Comparison of Diesel Particulate Filter Types Used in Underground Mining

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Outline

- Introduction
- Precious Metal Coated DPF
- Precious Metal DOC + DPF
- Base Metal Coated DPF
- Low NO_2 DPF
- Flow-Through Filters
- Test Results

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Introduction
Oxidation Mechanisms

- Two oxidation mechanisms;
  - NO_2 Oxidation
    - High loading DOC is upstream the DPF to produce NO_2 from the ~90% engine out NO
    - NO_2 oxidizes soot at low temperatures: 260-320°C
    - NO_2 consumption depends on soot load and that makes tailpipe NO_2 emissions uncontrolled
  - O_2 Oxidation
    - Two catalyst families;
      - Precious Metal Catalyst: reduce BPT to 300-360 °C
      - Base Metal Catalyst: reduce BPT to 375-420 °C

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Filter Balance Point

Balance Point: (PM Consumed) = (PM In) - (PM Out)

Back-Pressure Increases: (PM Consumed) < (PM In) - (PM Out)

Back-Pressure Decreases: (PM Consumed) > (PM In) - (PM Out)

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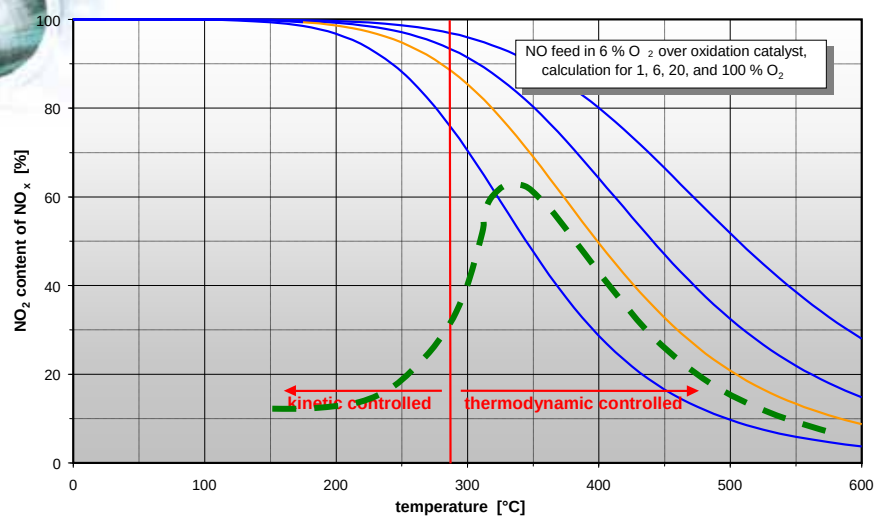
NO + O2 ←→NO2 Equilibrium



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Precious Metal Coated DPF

- Precious Metal catalyst on DPF uses O_2 oxidation
- Used on high load equipment
- Precious Metal catalyst generates NO_2 – possible slip
- Overall exposure level of NO_2 should be monitored closely as DPF are introduced to mine

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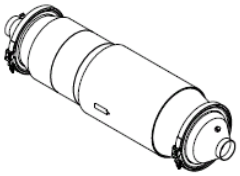
Precious Metal DOC + DPF

- Precious Metal DOC creates NO_2 for NO_2 oxidation
- Used on medium load equipment
- NO_2 slip occurs when there is no soot to oxidize
- Overall exposure level of NO_2 should be monitored closely as DPF are introduced to mine



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Base Metal Coated DPF

- Base Metal catalyst on DPF uses O_2 oxidation
- Used on high load equipment – highest temperature requirement
- Base Metal catalyst does not generate NO_2
- Used in coal mines or other NO_2 sensitive areas

Low NO_2 DPF

- Catalyst on DPF uses O_2 oxidation
- Used on high load equipment – high temperature requirement
- Catalyst does not generate NO_2
- Used in NO_2 sensitive areas and mines

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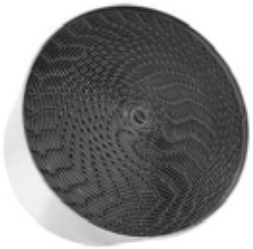
Flow-Through Filters

- Depending on design, may use NO_2 or O_2 oxidation
- Designed not to plug up if regeneration temperature are not met for extended period of time
- NO_2 slip possible
- Lower PM efficiency than Wall-Flow Filters



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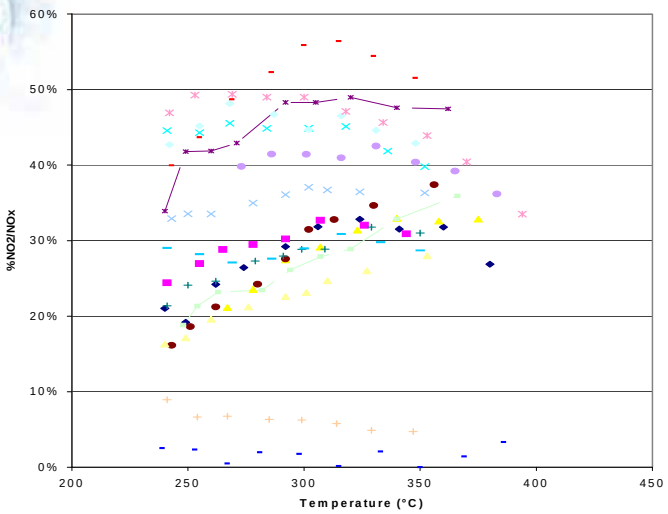
NO_2/NO_X Testing of Various Coatings



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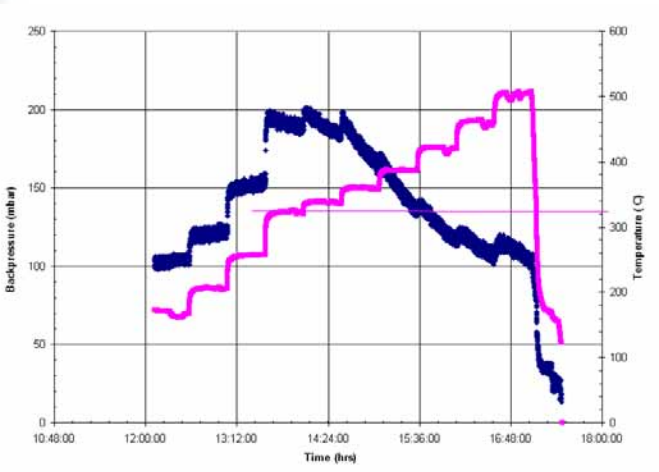
Balance Point Test for Precious Metal DOC + DPF



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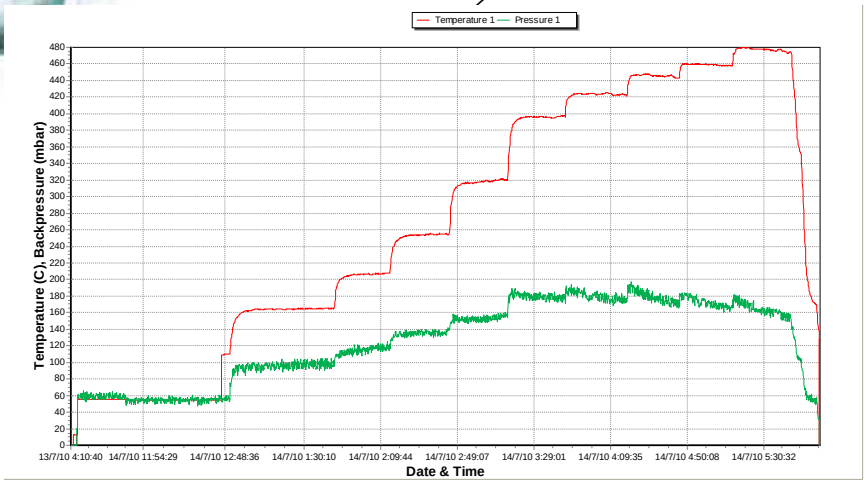
Balance Point Test for Low NO_2 DPF



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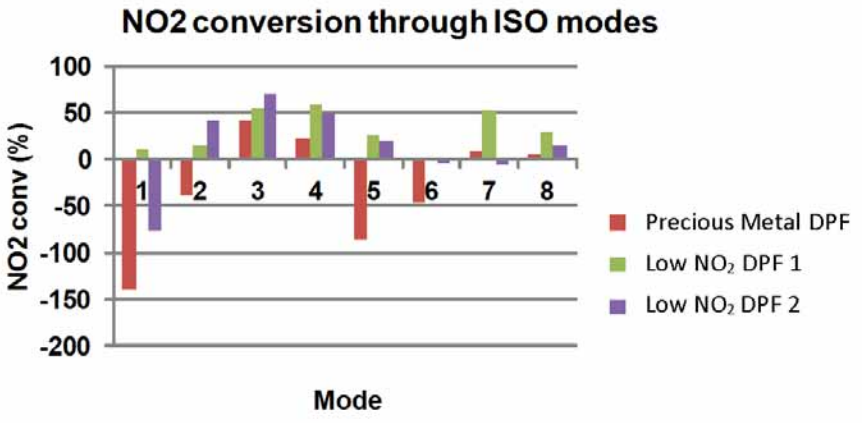
NO_2 Conversion for Precious Metal DPF and Low NO_2 DPF



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Summary

Properties	Precious Metal DPF	Precious Metal DOC + DPF	Base Metal DPF	Low NO_2 DPF	Flow-Through Filter
Conversion Efficiency – Particulate matter by mass	85-95%	85-95%	85-95%	85-95%	<60%
Conversion Efficiency – CO	90%	90%	0%	~50%	90%
Conversion Efficiency – HC	60-80%	60-80%	0%	~50%	60-80%
Effects on NO_x	NO_2/NO ratio may increase	NO_2/NO ratio may increase	No change in the NO_2/NO ratio	No change in the NO_2/NO ratio	NO_2/NO ratio may increase
Typical Balance Point Temperature	300 - 360 °C	260 - 320 °C	375 - 420 °C	320 - 400 °C	260 - 320 °C

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