Options for PM, Dioxin/Furan and Mercury Control Using ePTFE Technologies

McIlvaine Hot Topics
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Agenda

- Overview of W. L. Gore & Associates
- ePTFE membrane filtration for PM/PM$_{2.5}$
- REMEDIA Catalytic Filtration System for D/F
- Carbon-Polymer Composite Material for Hg
- Conclusions
Overview of W. L. Gore & Associates
Company Overview

- Founded in 1958
- Inventors of ePTFE membrane (patented in 1963)
- Associate-owned
- 8,500 associates
- 45 plants and sales locations globally
- Manufacturing in U.S., Germany, Scotland, Japan, and China
- Sales of approx $3 billion in fiscal 2010
- Ranked in the U.S. and Europe by Fortune Magazine as one of the top 100 company's to work for
Gore’s Four Divisions

- Electronic products
- Industrial products
- Medical products
- Fabrics
e-PTFE membrane filtration
What is Membrane Filter Media?

- ePTFE Membrane
- Fabric (Fiberglass or felt)
- Proprietary Lamination Process

Result: ePTFE Membrane Laminate
GORE® Filter Laminate
Gore In House Efficiency Testing on TSI Model 3160

- Gore Membrane/PPS #1
- Gore Membrane/PPS #2
- Gore Membrane/PPS #3
- Gore Membrane/22oz FG
- Other Membrane/PPS
- Coated PPS felt
- Standard PPS felt
- Standard Polymide Felt
PM Emissions Potential (based on USEPA ETV Data)

- Inlet dust concentration = 8 gr/dscf (+/- 1.6 gr/dscf)
- Outlet particle concentration (Total) = 0.0000073 gr/dscf (detection limit)
- Outlet particle concentration (PM$_{2.5}$) = 0.0000073 gr/dscf (detection limit)
- Calculated Efficiency = 99.99991%
- Disclaimers
  - This is a flat sample of laminate, not a finished filter bag; bag fabrication and bag installation introduce potential sources for leakage
  - This is a controlled laboratory test done at ambient conditions with a test dust
  - Results in a field application may be substantially different
GORE® Filter Bag with seam tape
GORE® REMEDIA® Catalytic Filtration System
GORE® REM EDIA® Catalytic Filter System
The Combination of Two Proven Technologies:
Surface Filtration

- Controls Fine Particulate
- Protects Catalyst
- Reduces Adsorbent Requirement
- Reduces Pressure Loss

SEM of ePTFE Membrane (x 3000)
Catalytic Filtration: Dioxin/Furan Destruction

- Catalyst Integrated into PTFE Fiber
- Proven Destruction of Dioxin
- Easy to install and use
**GORE® REMEDIA® Catalytic Filter vs. Adsorption**

**Adsorption Process**
- Raw Gas
- Activated Carbon
- Highly Contaminated Dioxin/Waste
- <0.1 ng/Nm³ Dioxin

**GORE® REMEDIA® Catalytic Filter System**
- Raw Gas
- Less Waste to Landfill
- >90% Dioxin Destroyed
- <0.1 ng/Nm³ Dioxin
Worldwide Proven Performance

![Bar chart showing dioxin levels (ng TEQ/Nm³) before and after Remedia treatment for various locations: TLB, IVBO, Karume, Ashibe, Phoenix, and Kasugai. The chart indicates significant reductions in dioxin levels after the Remedia treatment.]
D/F Emissions Reduction Potential with GORE® REMEDIA®

- Typical destruction efficiency for GORE® REMEDIA® is 90% to 99% based on inlet D/F concentrations of 1.0 to 10.0 ng/dscm.
- For a low inlet concentration (less than 0.1 ng/dscm), the expected efficiency would be between 50% - 90%.
- D/F emission limits of 0.004 ng/dscm for an existing source or 0.002 ng/dscm for a new source may be achievable with GORE® REMEDIA® depending on the inlet D/F concentrations.
Gore Carbon-Polymer Composite Material for Mercury Removal
Gore’s Mercury Removal Technology

- Gore’s carbon-polymer composite (CPC) tape material:
  - Activated carbon (chemically treated) and fluoropolymer composite tapes
  - Applied in stationary bed configurations
  - Will *not* be saturated by SOx or other acid gases, therefore, no frequent bed regenerations are required
Gore’s Mercury Removal Technology (Cont’d)

- Gore’s carbon-polymer composite (CPC) material (continued):
  - Flue gas conditions: low temperature (<100°C) and humid (>50%RH)
  - SOx and other acid gases are converted into aqueous acid solutions and expelled to the CPC tape’s outer surfaces, then collected
  - Hg are fixed on the carbon surfaces with high capacity (>1.0 wt%), long-term operation before sorbent saturation by mercury
  - CPC tapes are made into modular forms with low pressure drop
Small Scale Field Demonstration

- Plant Yates Demonstration (II) – Sorbent Module (Aug. - present)
  - The demonstrations were jointly carried out by Gore, EPRI, URS, and Southern Company
  - Tests were done at Southern Company’s Plant Yates power station
  - Slip stream flue gas was taken after limestone wet scrubber (from stack)

- Temperature: ~123F (51C)
- Humidity: 100%
- Flow Rate: 13.0 and 24.7acfm (5 and 9.5ft/second linear velocities)
- Carbon tape: eight 6” deep, 3.8” diameter cylindrical modules
- Testing date: July 31, Aug 30, Sept 16, Oct 26, Nov. 29
Small Scale Field Demonstrations (continued)

![Graph showing Mercury Removal over Operation Time (Days)].

- **Mercury Removal**
  - **Total Hg Removal - Six Modules**
  - **Total Hg Removal - Eight Modules**

**Operation Time (Days)**

**Mercury Removal**

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

- 0 20 40 60 80 100 120 140
Small Scale Field Demonstrations (continued)

![Graph showing SO2 Removal Efficiency (%)]

- SO2 Removal - six modules
- SO2 Removal - eight modules

**Operating Time (day)**

**SO2 Removal Efficiency (%)**

- 0 20 40 60 80 100 120 140
- 100 90 80 70 60 50 40 30 20 10 0

- Green triangle: SO2 Removal - six modules
- Blue square: SO2 Removal - eight modules
Summary – Gore Mercury Removal

- A unique sorbent material, carbon polymer composite material (CPC), has been developed for flue gas mercury and other contaminants removal.

- The CPC material is deployed in a stationary sorbent bed applications, and the sorbent bed does not require a frequent regeneration process.

- Field demonstration tests have shown that the CPC bed is effective for Hg/ SOx removal in coal-fired power plant for many months without requiring frequent regeneration or maintenance processes.
Conclusions
Conclusions

- **GORE® ePTFE membrane bags** have been used to achieve near zero particulate emissions for over 30 years in many different applications
  - For existing sources, GORE® membrane bags can be installed in current baghouses to assure compliance with MACT PM requirements
  - For new sources, GORE® membrane bags can be incorporated in new baghouse system designs
- **GORE® REMEDIA® catalytic filter bags** have been used in various incineration applications for over 10 years
  - Destroys D/F through catalytic reaction; no contaminated, spent activated carbon handle and dispose of
  - Capable of meeting D/F emissions of 0.002 – 0.004 ng/dscm (TEQ) depending on inlet D/F concentration
- **Gore Carbon-Polymer Composite material** is a new product for control of mercury emissions
  - Lab testing a small scale field trial results look promising
  - Gore has additional field pilot tests in various stages
  - More information may be available under a non-disclosure agreement
Questions?

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