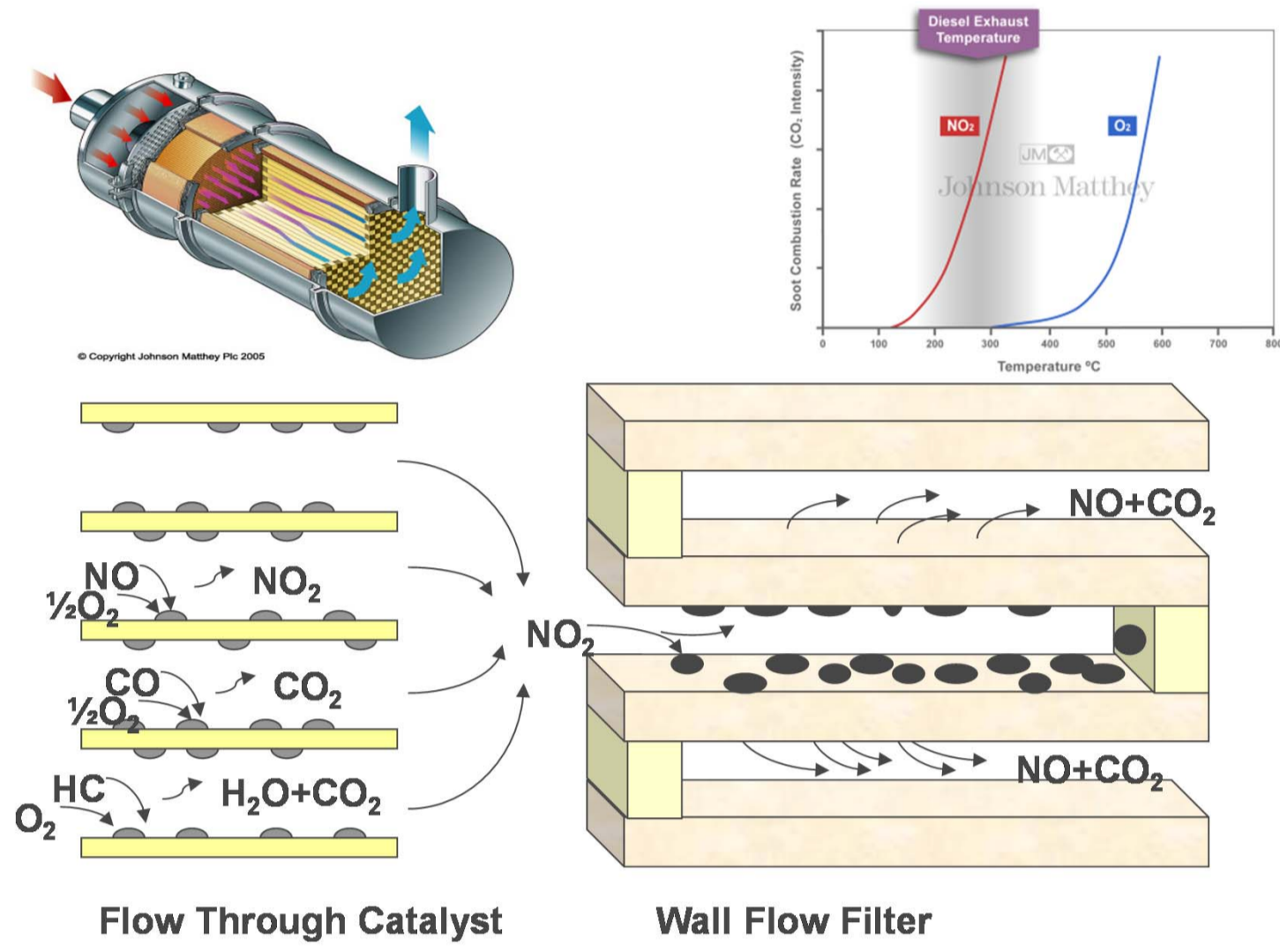
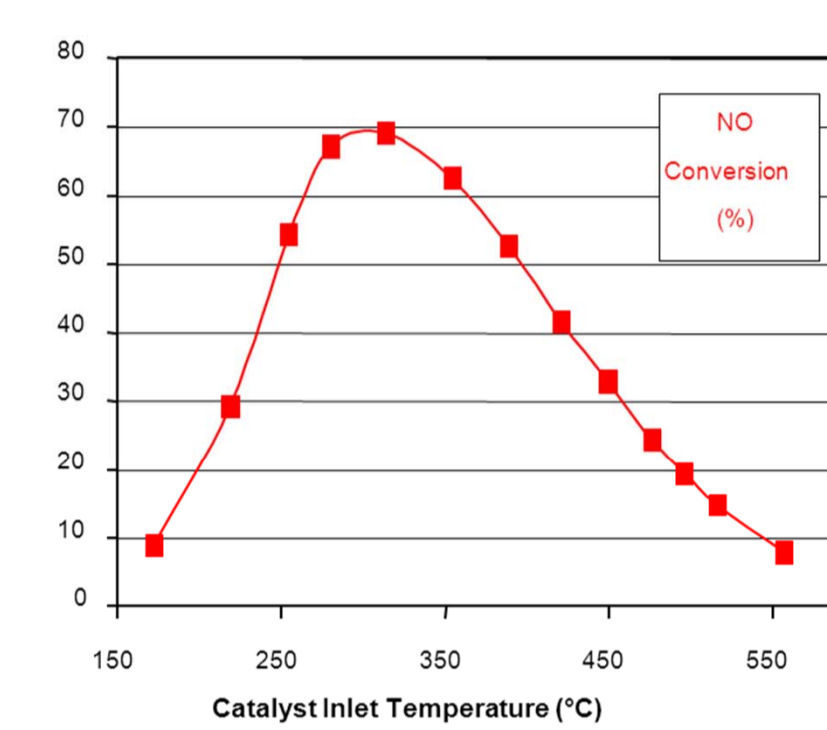
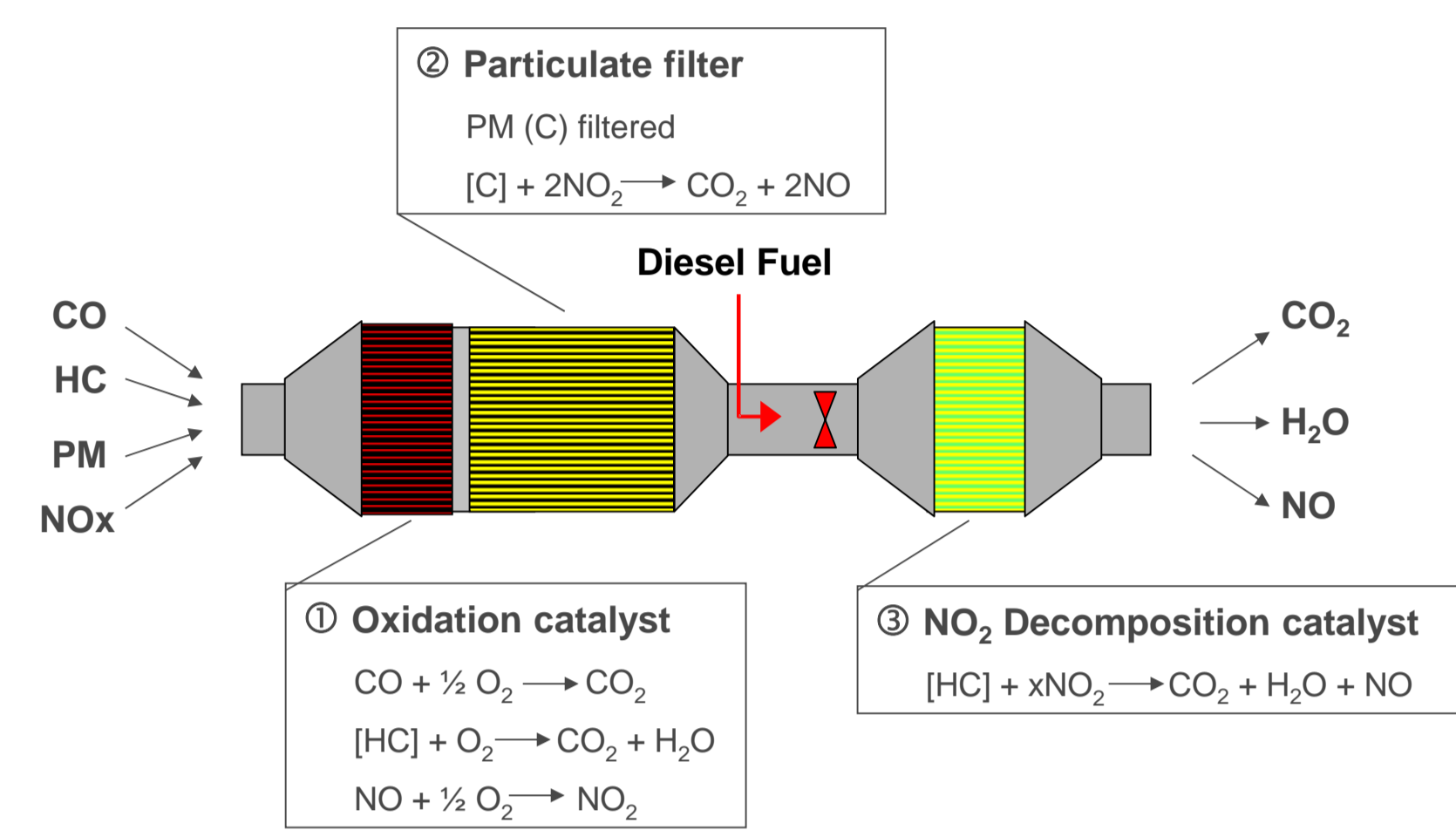


Progress toward an operational DPF for retrofitting heavy duty engines

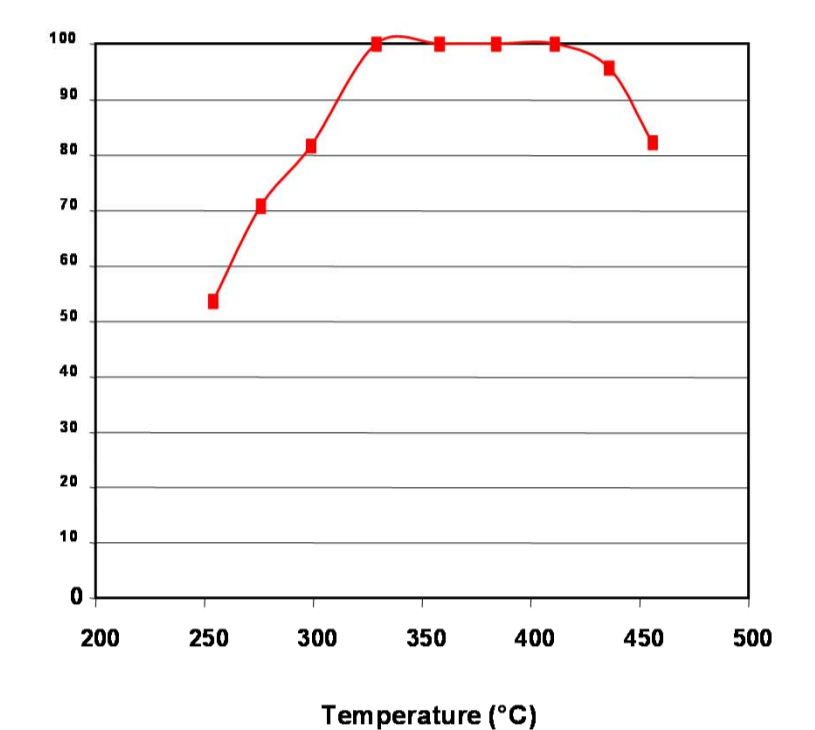
Joe Stachulak, Vale/Mirarco, Canada / Peter Werth, JM, Germany



THE LOW NO₂ "MINING" CRT® SYSTEM



NO to NO₂ over CRT® catalyst



NO₂ to NO over decomp catalyst

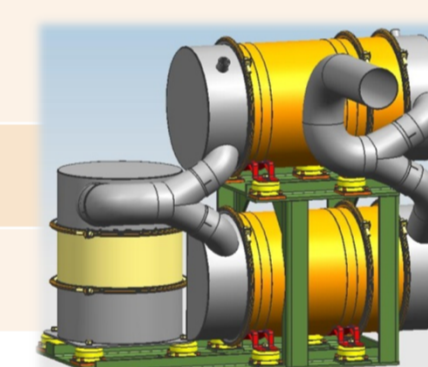
Similar system approved by CARB/EPA for bus/truck retrofit in US

Engine type

Machine manufacturer	Caterpillar
Machine type	Scoop tram R1700G
Engine manufacturer	Caterpillar
Engine type	C11
Engine certification	EPA TIER 3
Engine power	263 kW
Engine speed	1800 RPM
Engine displacement	11,1 Litres
Number of cylinders	6, in line
Aspiration	Turbo charged and aftercooler
Exhaust gas volume	3.143 m ³ /hour / 1500 kg/h
Exhaust gas temperature	460-470°C
Fuel	Diesel fuel, max.15 ppm Sulphur

DPF Filter Type

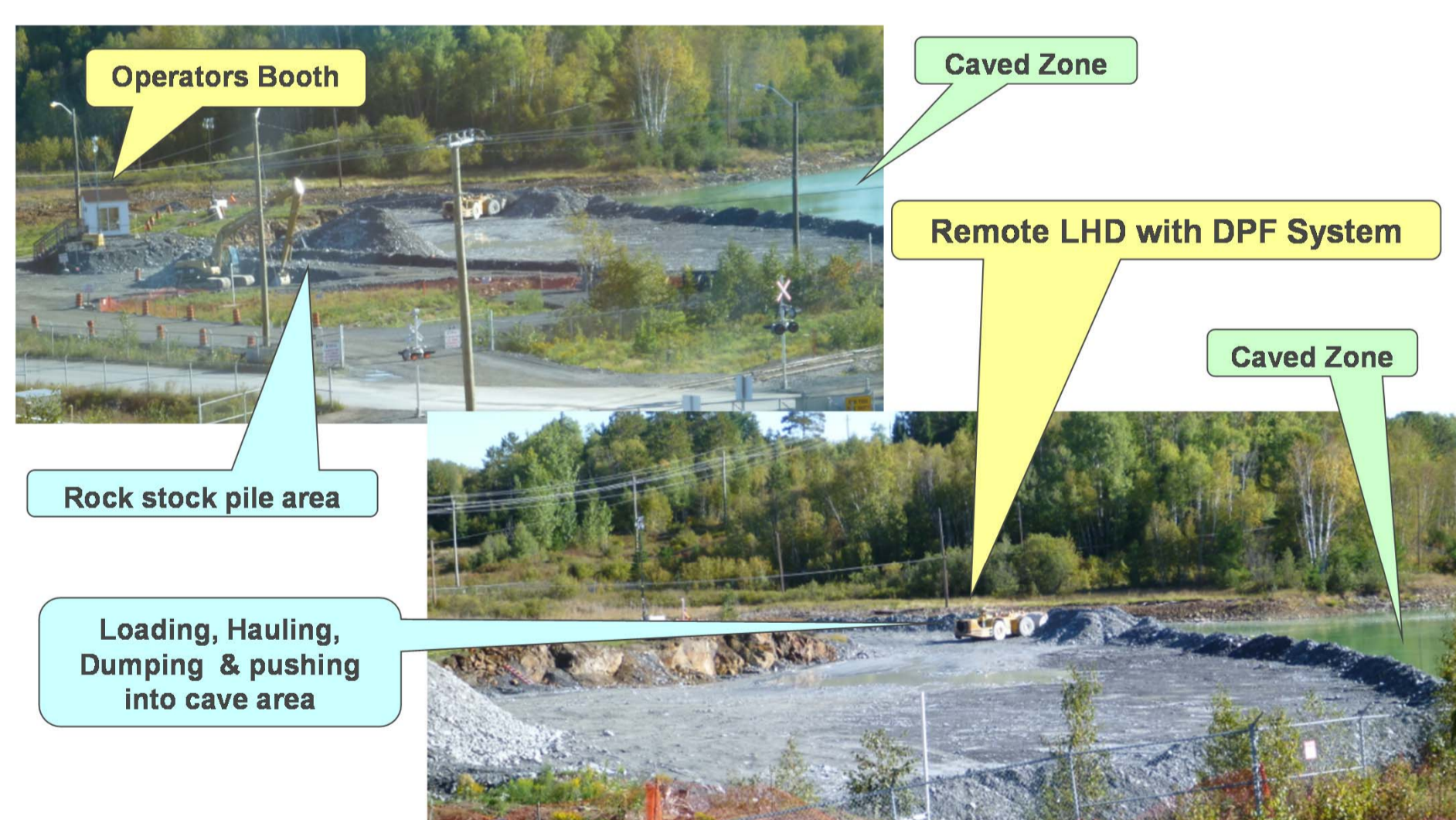
Filter type:	Johnson Matthey Mining-CRT 2 x 2012SL
Regeneration:	Catalytic, continuously during operation
Requirements:	ULSD Fuel, S< 50ppm Exhaust gas temperature >250°C for >50% of the operational time
Particulate reduction:	> 99% by particulate number
NO ₂ , CO and HC reduction:	Reduction
Filter body:	Stainless Steel



Totten's Mine Test Cycles

LHD Operation on Surface (Remote Control)

- Load from ground stock pile
(~ 200,000 tons to-date, 1200 hrs of operation)
- Haul on remote control some 100 to 1000 feet
- Dump material into old cave area on surface



Phase 2 – Results to Date

RESULTS & COMMENTS

- No operator involvement for DPF regeneration; normal operations
- Over-all the system operated very well with little maintenance & down time
- Operators need to minimize idle time to less than 20 minutes/hour due to < 250°C temperature which do not regenerate and cause accelerated plugging of filters
- DPF system was overhauled at 1200 hrs of operation

Totten Mine Test Site



Phase 2 – Surface Operations Summary

- Mining-CRT function successfully demonstrated
- Outstanding DPM reduction (smoke #9 reduced to 1)
- NO₂ tailpipe out is less than engine out emissions
- System is ready for Phase 3 (underground production testing)

