DPFi Technology Applications
Turning Cold Exhaust into Clean Results

Diesel emission controls for underground light duty vehicles

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Solving DPM Control for Light-Duty Diesel Vehicles Underground

Why Light-Duty Diesel Vehicles Matter

Disproportionate Impact: Even though light-duty diesel vehicles (LDDs) may have smaller engines, they often operate for long hours and in close proximity to workers, making their emissions a significant localized exposure risk.

Population Density: LDDs are numerous and frequently used for personnel transport and maintenance, often deeper in the mine where ventilation is most constrained.

Increasingly strict diesel particulate regulations, but current solutions for light-duty diesel vehicles (LDD) are ineffective and difficult to maintain. In Ontario, the exposure limit is 0.12 mg/m^3.

Standard DPFs fail often on LDDs due to low exhaust temperatures. Modified Toyota Land Cruisers are common in most underground mines

What is needed? Cost-effective, retrofit-ready DPM control solution for LDD vehicles that helps underground mines meet strict exposure limits, protect worker health, and extend vehicle life while maintaining uptime and simplicity.

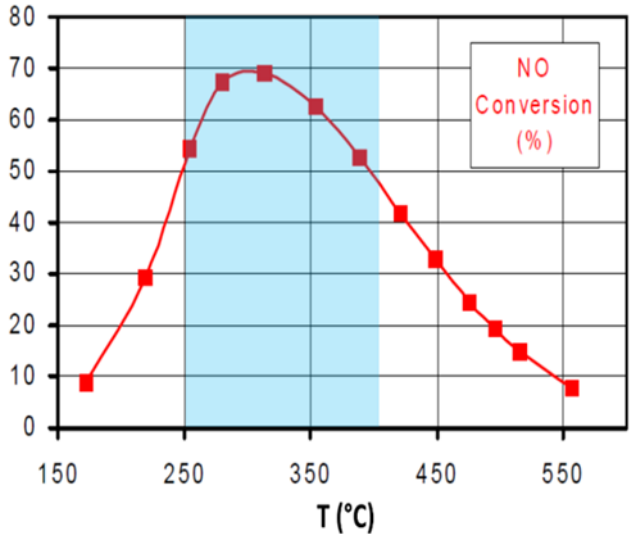
LDD Vehicles Have Proven to be Challenging

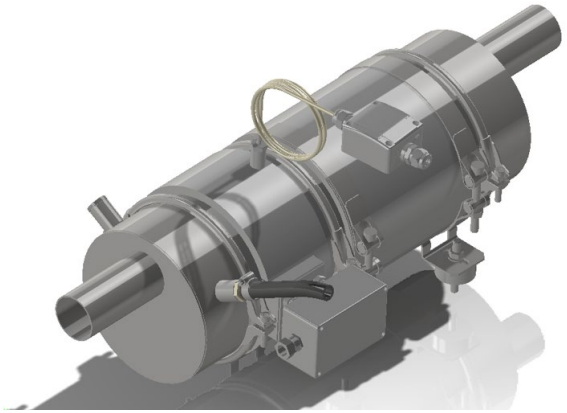
Retrofitting Light Duty diesel-powered vehicles with DPF's proving to be much more challenging.

- Had been perceived as minor contributors to exposure of underground miners to diesel aerosols and gases – we now understand that LDD vehicles can contribute up to 50% of the underground mine DPM load
- Operated over duty cycles characterized by low temperatures that do not favor passive DPF systems
- Disposable filter elements can be plugged with soot within hours.

The DPFi® Electrically Regenerated Filter

- Passive DPF's rely on NO_2 generation
- NO_2 formation needs 240°C+ for 40% of operation time
- LDD engines typically operate at <225°C – too cool for passive regeneration
- Filters can clog quickly—within hours
- The DPFi heater coil module raises the filter temperature to 600°C for about 60-90 minutes, during which oxygen can regenerate the filter to the original cleanliness

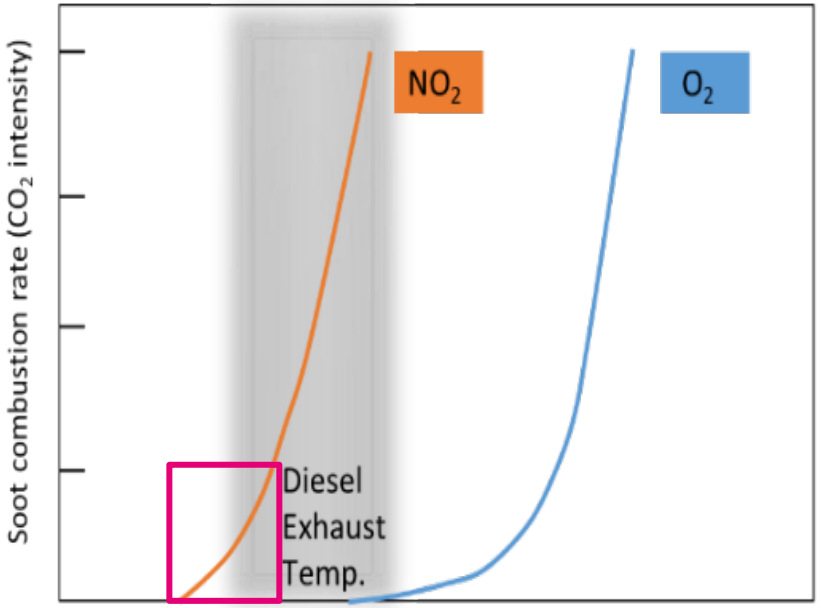


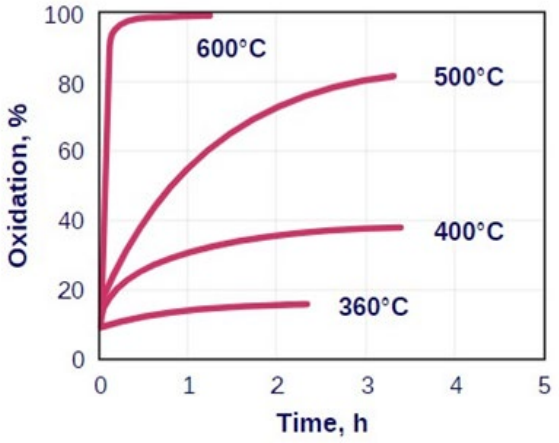


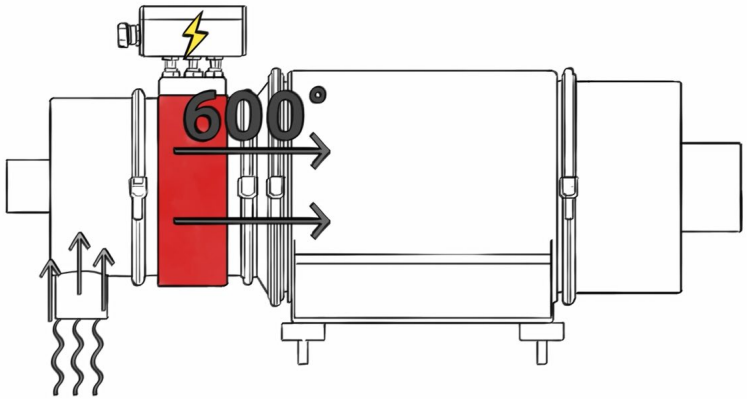
The DPFi® Electrically Regenerated Filter

Hot results for cool running engines

- Integrated electric heater regenerates DPF during downtime.
- Uses oxygen to combust DPM at 600°C over 60–90 minutes.
- Air supplied by vehicle-mounted compressor.







Oxidation of DPM Using Oxygen

Validation of the DPFi Filter System

Turning cold exhaust into clean results

Engine Dyno Test
Validate Design

- DPM rate and CO emissions
- Run the DPFi system on the same engine most common in LDD in underground mines
- Confirm the proper operating characteristics under all operating conditions

Field Trials
Demonstrate System on Toyota Land Cruiser

- Operate the Toyota Land Cruiser through a variety of operating conditions
- Perform multiple regeneration cycles to validate the DPFi filter system robustness

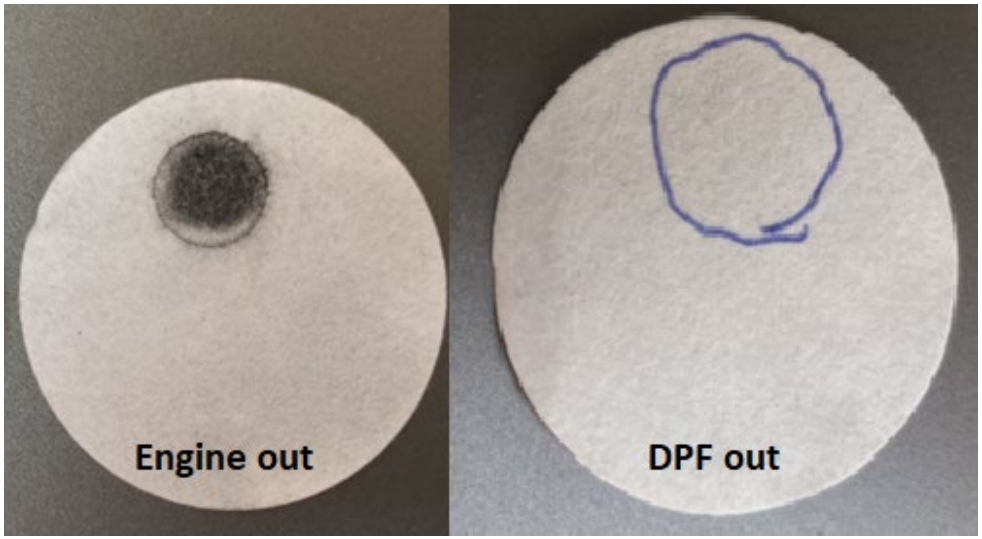
Field Experience
Initial Production

- Operator training for display response and regeneration
- Establish preventive maintenance plan with Mobile Equipment staff
- Determine spare part inventory levels

DPFi Field Trials

Special filter prepared to measure temperature throughout the filter

DPFi Emission Results



	Engine Out	DPFi System Out	Percent Reduction
Smoke Dot	9	0	100%
CO (PPM)	174.6	83.3	52%
NO_2 (PPM)	35.9	11	69%

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MineTerra

Toyota Land Cruiser with DPFi®

Used for mantrips and supply trips in underground gold mine

Production Experience

- Over 1400 hours without DPF swap for cleaning
- Plug truck in every day between shifts to build the habit of using electricity to keep the DPF regenerated

Testing, Review, and Certification

Ventilation Rate

Canada
CanmetMINING

Approved Ventilation Rate

Engine Manufacturer: MineTerra
Engine Model: Toyota 1HZ equipped with MineTerra DPFi module MTFA-11799
Governing Standard: CSA M424.2-90 (Non-Gassy Mines)

Certificate Number	Engine Rating and Fuel Rate at Sea Level	Sulphur in Fuel - ppm	Ventilation Prescription	
			CFM	m^3/s
1363	Toyota 1HZ 129hp (96 kW) @ 3800 RPM, 62.4 lb/h	15	5,000	2.35

Certificate	Engine	CFM	HP	CFM/HP
1363	Toyota 1HZ with DPFi	5000	129	38.8
1342	Cummins QSB4.5 FR95725 Tier 4f, Euro Stage V	5600	133	42.1
1347	Cummins F3.8 FR95678 Tier 4f, Euro Stage V	6200	134	46.3
1313	Cummins QSF 3.8 FR95227 Tier 4f	5500	130	42.3
1335	CAT C4.4 Tier 4f	5600	142	39.4
1355	Deutz TCD3.6L4 C5VI90D	4600	121	38.0

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DPFi Filter Demonstration Conclusions

Rewriting the rules of DPM control for light-duty vehicles

- DPFi system is a viable, proven solution for LDD’s in underground mining.
- Fills gap where passive DPF systems struggle.
- Offers clean, controlled, repeatable DPM reduction.
- Lowering emissions improves air quality faster than increasing airflow, which is expensive and energy-intensive
- Operators can reduce exposures, lower ventilation burdens, and extend the operational life of their diesel fleets while meeting current and future regulations.

Acknowledgements

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