Filter bags in RABH & PJBH for green cement plant

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Outline

- "Process" Bag Filter or just for APC ?
- How filter bags make cement plant Green ?
- EPA's ETV Data
- Filter bag Selection Criteria
- References and cost Benefit analysis

Process Filters

1. Kiln and Raw mill dust extraction
2. Cement mill (Finish Mill) dust collection
3. Coal Mill dust collection

Pressure drop and Airflow impact production rate and energy efficiency

Green Cement Plants with Membrane filters

- Reduced pressure drop >>
  - **Lower BH Fan power consumption**
- Increased flow rate >> Increased production rate >>
  - **Lower power consumption per ton of cement**
- Increased Bag life >> Reduced stoppages >>
  - **Lower power consumption per ton of cement**
  - **Reduced waste and maintenance cost**
- Reduced pulse pressure and cleaning frequency >>
  - **Lower compressed air energy consumption**
- **Stack Emission to less than 25 mg/Nm3 even with alternate fuels**
- **Reduce Dioxin and Furan**

Ø Cement Mill and Coal Mill Bag Filters :

Past	Present
• Cyclones with ESP • Low dust load • Low impact on Production by BF • Mostly OPC cement	• No cyclone only BF • High dust load • High impact on productivity • PPC, slag and more blended cement

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Cement Mill and Coal Mill Bag Filters

	Past	Present
Dust load, gm/Nm3	10 to 50	100 to 1000
Dust size, microns	10 to 50	0.1 to 50
Moisture %	< 5	3 to 15
Emission Norms	150	10 to 50
No. of bags	100 to 500	1000 to 6000

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Filter Media Is the "Heart of the Baghouse"

- Filter media selection effects
  - Pressure drop à production rate
  - Particulate emissions
  - Cleaning energy
  - Bag life
  - Maintenance cost and down time
  - Total annualized operating costs

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How do you Ensure quality of filter Bags ?

Conventional Bags (Low Tech/Low price Bag)	Membrane Bags (High Tech, High cost Bag)
• Weight • Permeability • Strength	? Data sheets are for the backing Fabric and not for the filtering element (Membrane)

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What are the most important factors for a good filter bag ?

- Provide reliable performance over many years so that equipment availability for production is maximized
  - Stable Gas flow rate and stable pressure drop over the life of the filters
  - Long, reliable and predictable bag life
  - Emissions below the permissible limits over the life of the filters

EPA (USA) has come up with a Test method to evaluate these properties in filter media

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Properties Tested by Environmental Protection Agency's ETV Program

- Emission
- Residual Pressure drop
- Number of cleaning cycles (Bag life)

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What is the ETV program?

- EPA's Environmental Technology Verification (ETV) Program develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment.

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What are the Benefits of the ETV Program?

- Provides objective, credible performance data to purchasers
- Facilitates technology acceptance and permitting at the state/local level
- Reduces risk for financial investors
- Levels the playing field among competitors through standardized tests and objective reporting
- Facilitates export of environmental products

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GORE's 3650 Laminate – PFM Type 62

W. L. Gore & Associates, Inc.L3650

Table 2. Baghouse Filtration Product Three-run Average Test Results for W. L. Gore & Associates, Inc.'s Fabric L3650

Verification parameter	At verification test conditions
Outlet particle concentration at standard conditions[a]	
$PM_{2.5}$, g/dscm (gr/dscf)	<0.000002 (<0.000007)
Total mass, g/dscm[b] (gr/dscf)	<0.000002 (<0.000007)
Average residual pressure drop, cm w.g. (in. w.g.)	2.45 (0.96)
Initial residual pressure drop, cm w.g. (in. w.g.)	2.36 (0.93)
Residual pressure drop increase, cm w.g. (in. w.g.)	0.18 (0.07)
Filtration cycle time, s	251
Mass gain of test sample filter, g (gr)	0.09 (1.39)
Number of cleaning cycles	87

NA = Not applicable – values shown are for three tests.
[a] Standard conditions: 101.3 kPa (14.7 psia) and 20 °C (68 °F). One or more of the impactor substrate weight changes for these results were near the reproducibility of the balance.
[b] Total mass includes the mass of $PM_{2.5}$ and larger particles that passed through the fabric.

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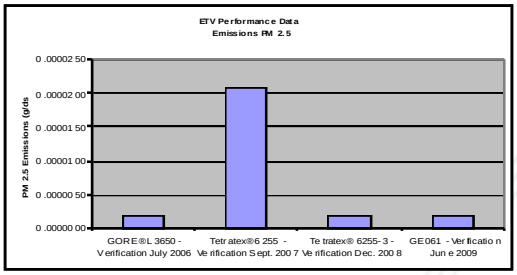
Emission PM 2.5 Comparison



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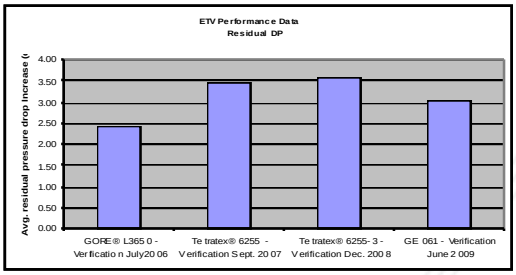
Residual Pressure drop comparison



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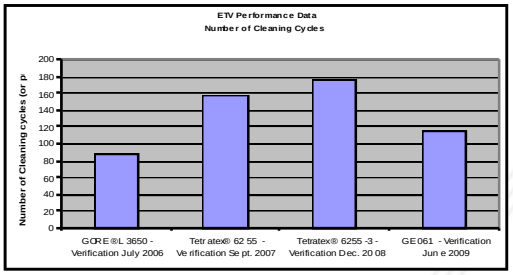
Number of cleaning cycles (Bag life) comparison



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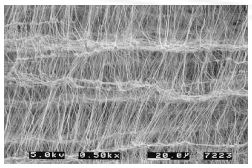
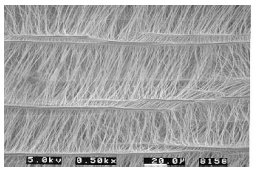
Comparison of EPA's ETV verification Data for Fiberglass Laminates

Company Name	W. L. Gore & Associates, Inc.	Donaldson	Donaldson	GE
Type of Filter Media	membrane fiberglass fabric	membrane fiberglass fabric	membrane fiberglass fabric	membrane fiberglass fabric
Brand Name /ETV Verification Date	GORE® L3650 Verification July 2006	Tetratex® 6255 Verification Sept. 2007	Tetratex® 6255-3 Verification Dec. 2008	GE 061 Verification June 2009
PM2.5 Emissions (gr/dscm)	Non detectable	10 times higher than Gore	Non detectable	Non detectable
Average Residual Pressure Drop (cm w.g.)	2.45	41% higher than Gore	46% higher than Gore	23% higher than Gore
Number of cleaning cycles (or pulses)	87	82% higher than Gore	100% higher than Gore	32% higher than Gore

SEM Photomicrographs



GORE ™ Membrane A Series
(Original developed in 1976)



GORE ™ Membrane P Series
Present quality in use in 2010

Properties for PTFE Membrane filter Bags

- **Membrane properties :**
  - Residual DP in ETV Test
  - No. of Cleaning cycles in ETV Test
  - Filtration efficiency for 1 µ size particles
- **Backing Fabric Properties :**
  - Fabric weight and type
  - Temperature resistance
  - MIT Flex Durability
  - Acid Flex cycles for the laminate
  - Anti-static property (For coal mill bag filter)
- **Type and properties of sewing threads**

Ideal Filter Media for PJ Kiln BH

Fabric Properties :

- Construction : 630 gsm Fluoropolymer-Fiberglass Composite / PTFE Membrane
- Continuous Operating Temp :260°C
- **MIT Flex cycles : > 100,000**
- Mullen Burst : 56 kg/cm^2
- Breaking Strengths : warp: 200, Fill : 150 Kg

ETV Data :

- Emission 2.5 µ : Less than 00001 g/dscm
- Residual DP in ETV Test : Less than 2.5 cmwg
- Cleaning cycles in ETV Test: Less than 100

Ideal Filter Media for RA Kiln BH

Fabric Properties :

- Construction : 339 gsm Acid-resistant Fiberglass/PTFE Membrane
- Continuous Operating Temp :260 °C
- Acid Flex Cycles : Warp > 10,000 , Fill > 1500
- Mullen Burst : 35 kg/cm2
- Breaking Strengths : warp: 131, Fill : 86 Kg

ETV Data :

- Emission 2.5 µ : Less than 00001 g/dscm
- Residual DP in ETV Test : Less than 2.5 cmwg
- Cleaning cycles in ETV Test: Less than 100

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Ideal Filter Media for Cement Mill BF

Fabric Properties :

- Construction : 475 gsm **Acrylic/polyester Felt** / PTFE Membrane
- Continuous Operating Temp :127 °C
- Mullen Burst : 24 kg/cm2
- Breaking Strengths : warp: 68 , Fill : 77 Kg

ETV Data :

- Emission 2.5 µ : Less than 00001 g/dscm
- Residual DP in ETV Test : Less than 2.5 cmwg
- Cleaning cycles in ETV Test: Less than 100

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Ideal Filter Media for Coal Mill BF

Fabric Properties :

- Construction : 475 gsm anti-static Acrylic/Polyester Felt/PTFE Membrane
- Continuous Operating Temp :127 °C
- Mullen Burst : 28 kg/cm2
- Breaking Strengths : warp: 68 , Fill : 77 Kg
- **Static Decay Time : 0.01 Seconds (NFPA 99)**

ETV Data :

- Emission 2.5 µ : Less than 00001 g/dscm
- Residual DP in ETV Test : Less than 2.5 cmwg
- Cleaning cycles in ETV Test: Less than 100

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Reference : Ambuja Cement

RA Kiln/Raw mill Baghouse:

- Replaced 25% (4 modules) of Bags with Gore bags
- Achieved: 4.3% increase in production, 15% Increase in Airflow, 10% Decrease in Pressure drop
- 2000 Update : Replaced bags in 8 more modules of this baghouse and 13 modules of second line.
- Nov 2009 Update : > 12 years without loss of any bag. Plant upgraded from 3300 TPD to 4500 TPD.

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Reference : Ambuja Cement
Cement mill Bag Filter

- 450 Gore bags installed in in place of 630 bags in Mill venting
- 180 holes were blanked off. Operating Air to cloth ratio : 1.2 m/min
- Bag filter operating at < 110 mmwg DP at full load.
- New set of Gore bags after completion of > 7 years of life
- Gore bags are operating at less than 30 mg/Nm3.
- No maintenance required on the system, due to bags.
- System reliability is very high.

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Reference : ACC Coal mill Bag Filter

- New 7000 TPD plant with vertical coal mill, total dust collection in the bag filter
- Installed 1350 Gore bags.
- Air flow : 3489 m3/min , DP across bags : 85 mmwg. Air to cloth ratio : 1.3 m/min
- New set of Gore bags after completion of > 7 years with no loss of bags.
- Gore bags are operating at less than 30 mg/Nm3.
- No maintenance required on the system, due to bags.
- System reliability is very high.

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Cost Benefit Analysis : Kiln Baghouse

- Installed baghouse cost with Gore bags is same price or 10% lower cost than conventional bags
- 9 to 12 years bag life with Gore bags in RABH as compared to 2 to 5 years with conventional bags
- Low stable DP >> High production rate over the life of bag (20% lower than other PTFE membrane bags and 40% lower than conventional bags)
- Lower annualized operating cost
- Stable and Lower emission over the life of the bags (< 25 mg/Nm^3)
- Reduced maintenance and down time

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Cost Benefit Analysis : Cement Mill and Coal Mill Bag filters

- Installed Filter cost with Gore bags is almost same price as with conventional bags (within 5 to 10%) with 200 – 300% more bag life.
- Increased Bag life (5 – 7 yrs)
- Low stable DP >> High production rate over the life of bag (20% lower than other PTFE membrane bags and 40% lower than conventional bags)
- Stable and Lower emission over the life of the bags
- Reduced maintenance and down time

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Future Likely Trends

- Green Cement Label
- Norm of < 65 units per ton of cement
- Increased use of alternative fuels
- Increased production of blended cement
- Fine and special grades of cement
- Emission norms for $PM_{2.5}$ and Dioxin/Furan

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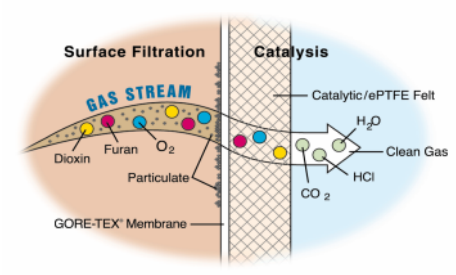
Remedia™ CATALYTIC FILTER SYSTEM

REMEDIA D/F Catalytic Filter System

The safest & simplest way to destroy dioxin

Destroys Dioxin/Furan & removes PM in a single step



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Green Cement plant with Gore Filter bags

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  - **Lower BH Fan power consumption**
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  - **Reduced waste and maintenance cost**
- Reduced pulse pressure and cleaning frequency >>
  - **Lower compressed air energy consumption**
- **Stack Emission to less than 25 mg/Nm3 even with alternate fuels**
- **Reduced Dioxin and Furan with use of MSW and Hazardous waste**

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Thank you
for your kind attention

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