



Base Metals

Photo: James Hodgins



Work with suppliers to ensure the best solutions meet emissions requirements

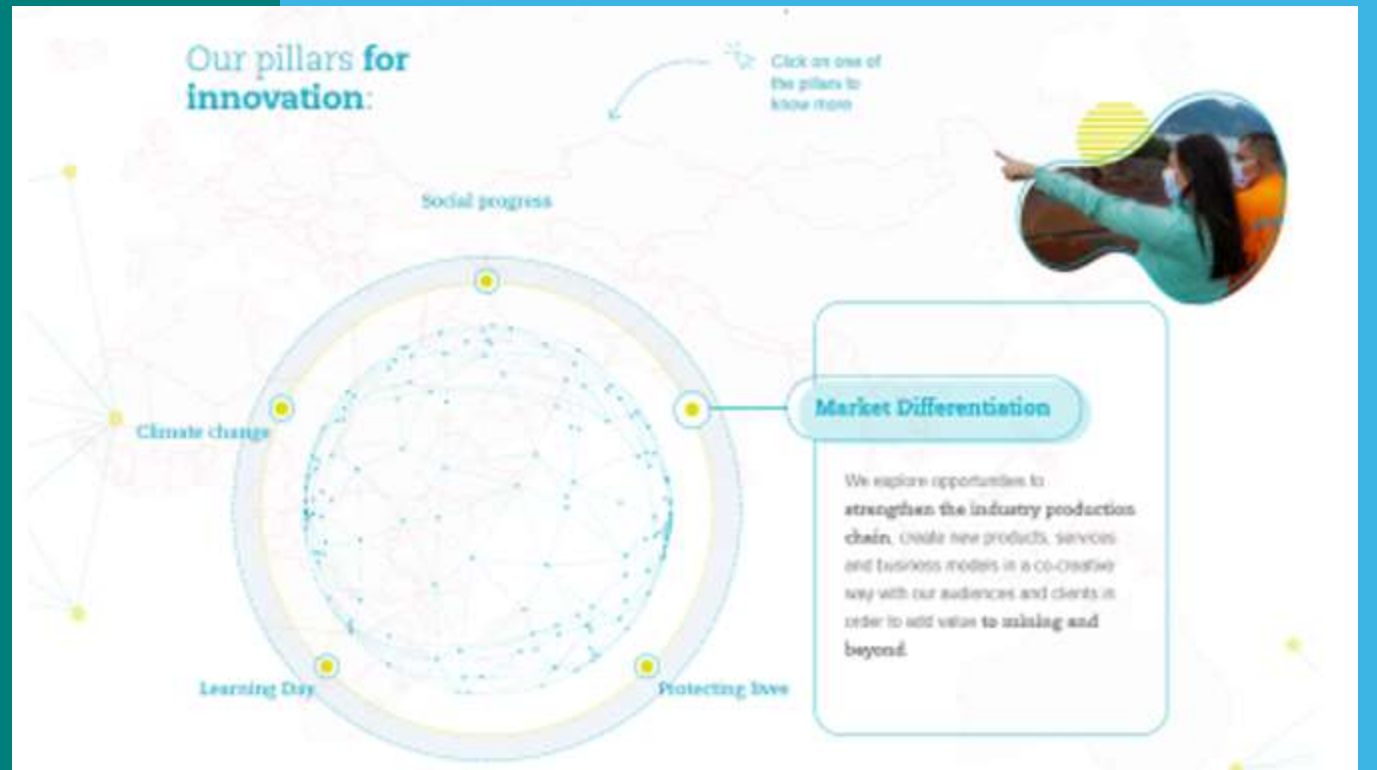


JM Johnson Matthey
Inspiring science, enhancing life

 **MineTerra**
Breathe Easy Underground

 **ALETEK** | BUILT TO PROTECT
AUSTRALIA NORTH AMERICA LATAM INDONESIA

Mammoth 
Equipment and Exhausts

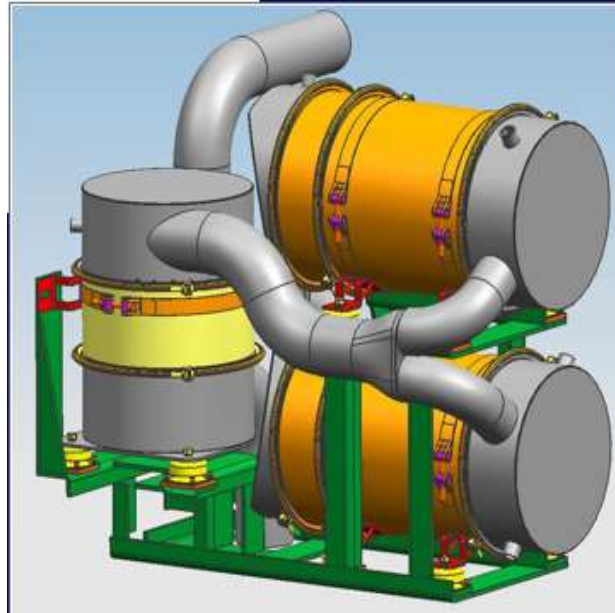


CCMN DPF

Roadmap

2012 Tried the Johnson Matthey Dual MCRT DPF on 515 scoop

- Invasive installation, required removal of one fuel tank.
- Issues with the Gen 1 dosing injector, JM updated injection system with Gen 2 injector and management system.
- Under close scrutiny for NO₂ slip.
- Site champion(Kevin Watson) and excellent support from JM, MIRARCO / Jozef Stachulak, CANMET and NIOSH/USA key to success.



CCMN DPF Roadmap

2015 Started to encounter elemental carbon exposures in main haulage on 3400L

- Tested Mammoth passive DPF on 231 truck.
- Filter performance studied by CANMET.
- Excellent results, embarked on our journey to install DPFs on all of our heavy haulers at time of rebuild.
- Concerns over PAHs raised at SHEEC.
- Filter tested at Southwest Texas Laboratory proven to be safe of PAHs.
- Operators noticed air quality improvements, noise reduction and less fatigue after mucking remote with DPF equipped scoops.
- This truck and filter arrangement was subject to CANMET testing at site using the SEMTECH portable gas analyzer.



CCMN DPF Roadmap

In 2018 CCMN Tried the Mammoth DPF in a Toyota Landcruiser w/1HZ6 Engine

- Installation was simple and fit in OEM arrangement
- Effective DPM reduction
- Soot loaded very quickly



CCMN DPF Roadmap

2022 Vale capital project at CCM to install DPFs on all heavy haulers.

- Completed installation of DPFs on 9 AD30 haulage trucks w/C15VR engines
- Typically, averaging 1500hrs between cleanings.
- Completed installation of DPFs on 7 R1700G scoop trams w/C11VR engines
- Typically, averaging 250-500hrs
- Installed DPF on 1 Cat grader.
- Installed DPF on water truck with a Cat C6.6 engine. Test Failed.

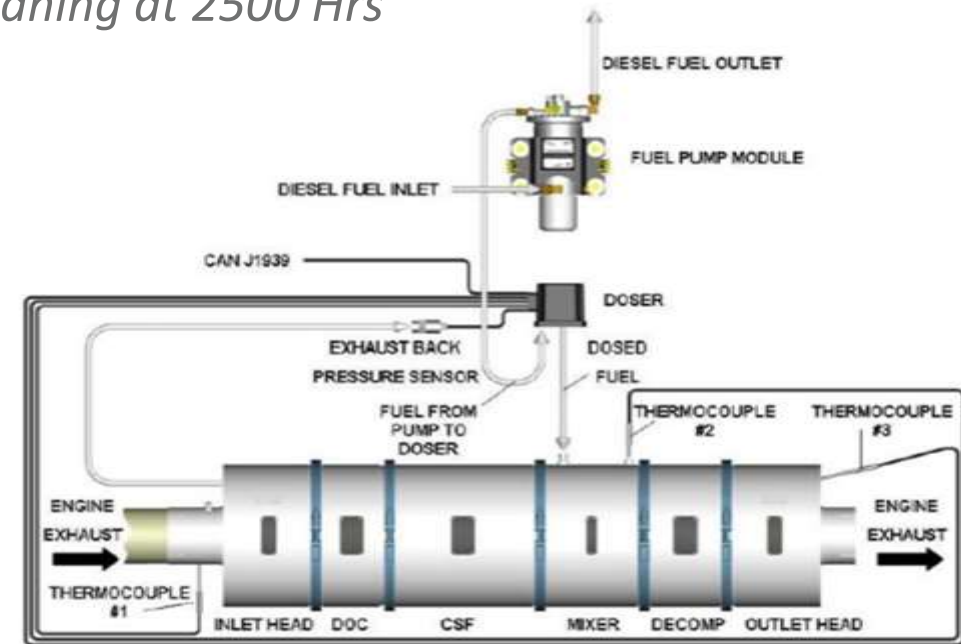




CCMN DPF Roadmap

2023 Testing Single MCRT on R1700G

- *Installed Single MCRT on 539 scoop Cat R1700G, does not require fuel tank removal, Gen 2 dosing injector*
- *Updated the wire harness protection and exhaust flange*
- *First cleaning at 2500 Hrs*



CCMN DPF Roadmap

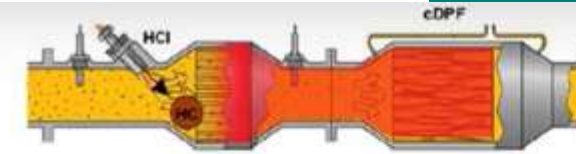


2024 Testing the ALETEK DPF

- *Installed September 2024*
- *Direct fit installation*
- *Mounts directly on to the manifold for highest exhaust gas temperatures*
- *Too early to assess*

DPF Selection

- *Install dataloggers on equipment to determine duty cycle. This will help determine which type of DPF to select for that application.*
- *Look at OEMs and all aftermarket suppliers for best selection.*
- *Understand maintenance requirements and challenges.*
- *Are there any significant changes to mine design in the LOMP, haulage cycles.*
- *Not a one size fits all selection process.*

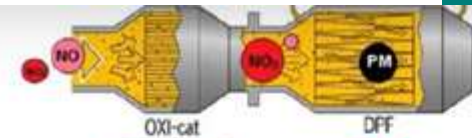


Requirements:

Temp. range: 550...650 °C
O₂-content > 5 Vol%
DOC w/ good HC/CO
performance over life- time



During active regeneration the ECU controls the fuel injections to increase the exhaust temperature to burn off the accumulated soot.



Requirements:

• Temp. range: 250. 350 .450 °C
• NO₂/ PM ratio > 12
• DOC w/ high NO/NO₂
performance over life- time



During passive regeneration the filter regenerates continuously during the regular operation of the engine, the source of heat is the exhaust gas stream itself.

Example- Vehicle running in continuously in highway at high loads



Emissions Testing

- *Establish baseline numbers for each piece of equipment when installing a DPF for future use when trouble shooting.*
- *ECOM test pre and post w/soot.*
- *DPM test and back pressure test.*
- *Testing to be preformed at regular service intervals.*

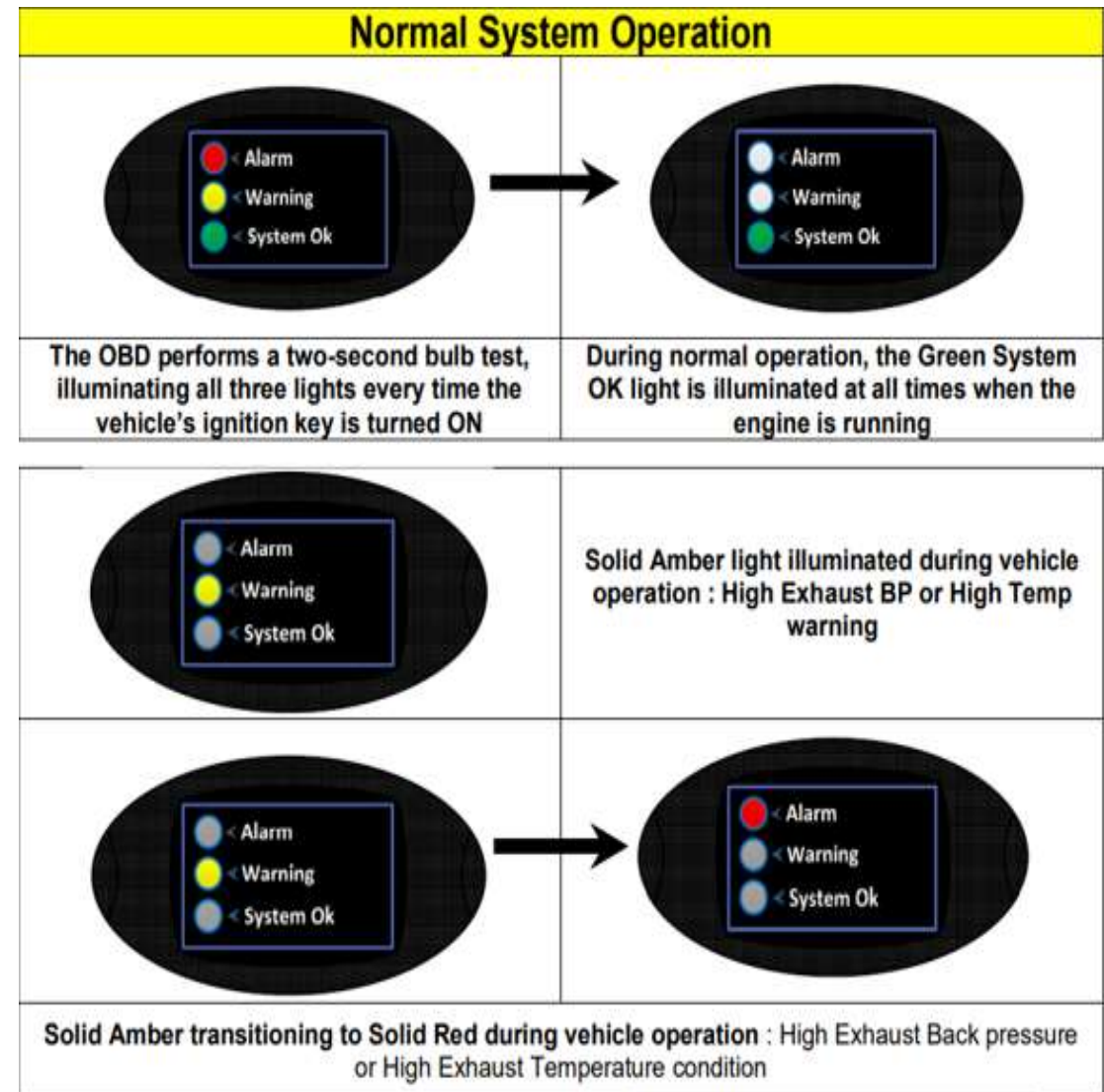


Operational Challenges

Idle time-One of the worst operational practices for DPFs is high idle time, in the past we used to average 25% idle time and that has risen to around 35% best case.

Operating outside of the set backpressure limits, we have equipment that continues to operate despite high back pressure warning lights.

Operator engagement through change management process.



DPF Maintenance

- *Engine maintenance and tuning is critical*
- *Inspecting turbo and waste gate operation, scheduled changeouts.*
- *Injector maintenance and scheduled changeouts.*
- *Valve sets.*
- *Exhaust gas, soot tests and backpressure*
- *To be performed at regular maintenance intervals.*
- *Soot and backpressure tests are a strong indicator of DPF health.*
- *Soot test scoring high on the Bacharach scale indicates DPF failing/damaged substrate.*
- *High backpressure indicates DPF is soot loaded and requires a clean or replace.*
- *Maintenance team engagement and training*



Successes

- *Healthier environment for our employees.*
- *DPF trials with vendors and CANMET support.*
- *Best prepared Vale mine for new regulations.*
- *Leading change.*

Challenges

- *Operator buy in, idle time and reporting backpressure warnings.*
- *Maintenance team buy in, understanding the systems and the requirement for thorough accurate testing.*
- *Filter testing, set criteria for testing and measuring outcome.*
- *Maintenance costs and downtime.*



Questions?

