JM

Johnson Matthey particulate filter solutions for diesel engines

Keep the power on and the air clean

Johnson Matthey
Inspiring science, enhancing life

CRT passively regenerating filter technology

48-filter CRT system

Diesel engines are essential for prime and emergency power generation, but diesel exhaust contains harmful particulate matter (PM). The diesel particulate filter (DPF) effectively traps PM, preventing it from entering the atmosphere.

Wall-flow in a DPF
Exhaust flows through channel walls, effectively trapping PM

Passive vs active filter regeneration

Regeneration is necessary to prevent soot accumulation that increases backpressure. Soot is removed from the filter by reaction with NO_2, or by reaction with O_2:

- **Passive regen** – Soot reacts with NO_2 at typical diesel exhaust temperatures. But a catalyst is required to form NO_2 from engine NOx.
- **Active regen** – O_2 reacts with soot at temperatures higher than those of typical diesel exhaust and heat must be supplied.

CRT(+) system

Johnson Matthey's **CONTINUOUSLY REGENERATING TRAP (CRT®)** technology combines a diesel oxidation catalyst (DOC) with a DPF to trap PM from diesel exhaust, while removing CO and HC. The DOC converts part of the engine NOx to NO_2 which reacts with soot to passively regenerate the filter.

Benefits:

- Level 3+ CARB verified
- Reduces PM up to 99%, tailpipe NO_2 within 20% of engine-out value
- No supplemental energy needed
- Compatible with ULSD and biodiesel
- Critical or hospital grade silencing

2-filter, low profile CRT system

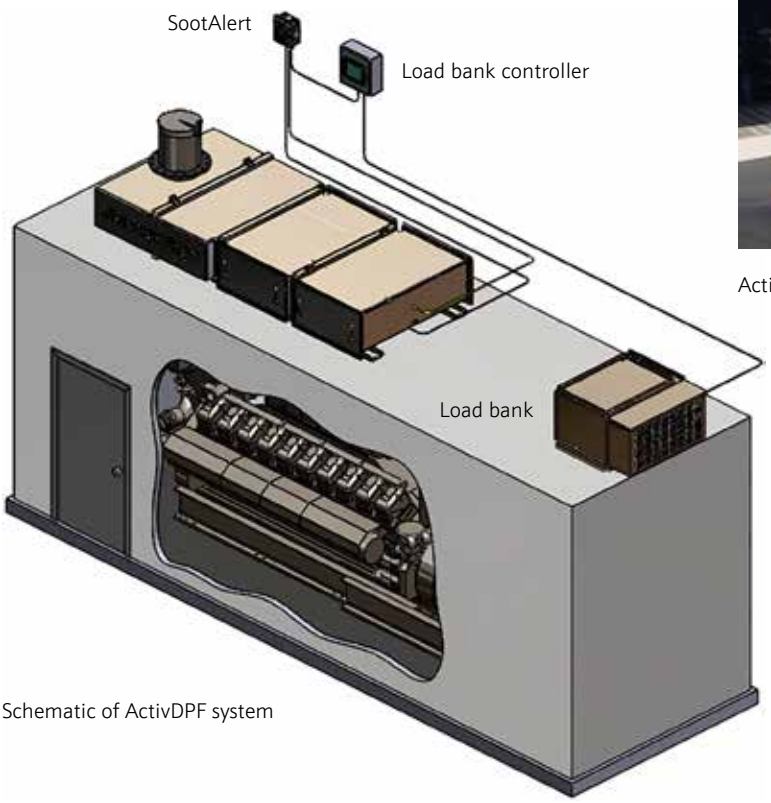
Johnson Matthey was the first to develop and patent the CRT technology. Millions of CRT systems have been installed on on-road and off-road vehicles and equipment, as well as stationary engines which range in power from 40 kW to 4 MW. Over 600 CRT systems have been installed on stand-by diesel generators used for emergency power at facilities such as hospitals, schools and data centers in California alone.

ActivDPF actively regenerating filter technology

ActivDPF system

Johnson Matthey's **ActivDPF™** system integrates the CRT system with a load bank for reliable filter regeneration when there is insufficient load for passive regeneration. The ActivDPF delivers the same benefits as the CRT system, plus:

- Exercising of the engine at loads recommended by engine manufacturer prevents wet stacking
- **SootAlert™** integrated with load bank controller monitors backpressure to automatically adjust engine load for filter regeneration
- Low capital cost compared to other active systems
- Low operating cost - fuel is only consumed during infrequent filter regeneration
- **ActivCRT™** is a CARB-accepted active solution



Schematic of ActivDPF system

SootAlert Monitor

Patented data logger and backpressure monitor indicates when and how long to regenerate the DPF

Features:

- 5 years data storage
- Easy HMI interface
- Remote monitoring
- 110 VAC or 24 VDC
- Alerts operator when
  - Regen Required Soon
  - Regen Required Now
  - Regen Complete

ActivDPF on 400 kW genset using 200 kW radiator-cooled load bank

SCRT systems for US EPA Tier 4F compliance

SCRT system

Johnson Matthey's **SCRT®** system integrates Selective Catalytic Reduction (SCR) with CRT technology to reduce NOx, CO, HC and PM from diesel exhaust. The **SCRT** system reduces emissions to comply with the US EPA Tier 4F, or even more stringent standards.

SCRT system features

Flexible packaging:

- Single-box housing allows single-lift placement onto roof
- Multi-component can be configured to fit into tight spaces, vertical or horizontal orientation

System control package:

- Alerts operator when and how long to regenerate the DPF
- Delivers precise quantity of urea or ammonia for optimum NOx reduction
- Monitors critical system parameters for safe and efficient operation

Noise attenuation:

- Hospital-grade or extreme attenuation

SCR catalyst:

- Extruded **SINOX®** honeycomb catalyst
- Pre-installed in element frames for durability and easy handling

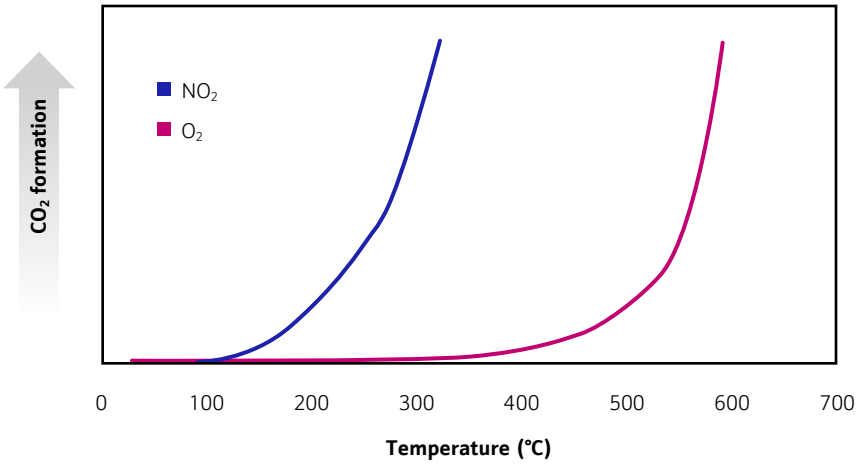
SCRT in single box housing

Multi-component SCRT

Pollutant	SCRT reduction efficiencies
NOx	>90%
PM	Up to 99%
CO	Up to 90%
HC	>70%

The SCRT is sized for stationary engines and gensets 100 kW to 4 MW.

ActivDPF vs other active DPF technologies



NO_2 and O_2 react with soot to form CO_2 and water vapor:

- Reaction of soot with NO_2 occurs at lower temperature, requiring less energy
- Combustion of soot with O_2 occurs at higher temperature, requiring more energy

Feature	ActivDPF system	Other systems
System description	DOC, filter, and load bank	Filter only
Product technology	Integrated load bank increases engine load	Filter heated by electrical resistance
Regeneration mechanism	Soot reacts with NO_2 that is formed over the DOC	Combustion of soot with O_2 at higher temperature
Energy consumption	Regeneration requires less energy	Regeneration requires more energy
Regeneration frequency	Only when needed	Continuously
Conversion of CO, HC	DOC converts CO, HC	Catalyst must be added for CO, HC conversion
Exercises engine per OEM recommendations	Prevents wet stacking to ensure reliable power generation	Operation can result in wet stacking, more maintenance
Value engineering	Single load bank shared between multiple gensets	Regeneration technology required on every single genset
Cost of ownership (capital and operating)	Lowest	Highest

SootAlert Monitor is standard on all ActivDPF and SCRT systems

- Remote monitoring of single or multiple gensets
- Easy access to historical data
- Remote data retrieval through internet/network connection

About Johnson Matthey

Johnson Matthey is a global leader in science that enables a cleaner and healthier world. With over 200-years of sustained commitment to innovation and technological breakthroughs that improve the function, performance and safety of our customer's products. Our science has a global impact in areas such as low emission transport, pharmaceuticals, chemical processing and making the most efficient use of the planet's natural resources. Today more than 13,000 Johnson Matthey professionals collaborate with our network of customers and partners to make a real difference to the world around us. For more information, visit www.matthey.com

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