Distribution of particulate matter to extend heavy-duty diesel particulate filter service life

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The performance of diesel particulate filters (DPFs) is highly dependent on the distribution of accumulated ash inside the filter channels where plug-ash is more beneficial than wall-ash distribution. Many authors have linked the distribution pattern to the type of regeneration i.e., active oxygen-assisted regeneration and passive nitrogen dioxide-assisted regeneration [1]. Other work has decoupled the type of regeneration from the distribution of ash particles in DPFs, putting more emphasis on how individual parameters affect the particles [2]. Optimizing the distribution of particles would not only extend the life span of the DPF but also improve the overall energy efficiency of the vehicle as a result of lower back pressure and less frequent regenerations.

A lab-scale test rig has been used for carefully controlled experiments for performance assessment and enhancement of DPFs. The system has the capability of reproducing similar results realized in full-scale heavy-duty engine tests, maintaining a close connection to the actual application. The effects of temperature, flow, particle type, and concentration have been investigated on field-retrieved DPFs. Particulate filters previously used in operating heavy-duty vehicles were prepared for sub-scale testing. From each full-size DPF, multiple cores were tested to comprehend the role of vehicle history. Different cycles of soot loading and regeneration processes were repeated and after each cycle, the performance of the DPFs was assessed to understand the effect of individual parameters.

DPF performance can be improved without the need for external processes and the degree of improvement is dependent on the history of the DPF. Particulate filters with ash particles accumulated evenly over the axial distance of the DPF are more likely to see changes in performance. Altering the filling degree of the filter channels i.e., reducing the volume occupied by particles as shown in Figure 1 can be realized by normal operation. The increase in available filter volume results in an improved operation of the DPF and extended time of use.

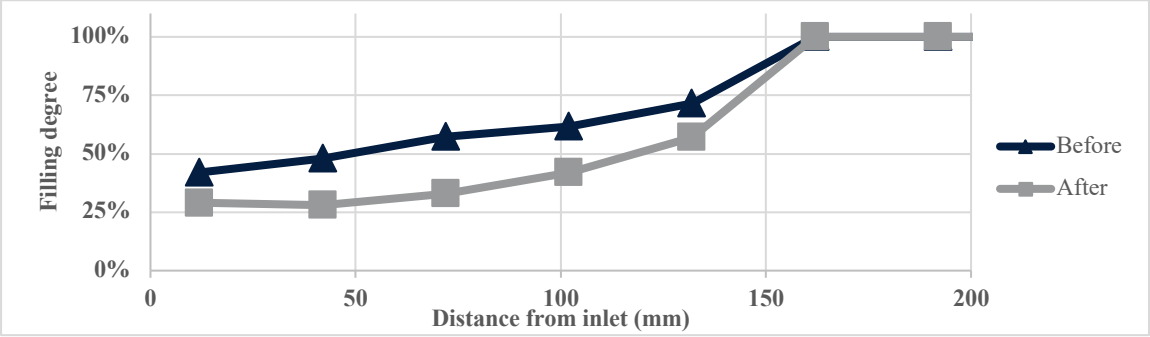

Figure 1 Volume occupied by ash in field-retrieved DPF before and after oxygen-assisted regeneration.

[1] T. Ishizawa, H. Yamane, H. Satoh, K. Sekiguchi, M. Arai, N. Yoshimoto, T. Inoue, *SAE Int. J. Commer. Veh.*, ,**2009**, 2, 164–175.
[2] A. Dittler, *SAE Tehcnical Paper 2012-01-1732*, **2012.**