

Retrofit Emission Controls for On-Road Diesel Engines

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www.meca.org
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Strategies to Reduce Emissions from In-Use Diesel Engines

- Retrofit – installing a verified emission control device on an existing diesel engine
- Refuel
- Repair/Rebuild
- Repower
- Replace



Experience with Diesel Retrofits Spans a Variety of On-Road Vehicle Applications...



... Construction Equipment...



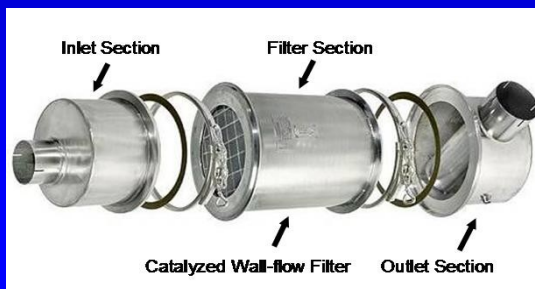
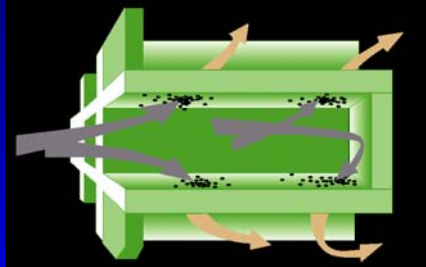
... Mining...



... and Other Off-Road Vehicle and Stationary Engine Applications



Wall-Flow Diesel Particulate Filters Offer the Highest PM Filtration Efficiency



- >85% PM reduction (ARB Level 3)
- Catalyzed DPFs require operation on ULSD
- Large reduction in toxics from catalyzed DPFs
- >200,000 retrofits worldwide
- >5 million OE applications
- Same technology as on MY 2007 OE trucks

Passively regenerated DPFs employ catalysts and available exhaust heat to burn captured soot – specified exhaust temperature requirements



DPFs with Active Regeneration Available for Retrofits



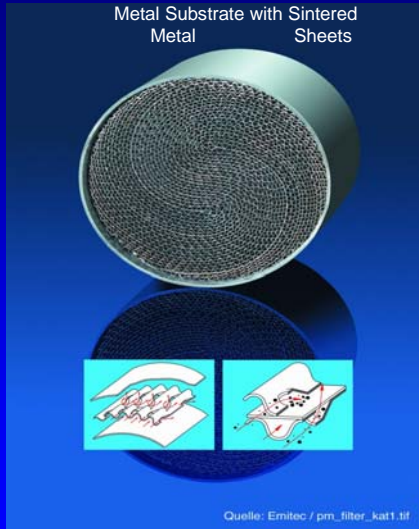
SOOT PARTICLE FILTER SYSTEMS
for mobile diesel engines.
Regeneration without NO_x!



- Suited for on- and off-road applications with low exhaust temperatures, including construction equipment, locomotives, and marine engines
- Example: Uncatalyzed wall-flow filter with electrical regeneration
- Example: Uncatalyzed wall-flow filter with a fuel burner



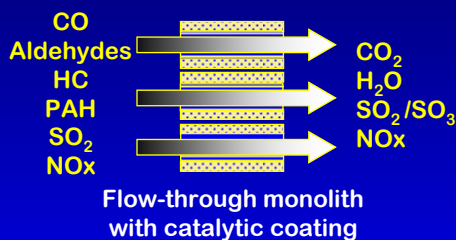
Flow-Through Filter Technologies



- 50-75% PM reduction (ARB Level 2)
- Can be catalyzed or used with a DOC
- Has applicability on older engines
- Resistant to plugging
- Ash cleaning generally not necessary due to open structure



Diesel Oxidation Catalysts

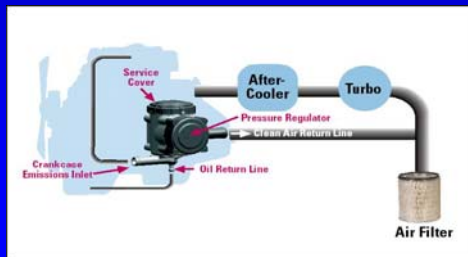


- 25-40% PM reduction (ARB Level 1)
- “Soluble” PM species are oxidized
- Large reduction in toxics
- DOCs have been retrofitted on on- and off-road vehicles for over 30 years
- Nearly universal application with >1 million retrofits worldwide
- Tens of millions of OE applications



Crankcase Filters Can Provide Additional PM Control

- Most existing diesel engines vent crankcase emissions directly to the atmosphere
 - Health concerns related to in-cabin air quality (e.g., school buses)
- Crankcase filters can reduce crankcase PM emissions by 90+%
 - On DPF-equipped vehicles, crankcase PM can represent up to 70% of total PM



Integrated Retrofit Solutions Emerging for Combined PM+NOx Reductions

- Lean NOx Catalyst (LNC) + DPF
 - 25% NOx reduction
- Low-Pressure Exhaust Gas Recirculation (EGR) + DPF
 - 40-50% NOx reduction
- DPF + Urea Selective Catalytic Reduction (SCR)
 - 60%+ NOx reduction



Challenges for Off-Road Retrofits

- Higher emissions than on-road heavy-duty engines
 - Uncontrolled before 1996
- More diverse engine/equipment applications than on-road
 - More older equipment
 - Wide horsepower range
 - Equipment stability
- More rigorous operating environment (vibrations, dust, uneven surfaces)
 - Can require extensive use of high-grade vibration isolators, especially in track-drive equipment
- Packaging constraints
 - Maintaining driver visibility



Policy Choices Have Significant Impact on Development of Retrofit Market

- Incentive funding important to get retrofits on engines early, but won't pay for everything
- Demonstration programs/funding help fill the retrofit verification pipeline
 - ARB/SCAQMD Off-Road Showcase Program
 - Texas NTRD funding for NOx retrofits
- Verification process needs adequate technical resources
- Regulatory certainty defines market opportunity



Summary/Issues

- Retrofit technology provides a cost-effective option for cleaning up PM and NOx emissions from a range of in-use diesel fleets
- A variety of retrofit technologies have been verified by both the U.S. EPA and California ARB for on-road and off-road diesel vehicles and equipment
- Significant experience with retrofit technologies exists for on-road vehicles; retrofit experience is growing for many off-road applications



Summary/Issues

- Application engineering is a necessary step to matching a diesel engine with the correct retrofit solution
 - Even “passive” solutions need maintenance (e.g., filter cleaning, urea for SCR)
 - Retrofit technologies are generally compatible with biodiesel (typically, B20 or less; biodiesel blend needs to meet existing specifications)
- **Successful Retrofits Require a Cooperative Effort Between Fleet Owners, Vehicle Operators, and Technology Providers**



www.dieselretrofit.org

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The purpose of this web site is to provide useful information related to diesel retrofit emission control technology. By making this information available, MECA hopes to assist interested stakeholders in establishing and operating more effective diesel retrofit programs.

The Manufacturers of Emission Controls Association (MECA) is a non-profit association incorporated in Washington, DC. MECA's mission is to provide technical information on emission control technology, thereby facilitating the establishment of strong and effective state, federal, and international air quality programs that promote public health, environmental quality, and industrial progress.

For an overview of this website, please refer to our [Site Map](#).

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