

ECT 2025 Conference

Evaluation of Next Generation filter technology with DOC-on-Filter, PGM coated DPFs, bare DPFs for Non-Road Application

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Outline of the presentation

- Perspective on Global Non-Road Regulations
- Non-Road DPF Market Trends
- Background of this study
- Design of Experiment
- Experimental Set-Up
- Results and Discussion
- Conclusion

HDD NR DPF Solution Trends for Global Markets

US & EU regions → Continue use of TW 300/7; engine and ATS optimizations (DOC-F) amid regulatory delays
CN & IN regions → Continue use of DC LP 300/9 and/or adoption of advanced DPFs to meet upcoming PN requirements

Attributes	US Tier 4F/ EU Stage V	China NR IV/India BS IV CEV/TREM V	Advanced High FE DPFs for Future application	
DPF Material	DuraTrap® TW	DuraTrap® DC LP	Next Gen High FE 300/7	Next Gen High FE 300/9
Geometry (nominal CPSI/WT)	300/7 ACT	300/9 ACT	300/7 ACT	300/9 ACT
Porosity (%)	High	Medium	Low	Low
Median Pore Size (µm)	Medium	Medium	Low	Low
Soot & Ash PD	Lower	Reference	Lower	Equivalent
Ash Capacity	++	+	++	+
PN Filtration Efficiency (Clean DPF)	Reference	+	+	++
Soot Capacity (Regen Interval)	Reference	++	+	++

Background of the Study

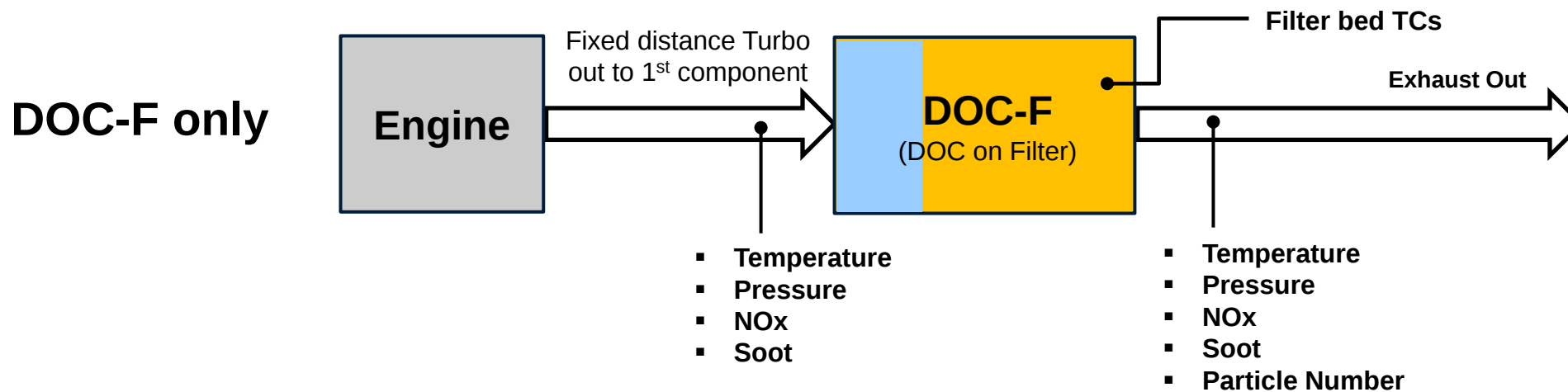
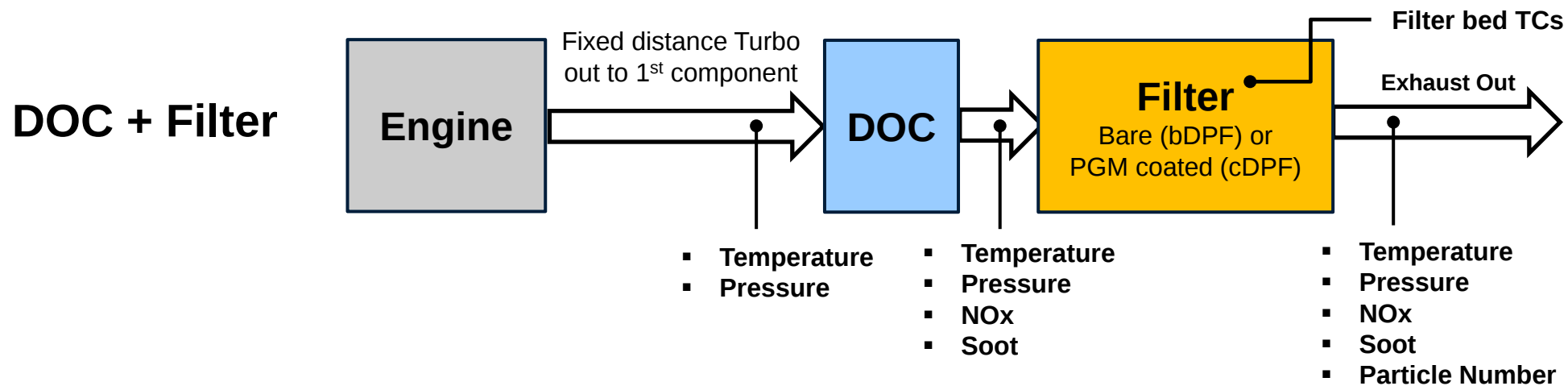
- Component integration and SCR upsizing may be necessary to meet future low NOx limits for non-road. Space for after-treatment is also a limiting factor, which may require innovative designs by combining components.
- Reduction in PM for future North American regulations and likely stringent PN standard for next round of Global non-road regulation may require advanced filtration solutions.
- We explored this potential system design change from a filter perspective and evaluated advantages and challenges of various system designs.

Design of Experiment

- Two (2) filter technologies evaluated in three (3) test configurations
 - DOC + bare DPF (bDPF)
 - DOC + PGM coated DPF (cDPF)
 - Zone coated DOC-on-Filter
- Key performance characteristics discussed,
 - PN Filtration Efficiency
 - Pressure Drop
 - Passive Regeneration
 - Active Regeneration

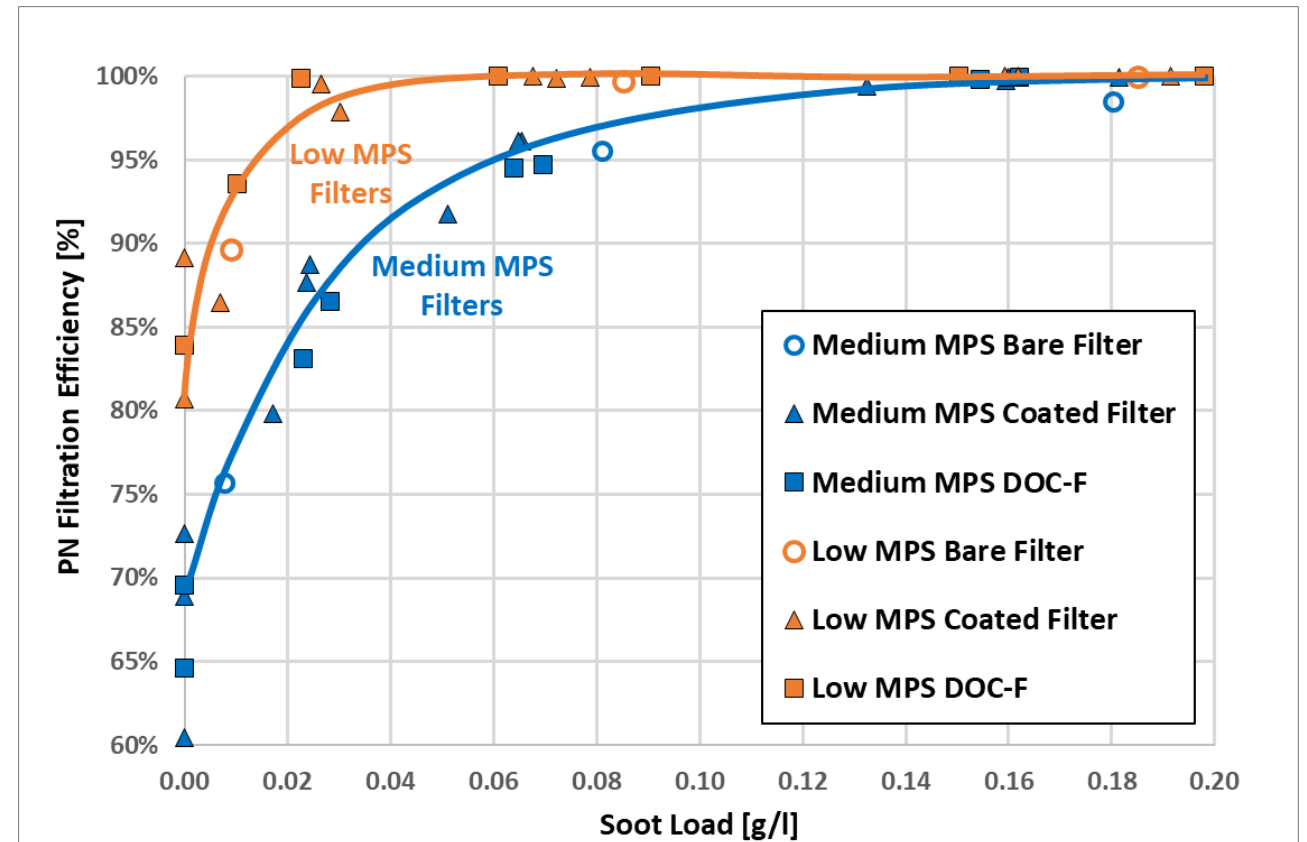
Filter Technologies (300 CPSI/7 mil WT ACT, ~22 L)	Uncatalyzed/ bare Filter (bDPF)	Homogeneously PGM coated Filter (cDPF)	Zone coated DOC-on-Filter (DOC-F)
Tier 4F/Stage V Medium MPS	X	Multiple coaters	Multiple coaters
Next Gen Filter Low MPS	X	Multiple coaters	Multiple coaters

Experimental Set-up



Results – PN Filtration Efficiency (FE)

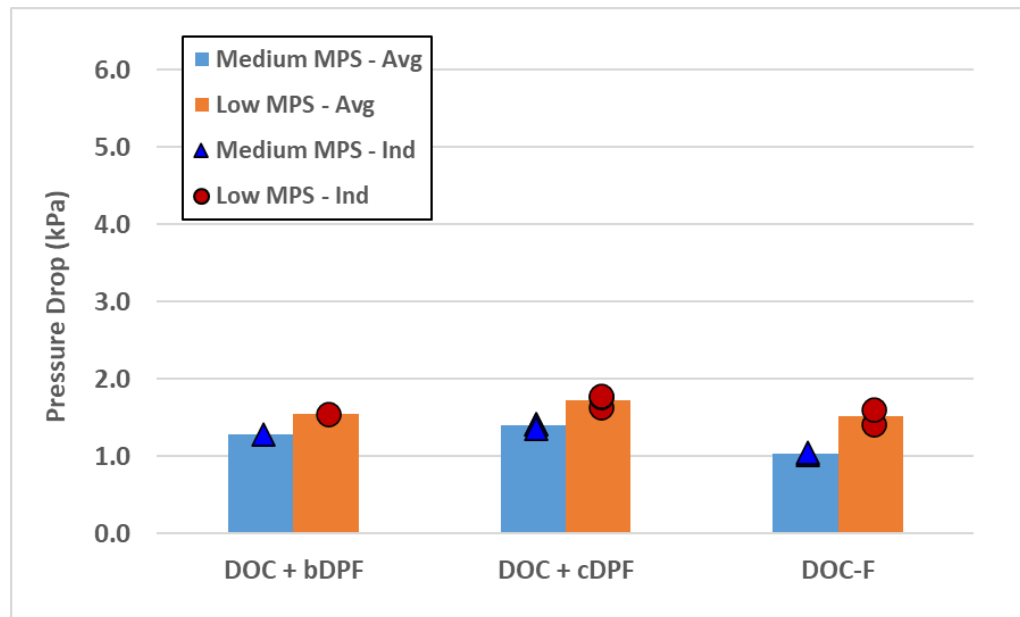
- >10% improvement in PN filtration efficiency with Low MPS filter at low soot loads (<0.05 g/L).
- No significant impact on PN FE observed due to coating types.
- PN 10nm results were equivalent to PN 23nm.



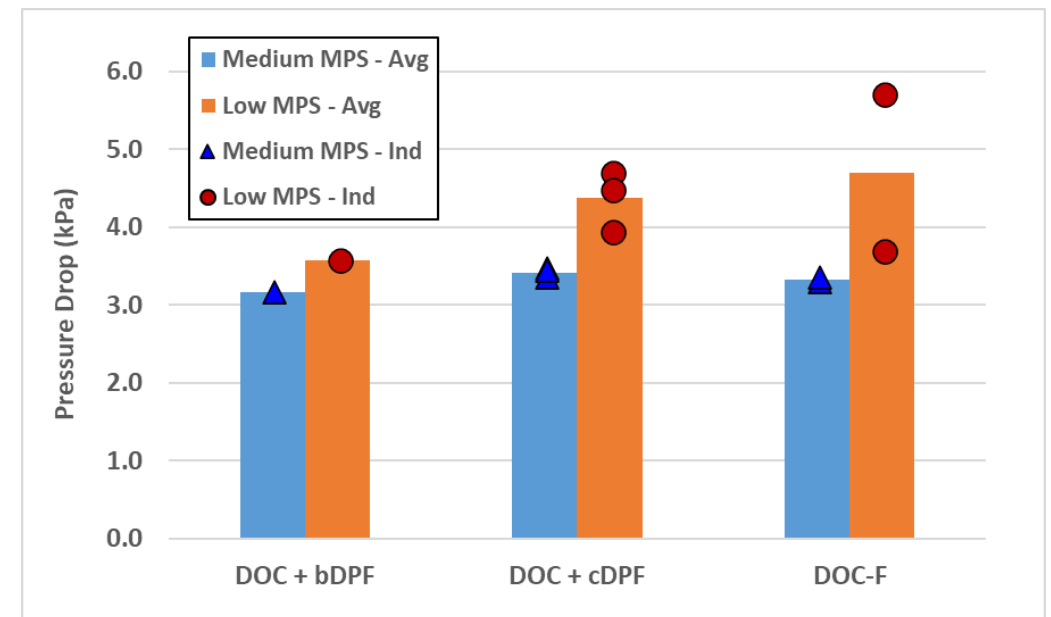
Results – Configuration Pressure Drop (PD)

- Without soot, DOC-F is slightly better. With soot, DOC+bDPF is slightly better.
- Good PD parity among Medium MPS coated filter samples, differences in PD observed for Low MPS filter coated samples.

Clean (0 g/L soot)



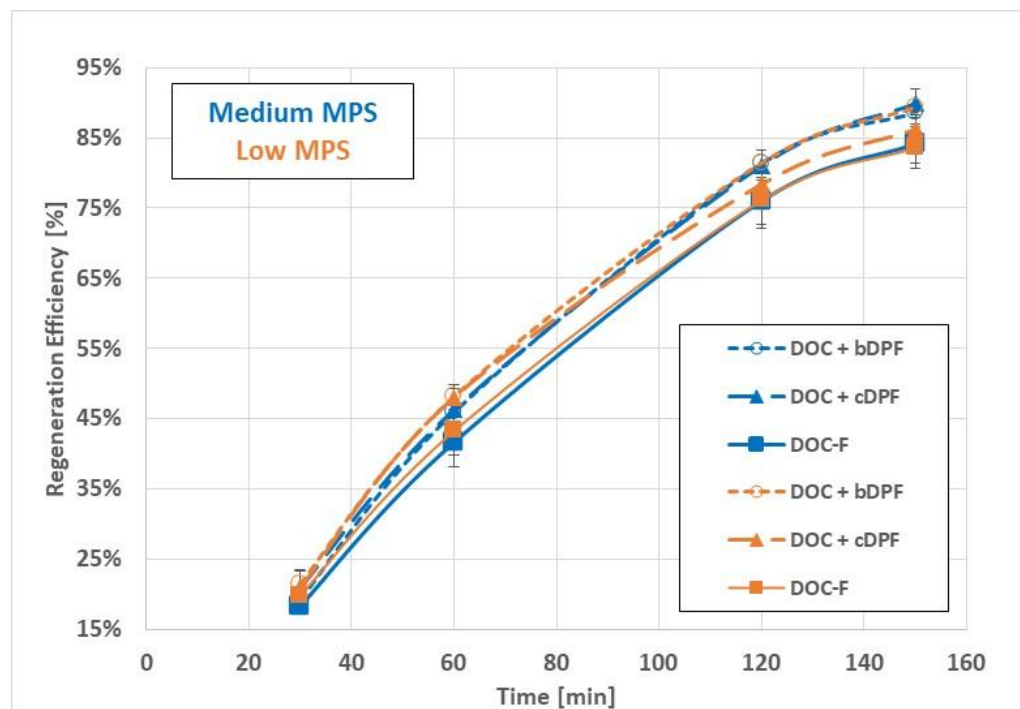
Soot Loaded (5 g/L soot) *



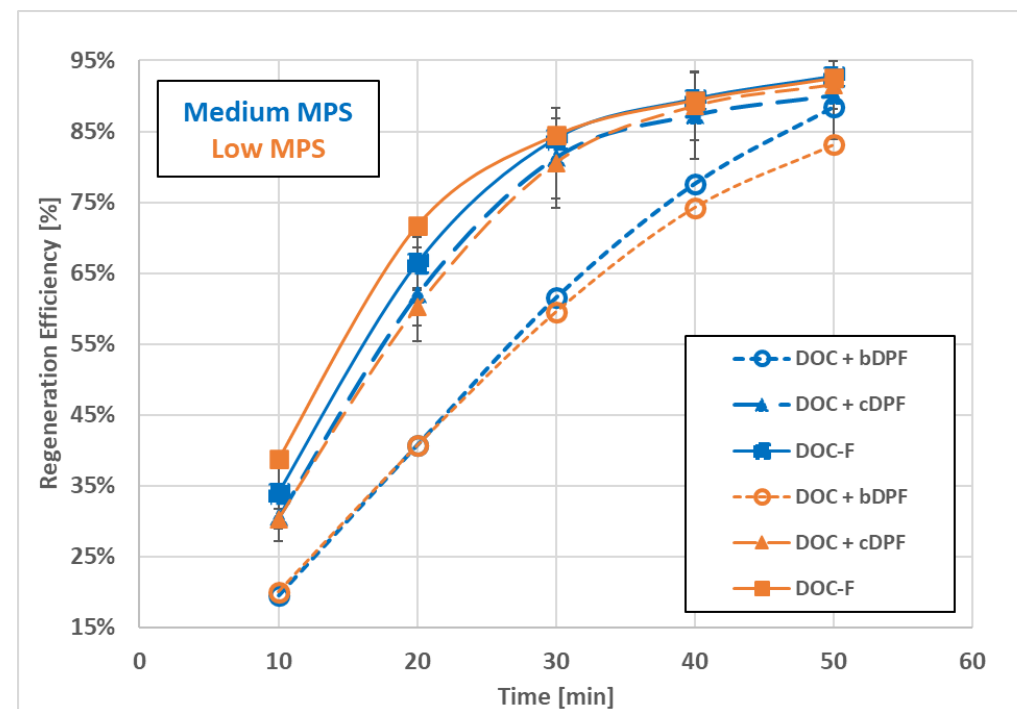
Results – Passive Regeneration

- DOC-F is equivalent to DOC+cDPF, DOC+bDPF is manageable.
- Similar performance among two filter technologies.

Passive Regen Efficiencies at 350°C

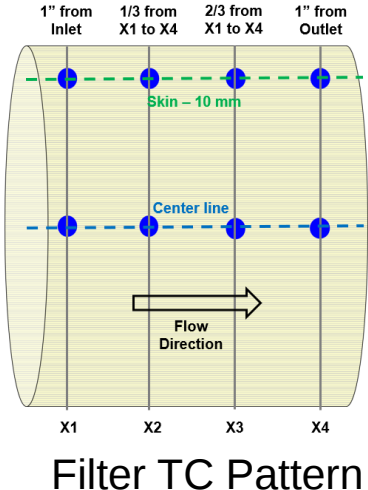


Passive Regen Efficiencies at 450°C

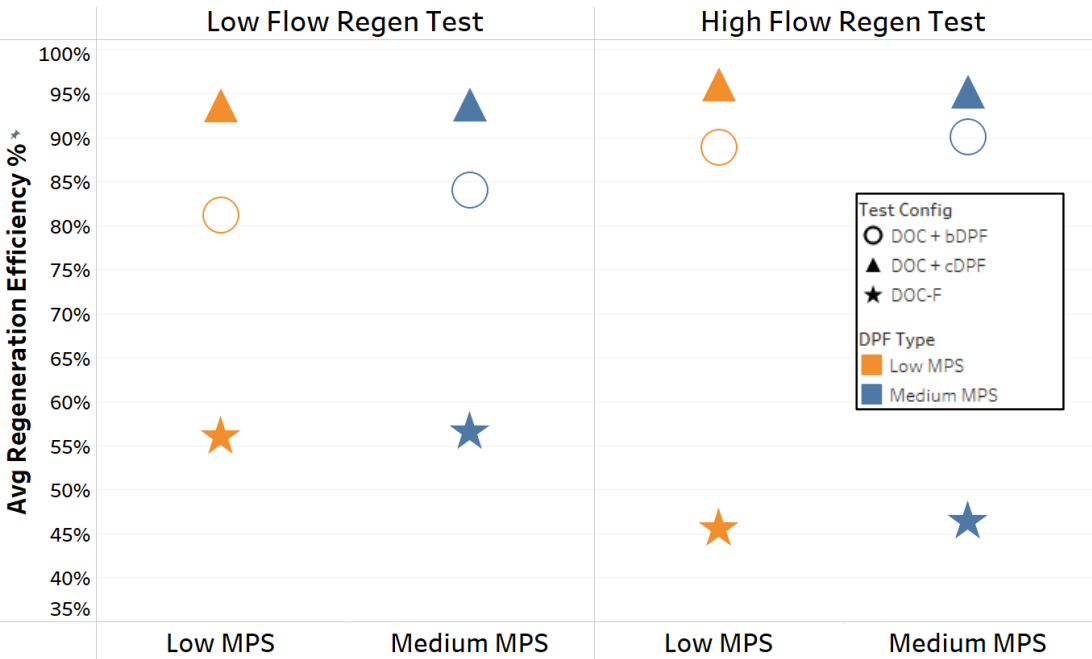


Results – Active Regeneration

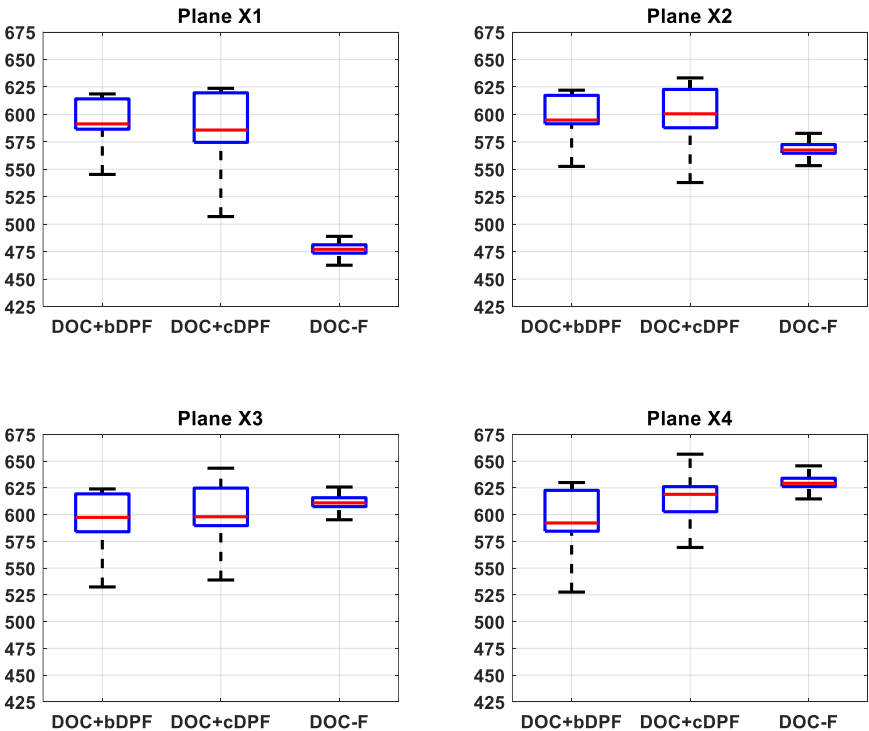
- Efficient active regeneration of DOC-F(s) is a challenge.
- Non-uniform temperature distribution contributing to inefficient soot oxidation in DOC-F(s).



Regen Efficiencies of test configurations



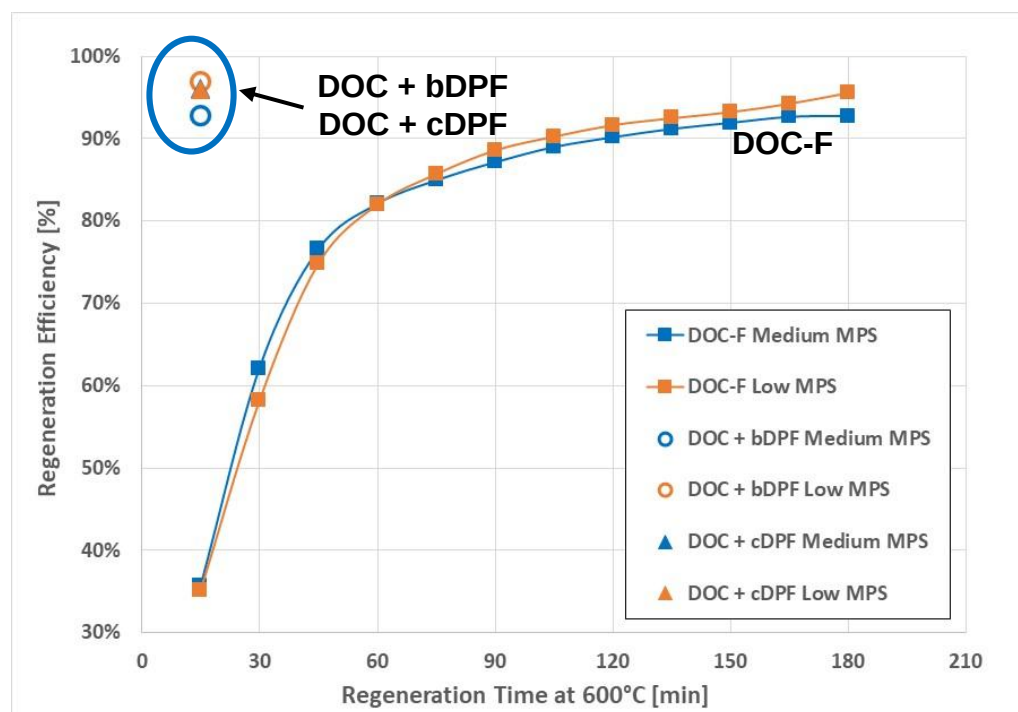
Filter Bed Temperature (°C) Distribution



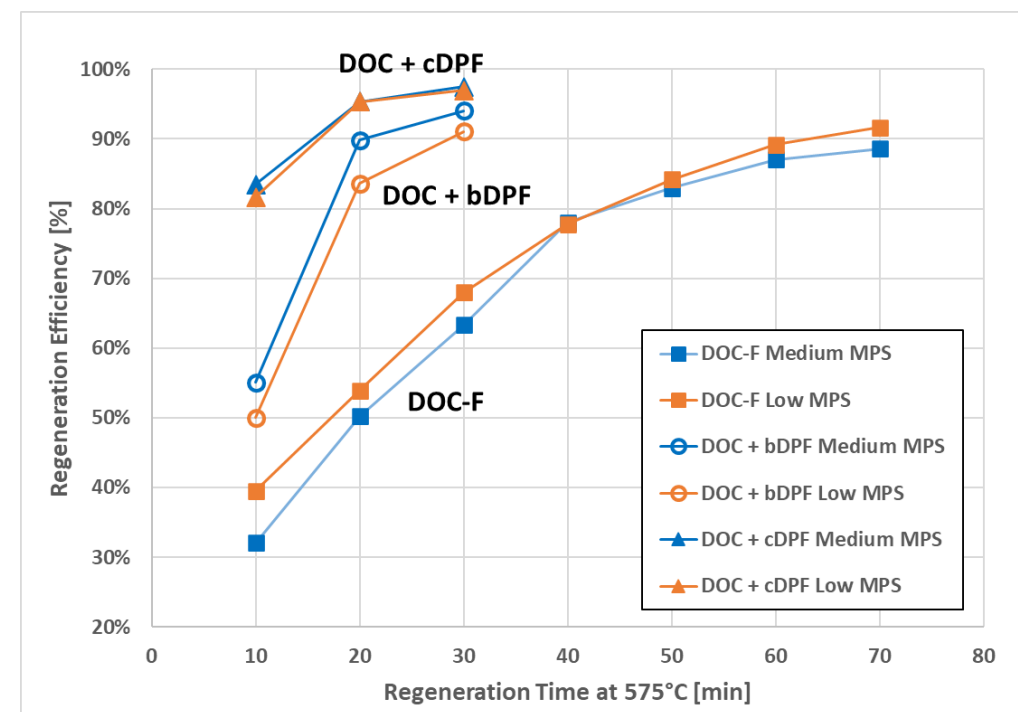
Results – Active Regeneration ...contd.

- Within the given conditions, up to 7x more time needed to regen DOC-F to >90% efficiencies.
- Regen flow, temp, residence time impact DOC-F regen efficiency

Steady-State Regen Efficiencies



Transient Regen Efficiencies



Results – In Summary

Performance Criteria	DOC + bare DPF (common for Tier4F)	DOC + coated DPF (common for most NR & OR regulations)	DOC-on-Filter
Space Saving	Equivalent	Reference	Space Saving
Filtration Efficiency	Can meet requirements (Medium MPS for PM markets)	Can meet requirements (Medium or Low MPS for PN markets)	Can meet requirements (Medium or Low MPS for PN markets)
Component Pressure Drop	Slightly better	Reference	Equivalent
Fully Passive Regen System	Good passive regeneration	Better passive regeneration at wide temp range	Equivalent to DOC + coated DPF
Passive + Active Regen System	Good passive regeneration Good active regeneration	Better passive regeneration Best active regeneration	Better passive regeneration Worst active regeneration

Conclusion

- Improved PN filtration is delivered with the next generation Low MPS filter over the current Tier 4F/StageV Med MPS filter technology, facilitating further PN reduction.
- At a component level, DOC-F is comparable to conventional DOC+filter architectures for pressure drop, passive soot regeneration.
- Efficient active soot regeneration on DOC-F may be a challenge due to multiple functionalities on a single component.
- Best technology pathway for future regulations will depend on space availability, soot regeneration strategy, DeNOx and DeSoot strategies, among other OEM specific considerations.

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