Particulate and Condensable Removal with a Membrane

McIlvaine Co. Hot Topic Hour
April 26, 2013

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- Technical expertise
  - Proven 30 years ePTFE manufacturing experience
- Superior customer service
  - Committed to satisfying customer needs
- Global presence
  - Worldwide sales and manufacturing capabilities
- Local support
  - Offices around the world

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Condensables

By definition – They are vapors that pass through the bag house then at some point transition to the solid phase – PM

Problem: Condensables can be 3x – 4x PM

CSAPR

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CSAPR Regulations

CSAPR (Cross State Air Pollution Rule)

Defined states reduce SO_2 emissions by 73% and NO_x by 54% from levels in 2005 (in CSAPR region)

Unknown when effective; Court of Appeals temporary stay- hearing in June 2012

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Utility REG's PM

LB/MWh	Filterable Particulate		Acid Gasses (Hydrogen Chloride)		Mercury	
	Existing	New	Existing	New	Existing	New
Not Low Rank Virgin Coal	0.3	0.007	0.02	0.0004	0.013	0.0002
Low Rank Virgin Coal	0.3	0.007	0.02	0.0004	0.04	0.04
		* Lb/MWHR		* /10 MMBTU		

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Perspective

Reduced By:

PM = 97.7%

Acid Gas = 98.0%

Mercury = 98.5 %

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Coal

Not Low Ranked Virgin Coal

Anthracite or anthracitic	-	>86 % fixed carbon <14 % volatile
Bituminous coal	-	<86 % fixed carbon >14 % volatile
Sub bituminous	-	>8300 <11500 BTU

Low Ranked Virgin Coal

Lignite A	-	>6300 < 8300 BTU
Lignite B	-	<6300 BTU

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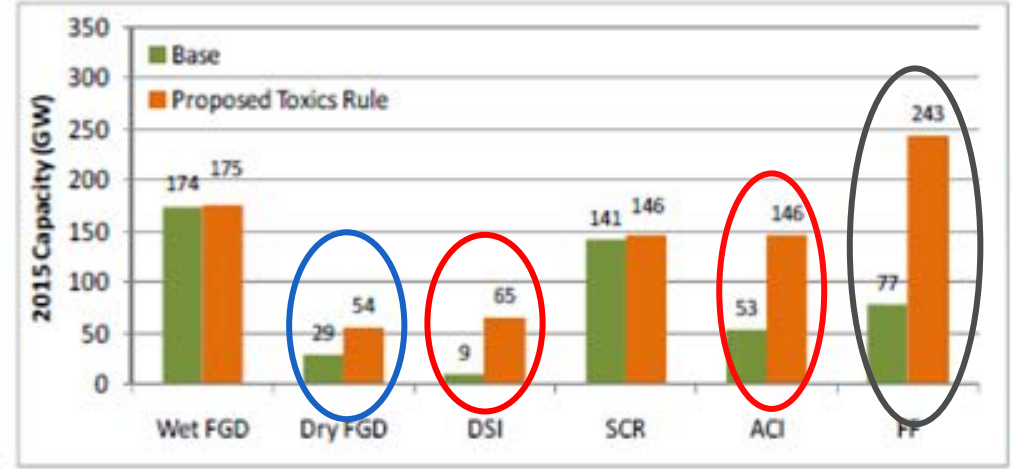
Planning Model



Retrofit pollution control installations on coal-fired capacity (by technology) with the base case and with the proposed Toxics Rule, 2015 (measured in GW capacity). Source: Integrated Planning Model run by EPA, 2011

FGD: flu gas desulfurization (scrubber)
DSI: dry sorbent injection
SCR: selective catalytic reduction
ACI: activated carbon injection
FF: fabric filter

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BENEFITS OF MEMBRANE

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Sorbent/Activated Carbon Injection

Increases Filter Bag Inlet Grain Loading

Lime/MilledLime/Hydrated Lime	2-45 microns PSD range
Sodium/Milled Sodium/Trona	7-30 microns PSD range

PAC Injection:

90-99% minus 325 mesh	5-20 microns PSD range

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ePTFE Membrane

ePTFE = Expanded Polytetraflouroethylene

- Membrane: Porous film made from PTFE
- Manufactured from 100% PTFE Polymer resin
- Thermally bonded onto a range of substrates
- A surface filtration membrane
- Acts as a primary dust cake*
- No pre-coat required *
- Inhibits fine particulate penetration
- Helps to preserve integrity of the substrate
- Helps to optimize filter performance

* Precoat for fuel oil at start-up.

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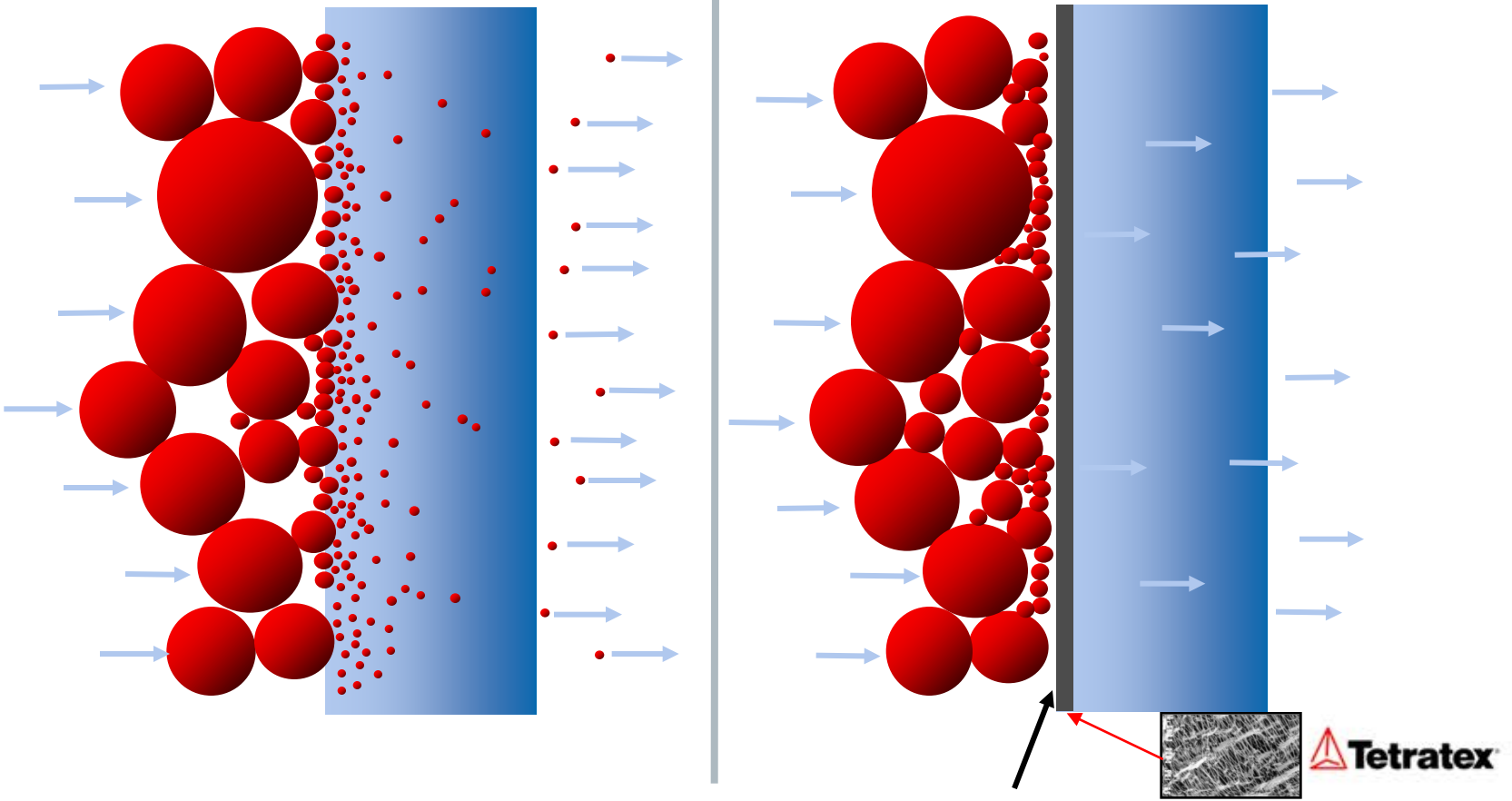
Depth Filtration - Surface Filtration



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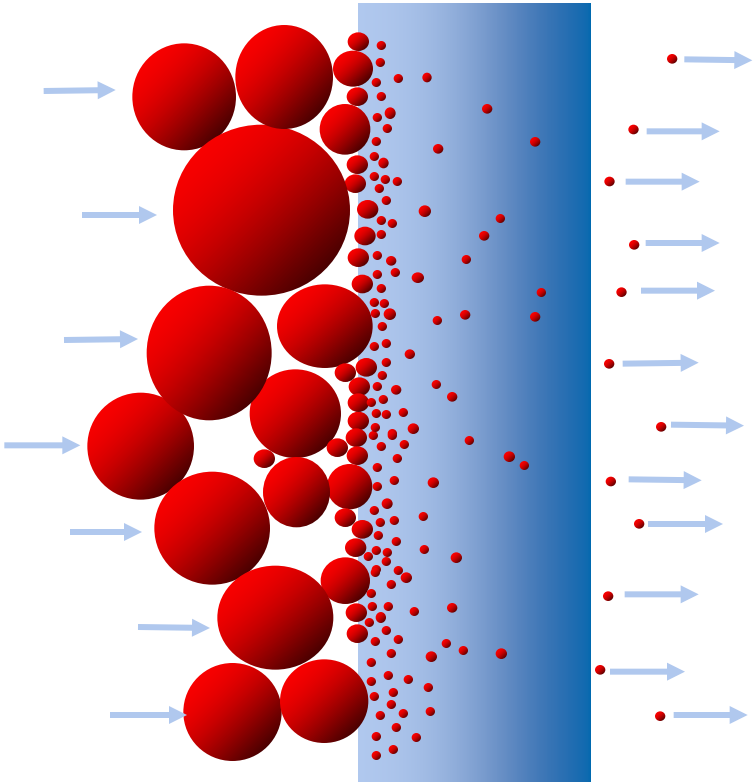
Depth Filtration



- Efficiency relies on cake formation
- Dust cake restricts airflow
- Requires high cleaning energy which imparts mechanical stresses
- Fine particles migrate into media causing abrasion damage
- Leads to blinding - High pressure drop

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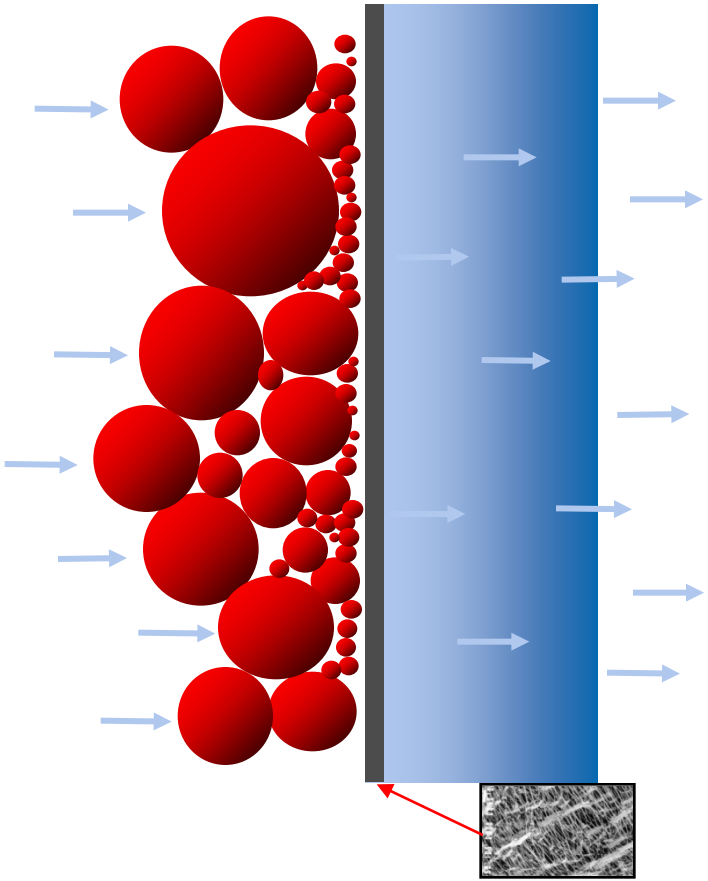
Surface Filtration - Tetratex®



- Acts as primary dust cake, no pre-coat required*
- Inhibits particle migration
- Low cake formation allows for reduced cleaning therefore less mechanical stresses
- Higher cleaning efficiency gives higher constant airflow
- Excellent cake release - Low pressure drop

* Precoat for fuel oil at start-up.

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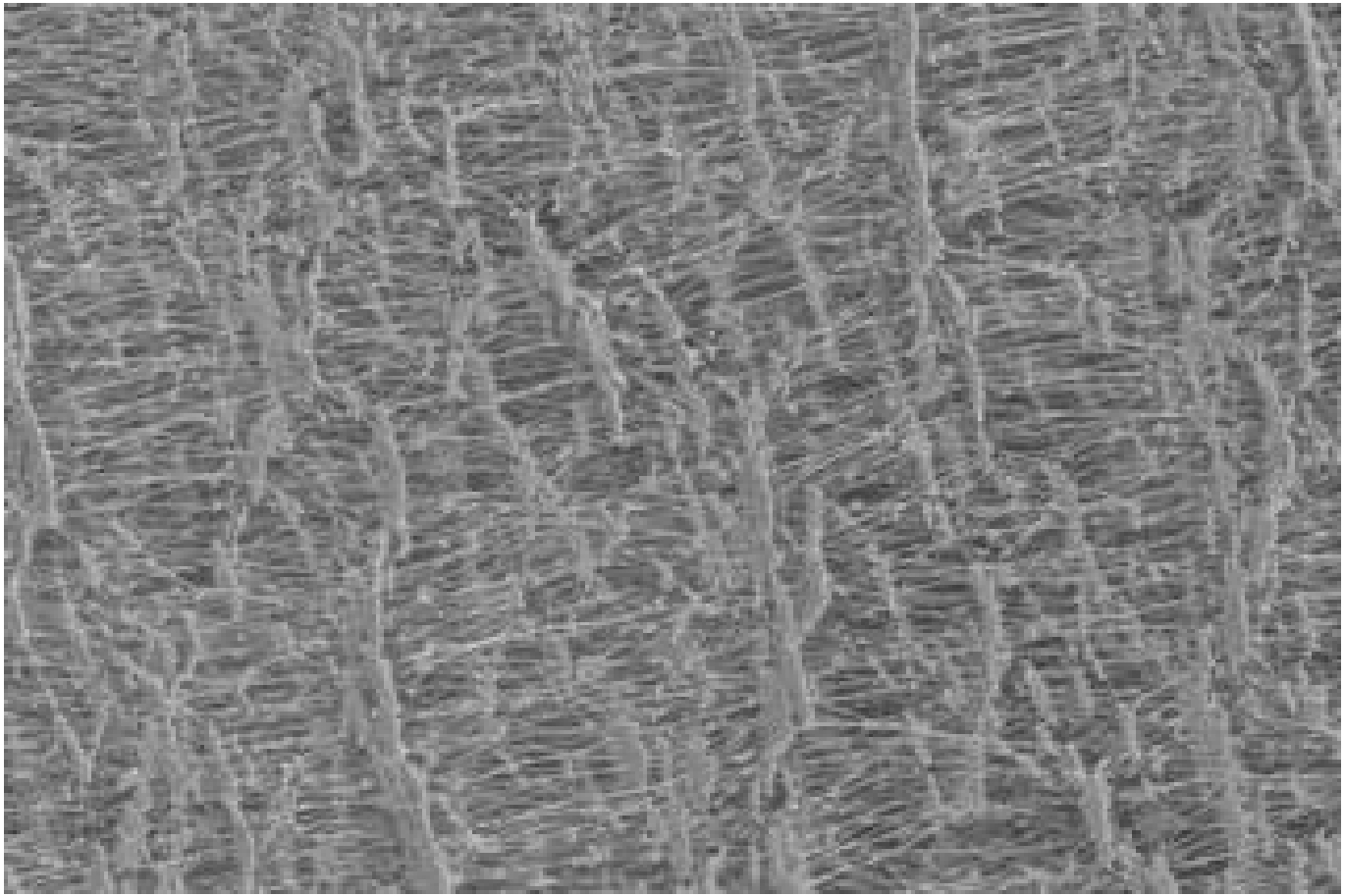
Membrane at 500x



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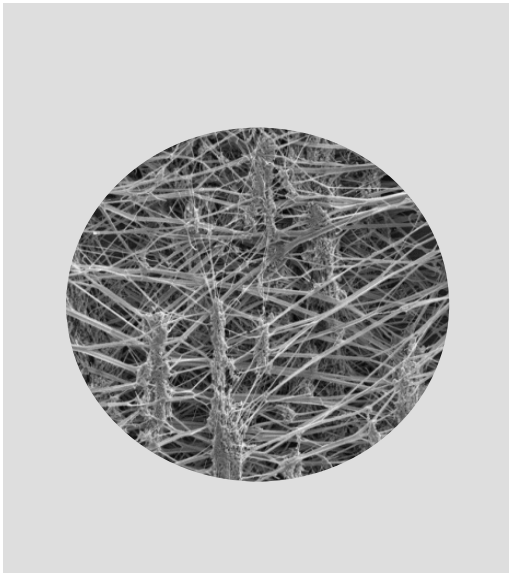
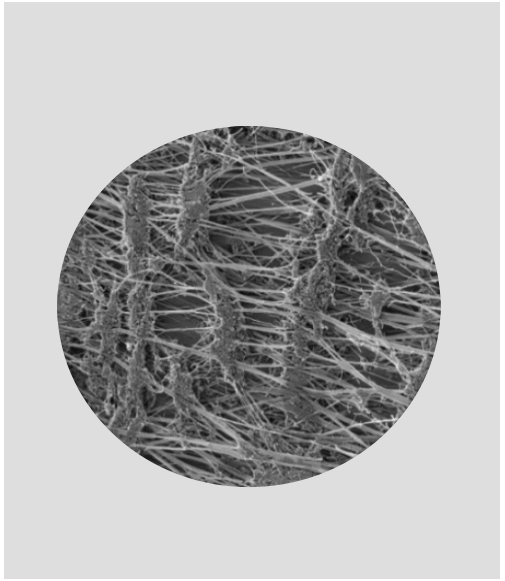
Microscopic View of Utility ePTFE Membranes



Tetratex *EXTREME* 10-20cfm@0.5”

Tetratex 7-12cfm@ 0.5”



Tetratex High Efficiency 3-8cfm@0.5”

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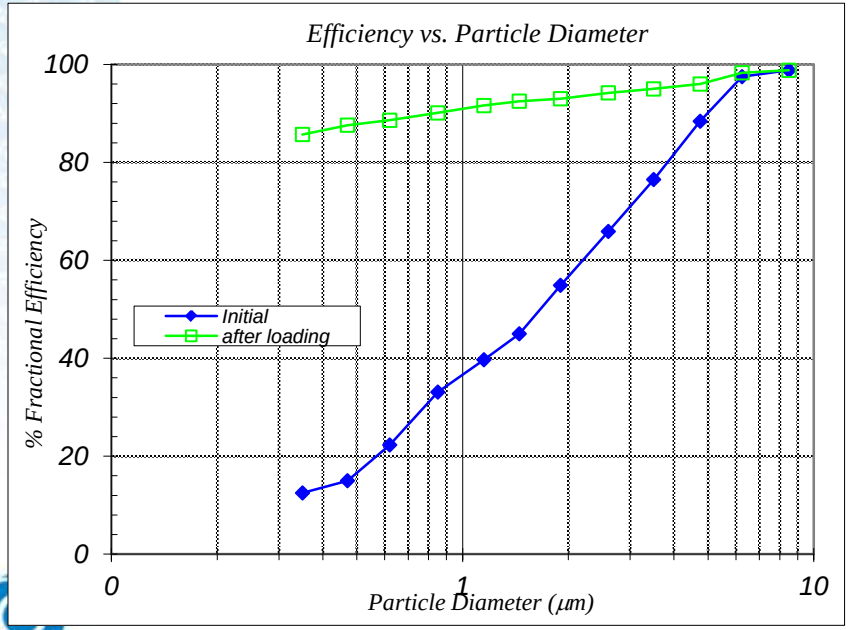
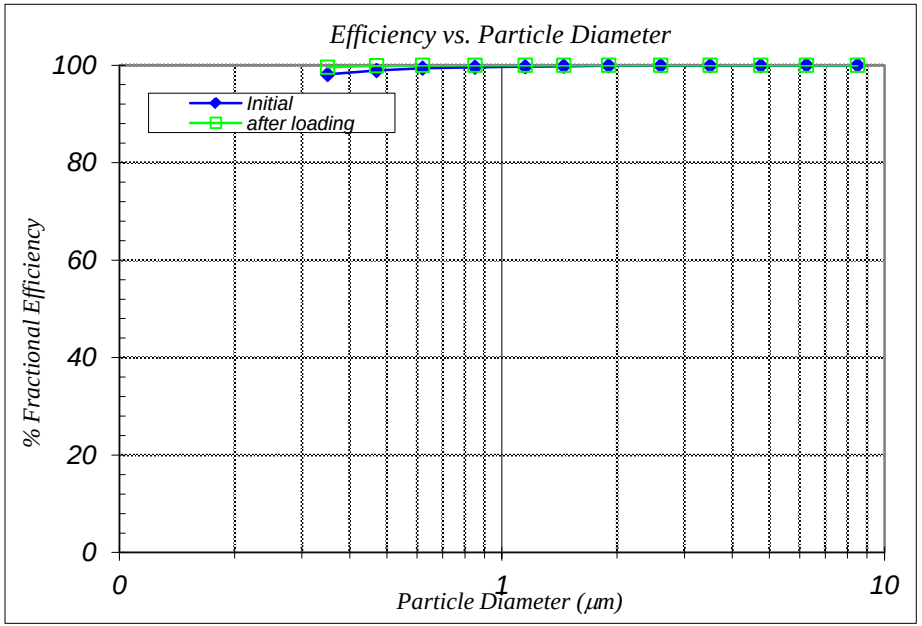
Efficiency Comparison: 16oz PPS

Conventional Media



Tetratex Laminate (8162)



* Independent test results conducted by LMS Technologies Inc. May 2012

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Efficiency Comparison: 16oz PPS

Conventional Media

Status	Initial	after loading
Size Range (mm)	% Efficiency	
DP ("H_2O)	0.185	0.385
0.3-0.4	12.5	85.7
0.4-0.55	15.0	87.6
0.55-0.7	22.3	88.6
0.7-1.0	33.1	90.1
1.0-1.3	39.7	91.6
1.3-1.6	45.0	92.5
1.6-2.2	54.9	93.0
2.2-3.0	**65.9**	**94.2**
3.0-4.0	76.5	95.0
4.0-5.5	88.4	96.0
5.5-7.0	97.5	98.3
7.0-10.0	98.8	98.8

Tetratex Laminate (8162)

Status	Initial	after loading
Size Range (mm)	% Efficiency	
DP ("H_2O)	0.756	0.956
0.3-0.4	98.1	99.6
0.4-0.55	98.9	99.9
0.55-0.7	99.4	100.0
0.7-1.0	99.6	100.0
1.0-1.3	99.7	100.0
1.3-1.6	99.8	100.0
1.6-2.2	99.9	100.0
2.2-3.0	**99.9**	**100.0**
3.0-4.0	99.9	100.0
4.0-5.5	99.9	100.0
5.5-7.0	100.0	100.0
7.0-10.0	100.0	100.0

* Independent test results conducted by LMS Technologies Inc. May 2012

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Observations and Concerns

1. Utility Bag Houses being built with Membrane bags
2. Is current instrumentation capable of measuring accurately and repeat ably to the new standard
3. CSPARR ?
4. Outlet particulate emissions leaving the system shall not exceed -- X mg/m^3
5. The box – the bag –fused seams – stitched seam - taped seams (vertical& horizontal) – sewing on rings

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Thank You

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References:

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NESHAP - **http://www.epa.gov/compliance/monitoring/programs/caa/neshaps.html**

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