Key Issues When Selecting Fabric Filter Bags to Achieve Optimum Bag Life

McIlvaine Company Hot Topic Hour

"Fabric Selection for Particulate Control"

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What Will Be Covered?

- Cleaning Methods & Filter Media Options (CFB)
- Emission Goals and Design & Selection
- Time v. Temperature Study
- Emission Performance in Lab (Membrane vs. Felts)
- Relative Bag Performance
- Cost Considerations
- Factors Affecting Life & Performance
- Importance of Fabric & Bag Specifications
- QA/QC Program
- Initial Bag Installation
- Bag Monitoring
- Managing Bag Life – An Action Plan

Cleaning Methods & Filter Media Options (CFB)

Pulse Jet

1) PPS Felt
2) P-84® Felt
3) Teflon® Felt
4) PPS Felt/ePTFE membrane
5) PPS Felt/PTFE Resin
6) Woven Fiberglass
7) Woven Fiberglass/ePTFE membrane
8) PPS Felt/P-84® Blends
9) Aramid (Nomex®) Felt

Reverse Air

1) Woven Fiberglass
2) Woven Fiberglass/ ePTFE membrane

Design Considerations & Trade-Offs

- Provide Required Filtration (0.000x grains/ft^3)
- Obtain Optimum Bag Life
- Provide Required Cleaning Capability
- Distribute Gas & Dust Equally
- Provide Effective Dust Removal From Collector

N.B.

Lower G/C gives longer bag life & lower ΔP (trade-off capital vs. operating cost)

Good design & PM retains design cleaning frequency (low)

Longer Bag Life

Design:
Fabric Selection Considerations

Gas Stream

- Temperature
- Moisture
- Chemistry
- Dust Loading

Fabric

- Filtration Performance
- Temperature Max
- Release Properties
- Pressure Drop
- Life/Durability
- Costs

Dust Characterization

- Abrasiveness
- Stickiness
- Explosiveness
- Flammability

Other

- ePTFE Membrane
- Coatings/Treatment
- Blends
- Scrim
- Hardware

Fabric Selection Chart

Fabric	Max Continuous Temp	Surge Temp.	Acid Resistance	Fluoride Resistance	Alkali Resistance	Flex Abrasion Resistance	Relative Cost*
Cotton	180 °F	200 °F	Poor	Poor	Good	Very Good	0.3
Wool	200 °F	230 °F	Good	--	Poor	Fair	--
Polypropylene	200 °F	200 °F	Excellent	Poor	Excellent	Very Good	0.4
Acrylic	265 °F	284 °F	--	--	Fair	Good	0.4
Polyester	275 °F	300 °F	Fair	Poor to Fair	Fair	Very Good	0.4
Basofil®/ Melamine	375 °F	-- °F	Good	--	Excellent	--	--
PPS	375 °F	425 °F	Good	Good	Very Good	Very Good	1.0
Nomex®/ Aramid	400 °F	425 °F	Poor to Fair	Good	Good	Excellent	0.9
P-84®/ Polyimide	400 °F	500 °F	Fair	Fair to Good	Fair	Good	1.7
Teflon®/PTFE	450 °F	500 °F	Excellent	Excellent	Excellent	Fair	4.7
Glass Felt	500 °F	550 °F	Good	Poor	Fair	Fair	1.6
Woven Fiberglass	500 °F	-- °F	Fair to Good	Poor	Fair to Good	Fair	0.8

*Relative Cost – PPS Pulse Jet Bag 5”∅ x 10’ Long

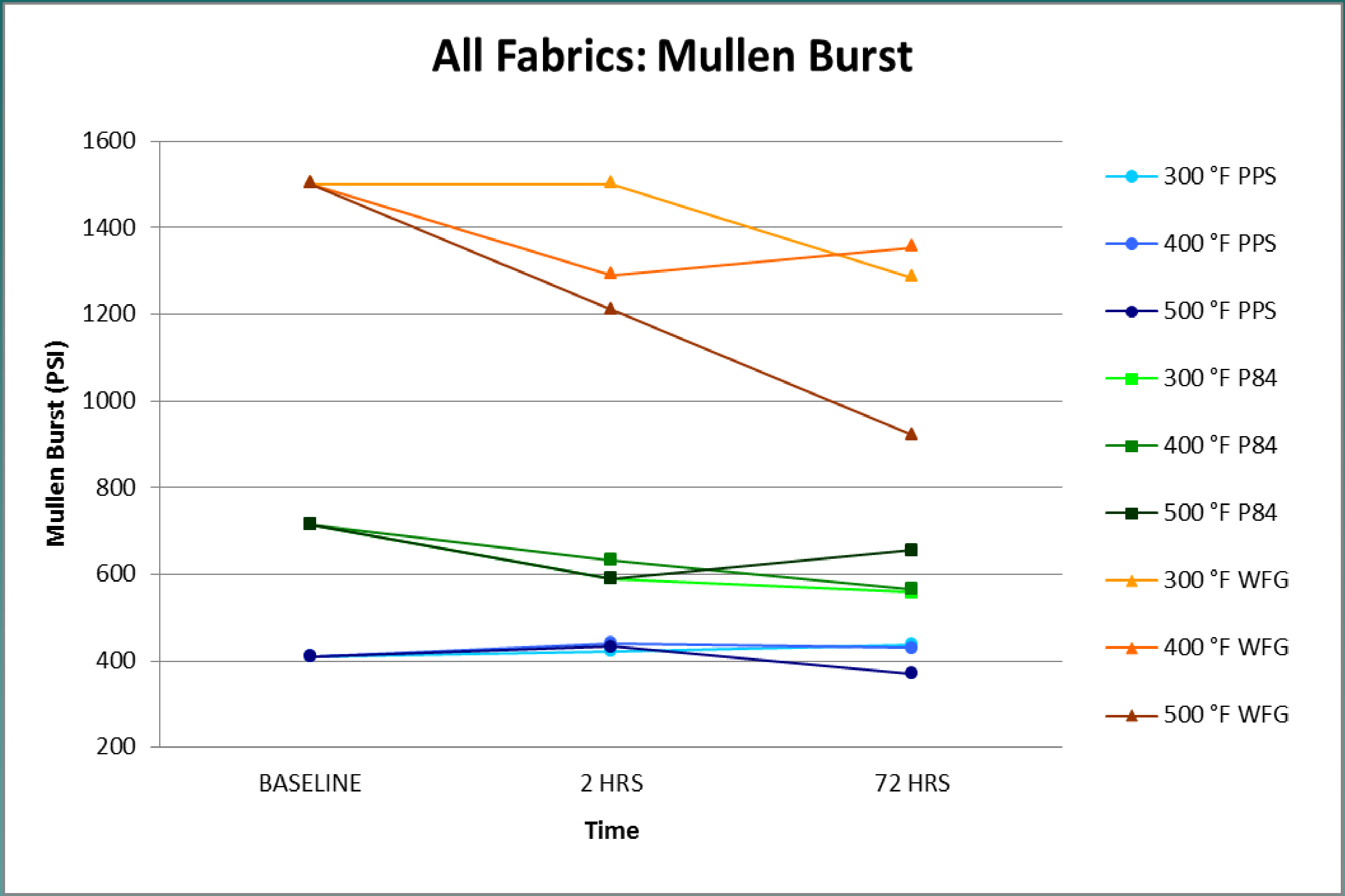
Time v. Temperature Study Summary of Results

SUMMARY OF TEST RESULTS

ALL FABRICS (PPS, P-84, & WFG w/ePTFE Membrane)

TEST PERFORMED		BASELINE	300 °F AFTER 2 HRS	300 °F AFTER 72 HRS	400 °F AFTER 2 HRS	400 °F AFTER 72 HRS	500 °F AFTER 2 HRS	500 °F AFTER 72 HRS
WEIGHT, oz/yd²								
PPS		15.13	15.06	15.11	14.87	14.83	14.97	14.96
P84		18.66	17.92	16.68	18.11	16.91	16.90	18.71
WFG		23.28	23.18	23.10	23.52	23.50	23.40	23.42
PERMEABILITY, fpm								
PPS		34.9	36.2	37.4	38.6	39.0	31.3	30.8
P84		20.8	21.7	30.7	21.8	27.8	23.9	20.8
WFG		4.6	5.4	5.9	5.5	5.8	5.5	5.8
SHRINKAGE-%								
PPS	WARP	-	0.77	1.01	1.75	2.16	8.79	8.91
	FILL	-	-0.01	0.25	0.49	0.66	5.23	5.75
P84	WARP	-	0.08	0.17	0.25	0.51	1.65	3.58
	FILL	-	0.16	0.37	0.27	0.52	1.52	3.71
WFG	WARP	-	0.02	0.18	0.13	0.23	0.33	0.40
	FILL	-	-0.02	0.01	-0.17	-0.08	0.14	0.21
MULLEN BURST, psi								
PPS		410	423	438	440	430	433	370
P84		715	590	558	633	565	590	655
WFG		1500	1500	1285	1290	1355	1210	920
TENSILE STRENGTH, lbs/in								
PPS	WARP	87	83	87	90	87	81	63
	FILL	144	147	142	140	141	126	99
P84	WARP	86	94	79	92	94	111	105
	FILL	170	166	161	174	190	180	181
WFG	WARP	500	500	500	500	500	475	329
	FILL	500	500	500	500	500	500	475
MIT FLEX, # flexes								
PPS	WARP	190220	233252	121986	241888	159490	75224	56949
	FILL	137731	121278	88662	131724	81249	87791	25023
P84	WARP	102267	198072	54316	17948	35810	95863	35148
	FILL	314043	59618	50048	34308	35639	80773	28664
WFG	WARP	32566	19802	41749	27550	21896	26778	19556
	FILL	28282	23177	18545	15429	16943	12839	9915

Time v. Temp. Summary Graph



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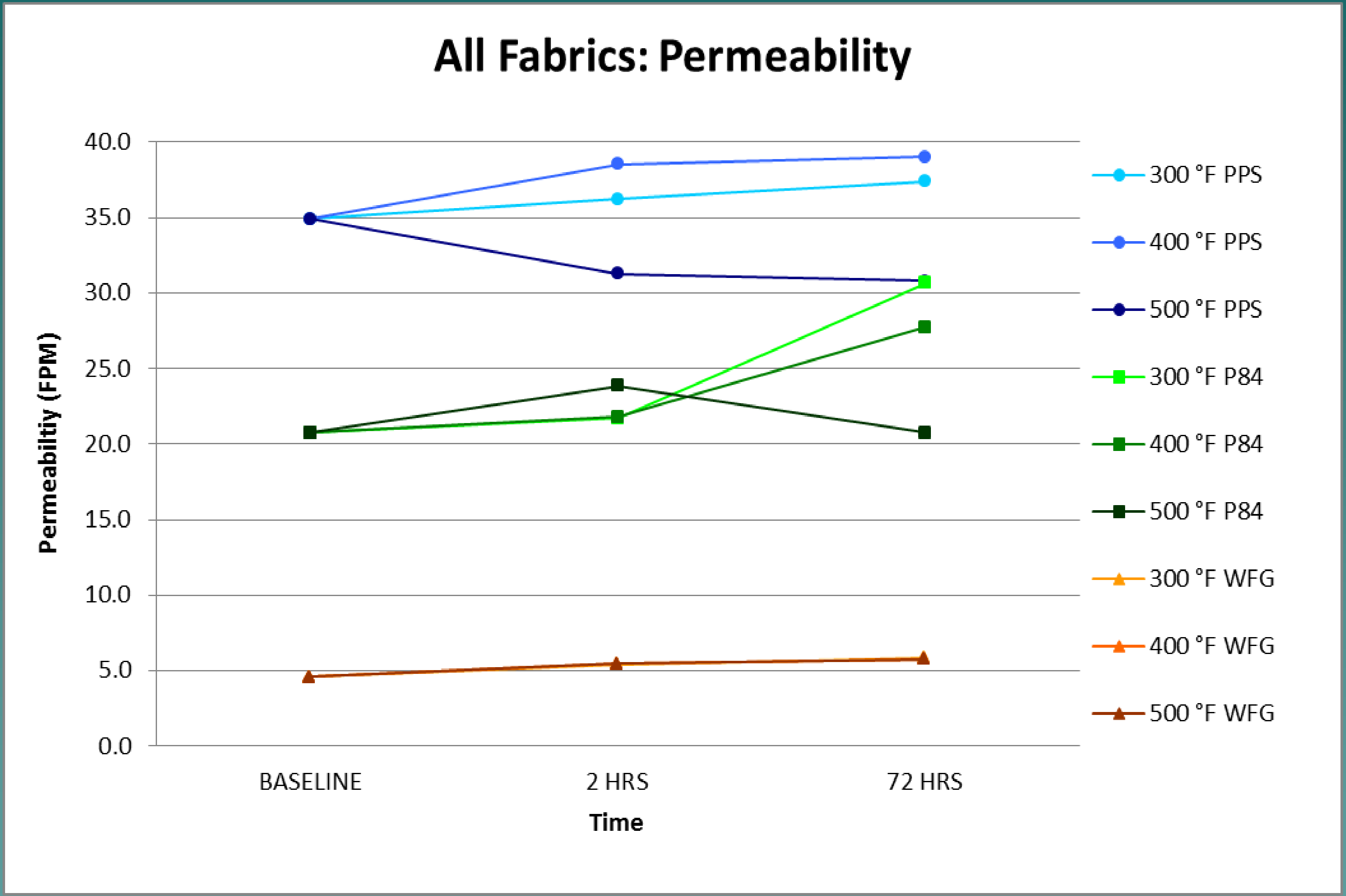

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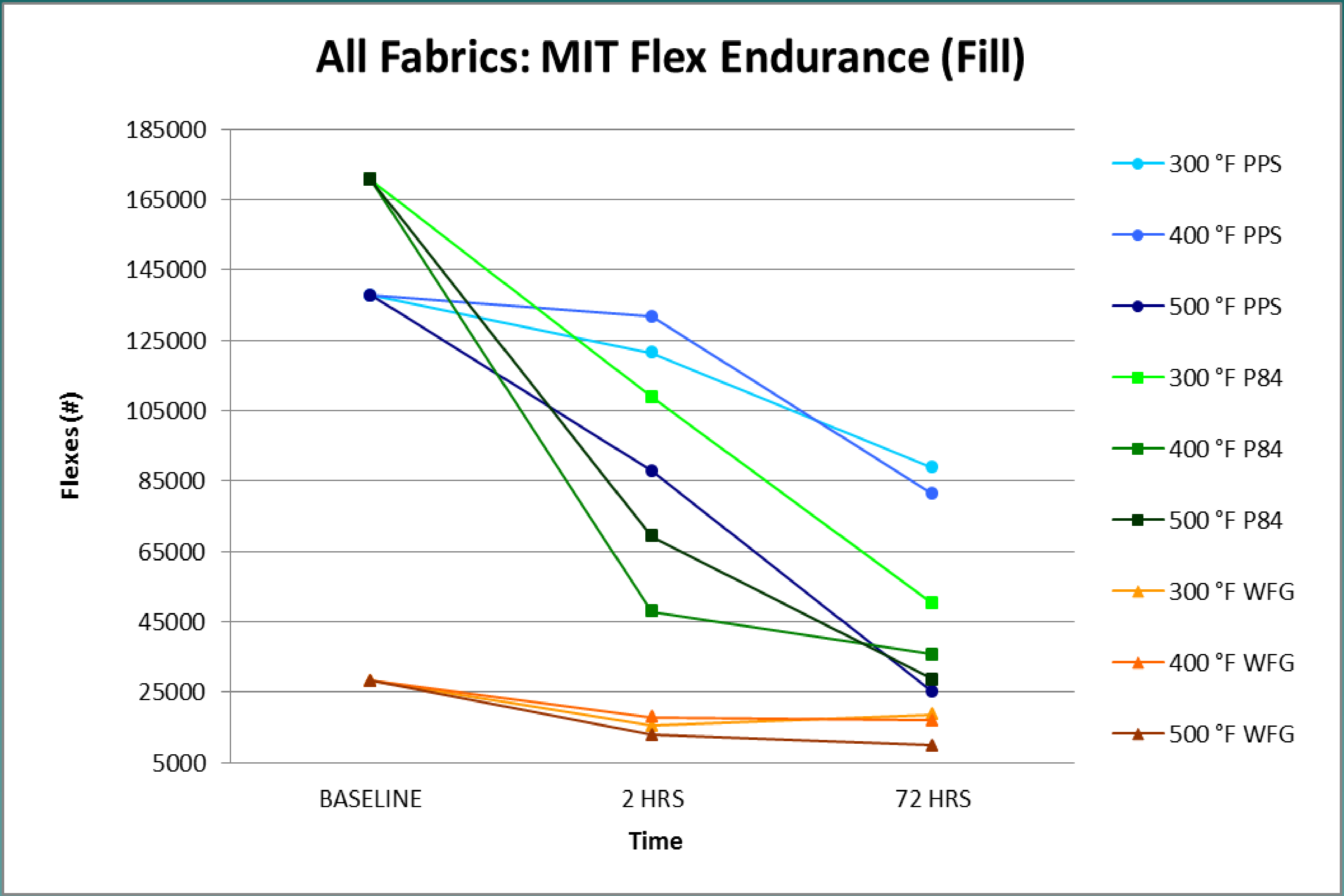

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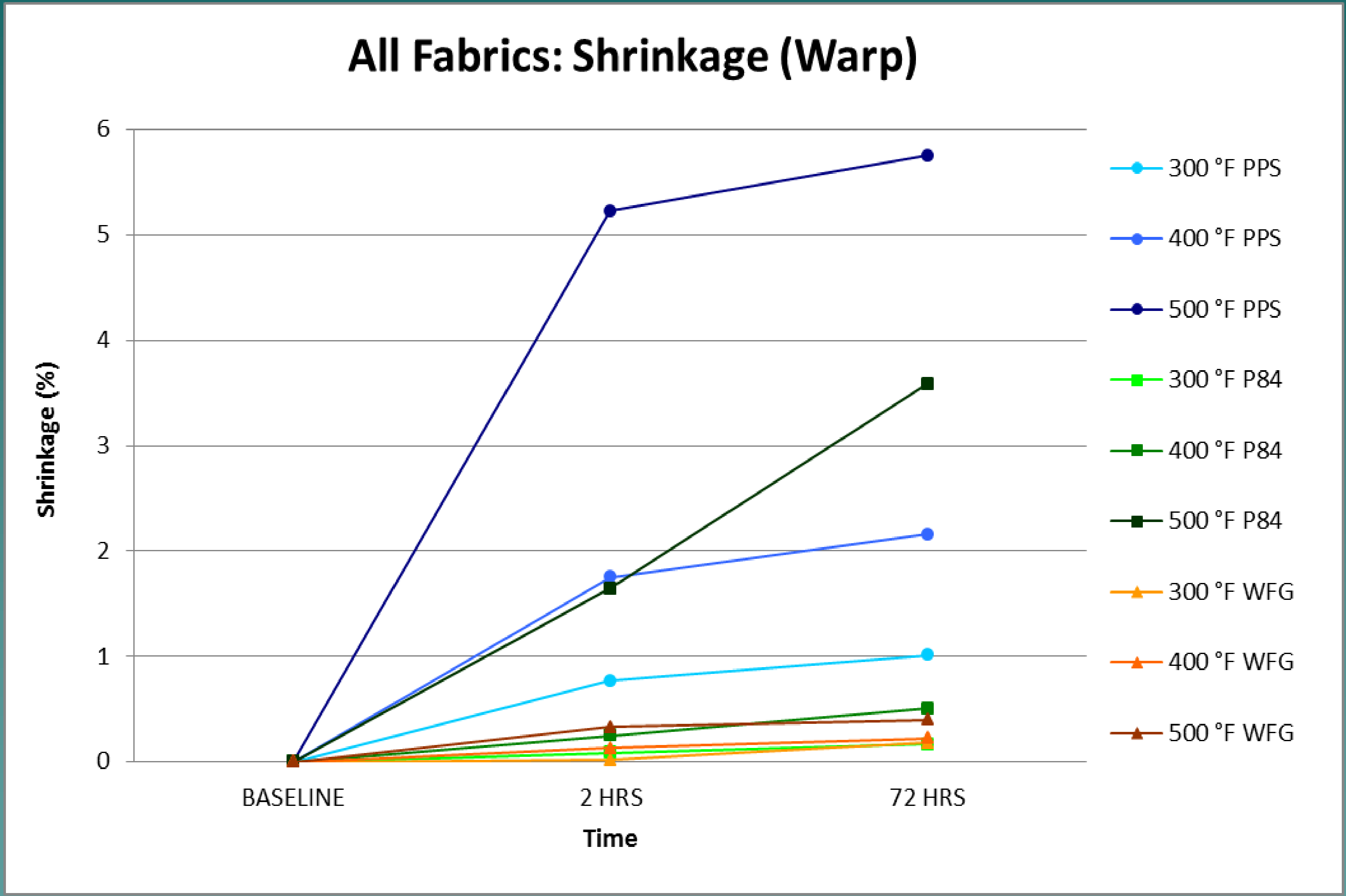


Emission Performance in Lab

(Membrane v. Felts)

	Fabric Type		
Parameter:	PPS Felt	P-84 Felt	Woven Fiberglass w/ ePTFE Membrane
Outlet PM 2.5 Particle Concentration, gr/dscf	0.0000669	0.0000482	0.0000007
Number of Pulses	179	168	108
Residual Pressure Drop, Performance Test Period, inches w.g.	1.04	0.94	1.05
Removal Efficiency % (PM 2.5)*	99.99879	99.99911	99.99999

$$* \frac{(\text{Dust Concentration} * 0.5287) - \text{PM 2.5 Outlet Concentration}}{\text{Dust Concentration} * 0.5287} * 100$$

Relative Bag Performance Conclusions

- Filtration performance of P-84 and PPS felt similar and very good.
- Filtration performance of WFG/Membrane excellent.
- Other study* shows membrane out-performs traditional felts.
- Bag Life
  - PPS Felt, can exceed 5 years
  - P-84 Felt, can exceed 2½ years
  - WFG/Membrane, dependent on multiple factors
- Cost of Bags
  - P-84, commands a premium (1.7)
  - WFG/Membrane, (.8)
- Ultimate decision is a function of site specific inlet definition and cage design.

Cost Considerations

- Current pricing per bag, 33' long by 5" diameter:
  - PPS Felt ~ $81-90
  - P-84 Felt ~ $143-158
  - WFG/Membrane ~ $73-81

Premature Bag Failure: Factors Affecting Bag Life

- Design and Manufacturer
- Installation
- Gas Flow
- Gas Temperature
- Gas Acidity
- Dust Loading & Particle Size
- Cleaning Intensity/Frequency/Duration
- Bag Tension
- Adjacent Bag Life

Premature Bag Failure: Causes

- Mechanical
  - Dust Abrasion
  - Over Cleaning
  - Bag Tension
  - Adjacent Bag
- Thermal
  - Excessive Temperature
  - Dew Point
- Chemical
  - Acids
  - Alkalies
  - Condensation (Organics, Acids, Water)

Importance of Fabric & Bag Specifications

- Spec is the basis for the QA/QC
- The details & comprehensive breadth are critical
- Without the spec there can be no recourse
- Drawings & quantitative acceptable tolerances are required

QA/QC Program: Purpose and Description

- To insure a new bag set conforms to a material and construction specification
- Primary focus on specifying and testing of fabric durability & mechanical performance
- Verification of filtration & pressure drop performance
- Prevent contamination of “clean side”

QA/QC Program: Initial Installation of Bags

- The bag set is the most important item in the baghouse
- The entire bag set and associated hardware must be properly installed and are key to successful operation
- Inspect all system components thoroughly before installation and again prior to initial start-up for compliance to specifications and for correct assembly
- Retensioning of RA bags very important

Bag Monitoring Program: Purpose and Description

- To determine the retention of strength and flow characteristics of a bag set with on-stream time.
- Used as an aid in determining the useful life and scheduling the replacement of a bag set.
- Diagnostic tool in assisting the client or his agent in troubleshooting a baghouse.

Bag Monitoring With Stream Time

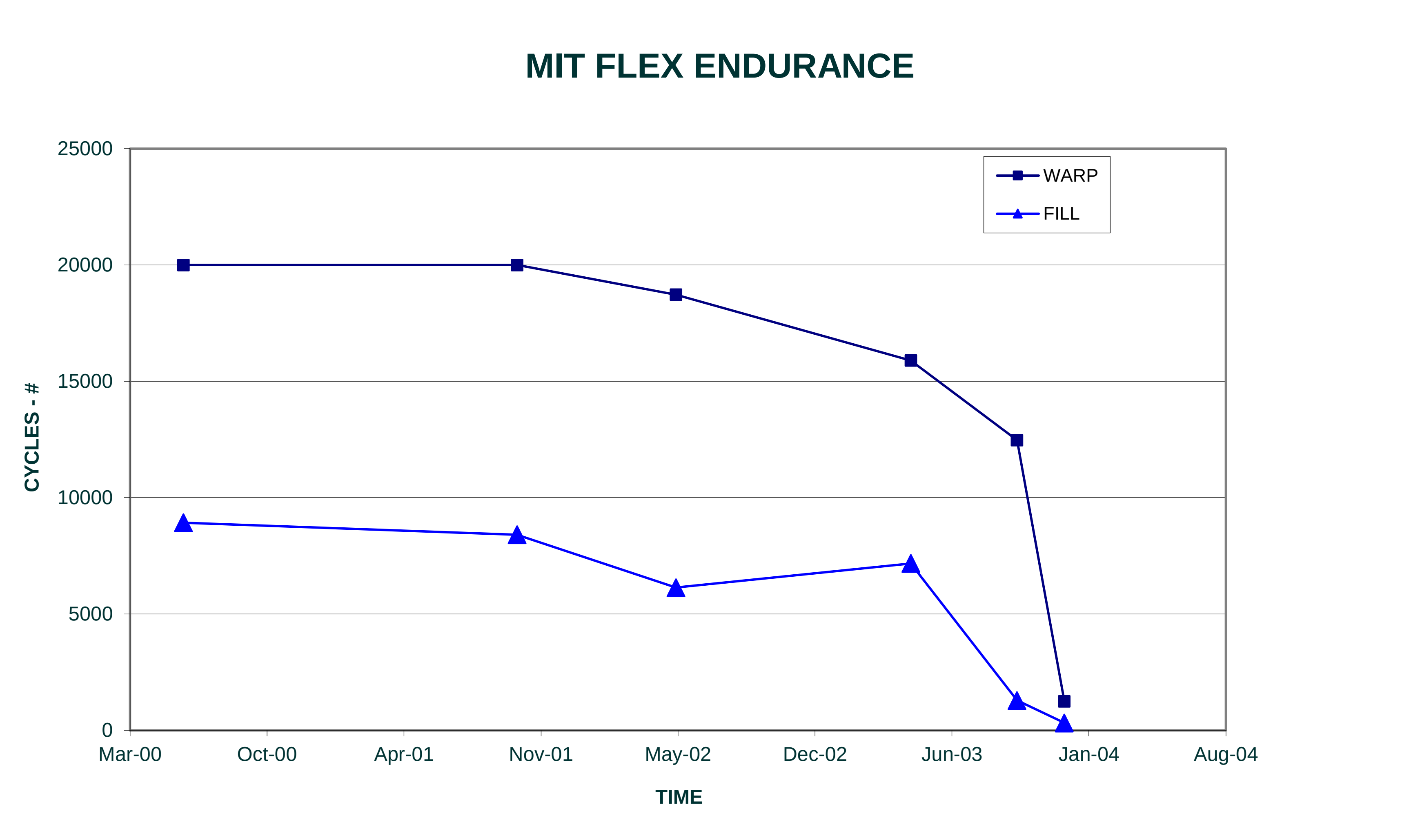
Fabric Type A

Bag Status	Tensile (lb/in)		Flex (#cycles)		Burst (psi)	Permeability (FPM)	
	Warp	Fill	Warp	Fill		Dirty	Clean
New	232	226	3100	778	405	68	68
4-wk	117	57	550	68	209	10.9	83

Fabric Type B

New	123	109	> 50,000	> 50,000	307	37.2	37.2
4-wk	101	81	> 50,000	> 50,000	263	10.8	36.2

Bag Monitoring



Bag Monitoring Program: Example

UNIT 1		
1-13		1-14
1-11		1-12
1-9		1-10
1-7		1-8
1-5		1-6
1-3		1-4
1-1		1-2

6 mo.	Initial Test	3 bags
1 yr.	2nd Test	3 bags
18 mo.	3rd Test	3 bags
2 yr.	4th Test	3 bags
30 mo.	5th Test	2 bags
33 mo.	**	4 bags
36 mo.	**	4 bags

** When fabric deterioration accelerates,increase testing frequency to every 3 months with four bags per pull/test

Test Bag location random – never same hole

Each program is custom designed

Managing Bag Life – An Action Plan

- SELECTION - Select media for the inlet gas constituents & process operation.
- SPECIFICATION - Specify filter media, thread, bag and hardware.
- QUALITY ASSURANCE - QA/QC program to insure what is delivered meets the spec.
- INSTALLATION - Oversee the installation of the bags and perform leak tests.
- BAG MONITORING - Test periodically. Increase frequency if strength or permeability decline steeply.
- IDENTIFY & CORRECT – Immediately fix any leaks or high ΔP.

Preventing the dust from entering the "clean side" of the baghouse and bags is a must.

THANK YOU FOR LISTENING

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Questions?