



# An Active Sootfilter Regeneration System for Light Duty Vehicles

## Design and Field Trials

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MDEC 2001



## Agenda

- Motivation
- Design Concept
  - Requirements
  - Features
  - Function & Specifications
- Design Verification
  - Regeneration Performance
  - Field Tests
  - Emission Performance
- Conclusions



## Motivation: Regulations

- **DPM is classified as a carcinogen substance**
- **Anticipated Emission Regulations**
- **MSHA rules of 2001 for Underground Metal and Nonmetal Mines (30CFR Part 57):**
  - Average 8h exposure as of July 2001: 400  $\mu\text{g}/\text{m}^3$  total carbon
  - Average 8h exposure as of Jan. 2006: 160  $\mu\text{g}/\text{m}^3$  total carbon
- **MSHA rules of 2001 for Underground Coal Mines, non-permissible:**
  - 2.5 gr/h DPM as of January, 2005 (HD)
  - 5.0 gr/h DPM as of May 2001 (LD)
- **MSHA approved Diesel Engines under Part 7, Subpart E:**
  - Require DPM filters to obtain 2.5 as well as 5.0 g/h



## Motivation: Limitations of passive filters

- **Active sootfilter systems address the limitations of passive sootfilters**
- **Independent of exhaust temperature**
  - Any duty cycle and any application is feasible
- **Works also for high fuel sulfur level**
  - Sulfur can complicate or prohibit passive regeneration approach
- **Feasible for older / dirty engines**
- **No runaway regeneration possible**
  - Active regeneration is controlled
- **No excessive engine backpressure built-up**
  - Scheduled regeneration of filter



### Design Concept: Requirements

- High filtration efficiency
- Ease of use
- Universally deployable
- Proven concept
- Safe operation



### Design Concept: Features

- Electrical heater and combustion air integral with regeneration control system
- System is protected from overheating by built-in safety features
- Regeneration is controlled and follows a pre-programmed schedule
- System annunciation panel alerts the operator to system status
- Silicon Carbide Substrate



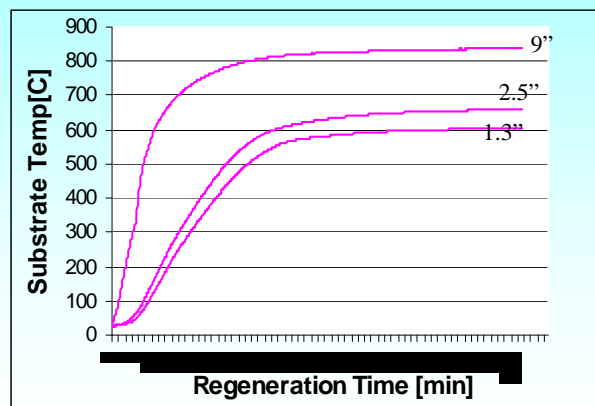
### Design Concept: Function & Specs

- Operation duration of 8 hours
- 40" backpressure
- Exchangeable Filter – no downtime
- 120/240 VAC, 20A
- Compressed air on-site



### Design Verification: Regeneration Performance

Temperature distribution in filter substrate during one regeneration cycle in 9", 2.5", 1.3" substrate depth



### Design Verification: Field Tests

Vehicle: JCB 185 skid steer loader,  
Perkins 1004-4, MY2000,  
DI, NA 70 hp

Operation: 10 hour shift

Start: December 2000

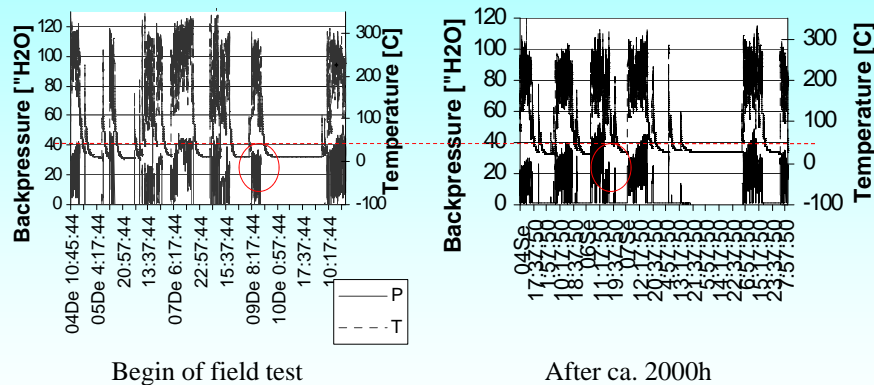
Equipped with:

- SiC Filter
- Data logger
- Backpressure Indicator



### Design Verification: Field Tests

Exhaust backpressure-temperature trace over one week



## Design Verification: Emission Performance

Certification of DCL Sootfilter to BUWAL/VERT protocol

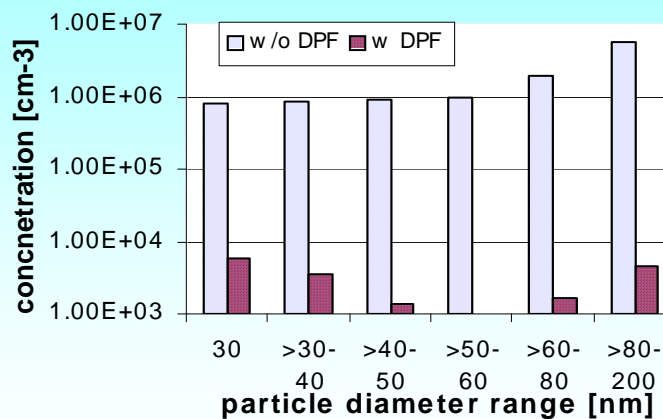
- ISO 8178 C1 test cycle, 4 points
- gravimetric, dilution tunnel, and standard SMPS methods

Total particulate number reduction: >99 %



## Design Verification: Emission Performance

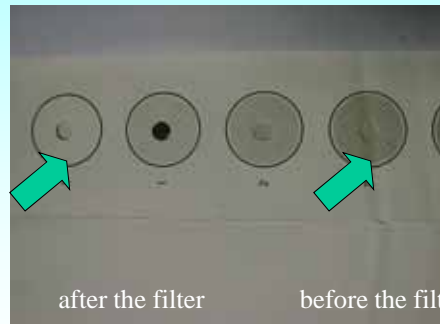
Particle number within particle size group with and w/ DCL filter



## Design Verification: Emission Performance

### On Field Test Vehicle

- Smoke index number based on TÜV-12-RgG-018 smoke test
- High idle



## Conclusions

The DCL active filter system provides:

- effective, reliable, and safe approach to ensure sootfilter regeneration,
- high DPM filtration efficiency, and
- duty cycle independents; thus, broadened window for sootfilter applications

for light duty vehicles, such as tractors and people movers.





**Thank You**

**DCL International Inc.**



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