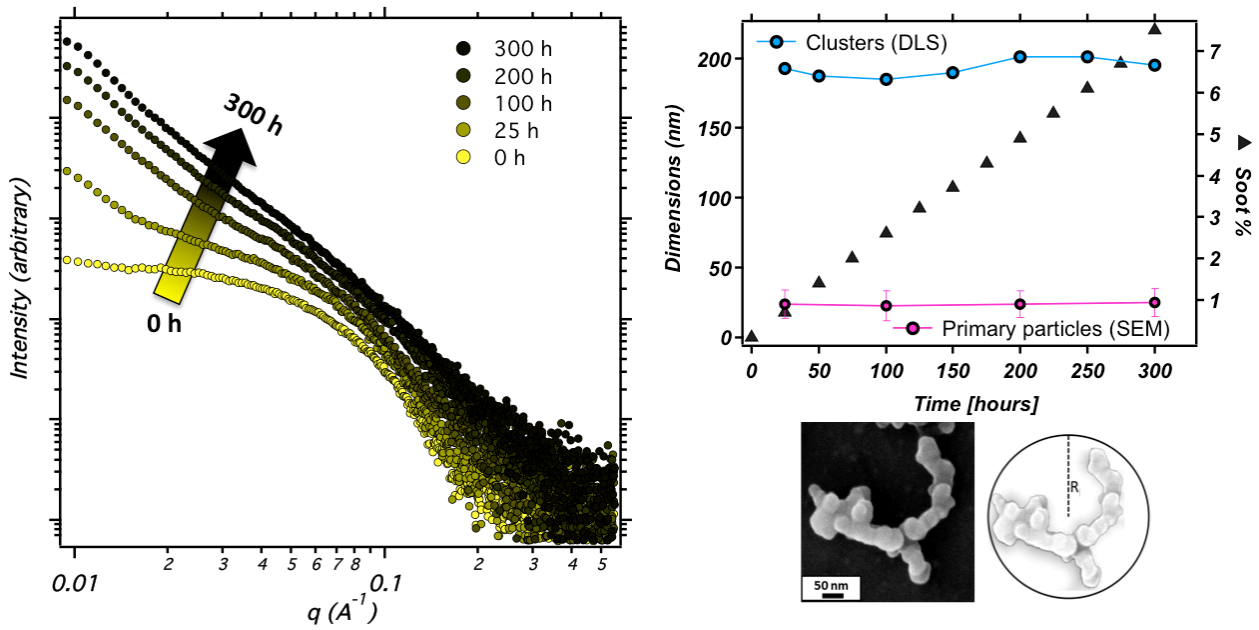

Figure 1 SAXS curves of exhaust oil at increasing working times up to 300h (left). Soot amount and dimensions of clusters and primary particles as a function of working times (top right). Example of soot cluster (SEM micrographs) (bottom right).

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[1] I.M. Kennedy, *Prog. Energy Combust. Sci.*, 1997, **23**, 95.