

REINHOLD ENVIRONMENTAL Ltd.



2011 APC Round Table & Expo Presentation

July 11-12, 2011, in Cleveland, OH / Hosted by FirstEnergy

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Fabric Filter Bag Life Optimization

Presented at:

2011 APC Roundtable
Cleveland, Ohio

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Introduction

- ◆ Causes of Premature Bag Failure
- ◆ Design Considerations and Trade-Offs
- ◆ Preventive Maintenance Programs
- ◆ Importance of Fabric & Bag Specifications
- ◆ Quality Assurance/Quality Control
- ◆ Bag Monitoring Programs
- ◆ Extending Bag Life



Premature Bag Failure: Factors Effecting Bag Life (PJ & RA)

- ◆ 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

◆ Chemical

- Acids
- Alkalies
- Condensation
(Organics, Acids,
Water)

◆ Thermal

- Excessive
Temperature
- Dew Point



Premature Bag Failure:

Typical Causes of Pulse Jet Bag Failures

- ◆ Dust on "clean side" – accelerates bag-to-cage wear
- ◆ High velocity dust abrasion - Bottom of bag
- ◆ Chemical attack from flue gas contaminants coupled with acid dew point excursions
- ◆ Bag-to-cage abrasion - Bad fit, poor design, damaged cage
- ◆ Bag-to-bag abrasion - Too close, bent cages, high can velocity
- ◆ Mechanical abrasion in top 1/3 of bag - misaligned Venturi or pulse pipe
- ◆ Process upset conditions - Fabric temperature capability exceeded; particulate is introduced to blind or attack the fabric



Premature Bag Failure: Case Study 1 – Pulse Jet Bag

Case 1:

1 bag tested, CFB, Fiberglass w/ePTFE membrane

Results:

Holes on horizontal ring spacers, abrasions on collection side, fill direction flexes low, “clean side” dust present

Conclusions:

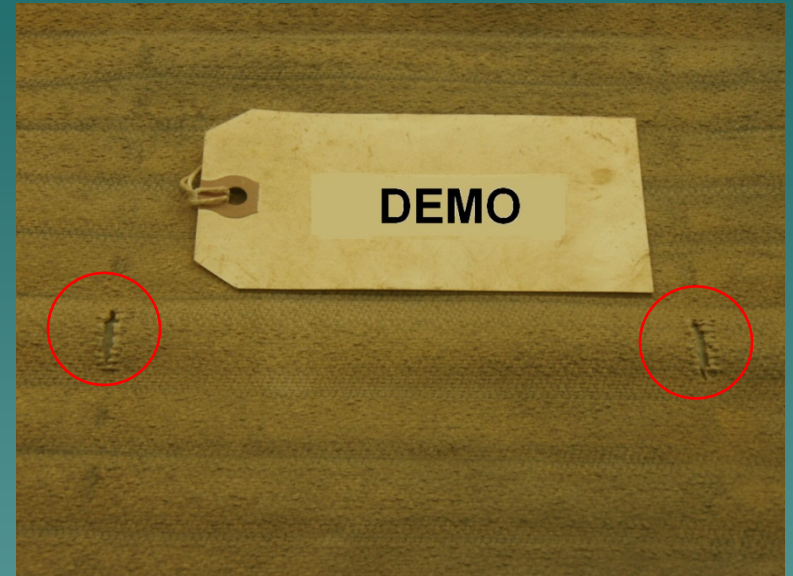
Physical damage consistent with bag-to-cage abrasion

Possible causes - excessive cleaning of bags, dust or rust on cage rings, improper bag-to-cage fit

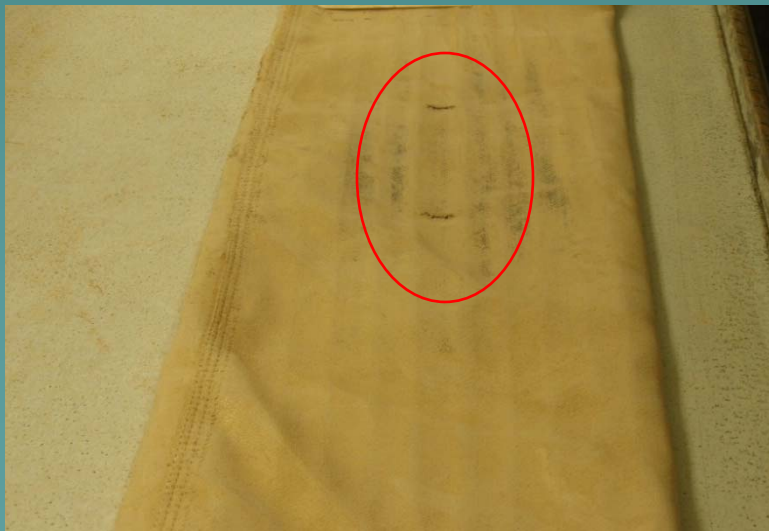


Premature Bag Failure: Case 1 Photos – Pulse Jet

Holes at horizontal
ring spacers in
middle of bag
(non-collection side)



View of holes at
horizontal ring
spacers from
collection side



Premature Bag Failure: Case Study 2 – Pulse Jet Bag

Case 2:

1 bag tested, CFB, Felt

Results:

Low perms, pearling of dust, strong cage lines, moderate dust on clean side, holes along or in between vertical stringers

Conclusions:

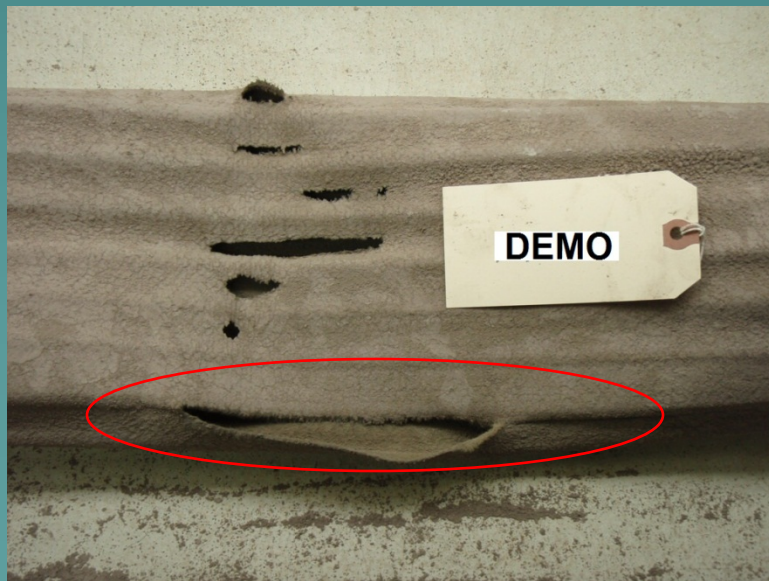
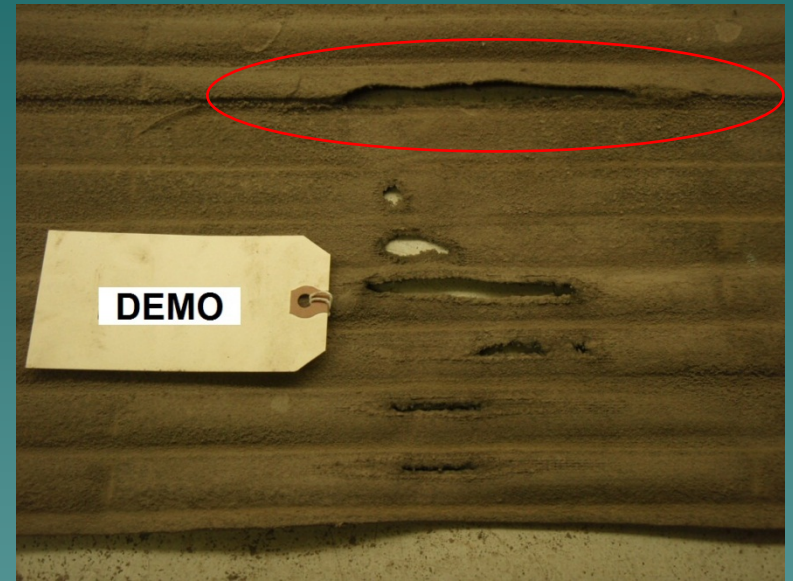
Good strength retention, low perms due to “clean side” contamination, larger hole on a cage line was first to form allowing dust to enter and “sandblast” other holes from inside out. Bag had excess fabric around circumference – bag-to-cage fit issues.



Premature Bag Failure

Case 2 Photos – Pulse Jet

Large hole along vertical wire cage line & seven resulting holes (non-collection side)



View of all holes along or in between cage lines from collection side



Premature Bag Failure: Case Study 3 – Pulse Jet Bag

Case 3:

1 bag tested, Fly Ash/Coal Dust, Fiberglass w/ePTFE membrane

Results:

Clean side dust, low perm recovery, failure on vertical cage line, missing membrane in multiple areas

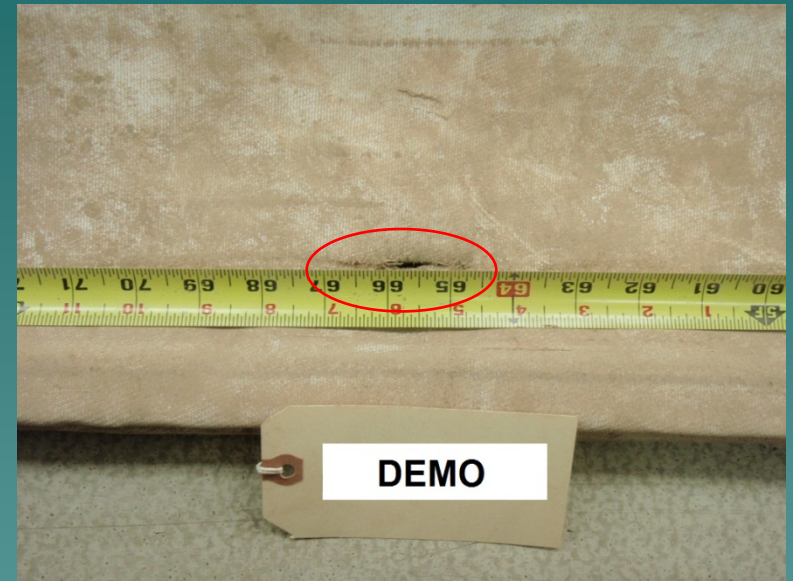
Conclusions:

Missing membrane possibly due to manufacturing problem – allowed dust penetration and subsequent abrasion at cage line causing holes to form



Premature Bag Failure Case 3 Photos – Pulse Jet

Bag failure along
vertical cage line
(collection side view)



Areas of missing
membrane on the
collection side



Premature Bag Failure:

Typical Causes of Reverse Air Bag Failures

- ◆ High velocity dust abrasion - Inside bottom of bag
- ◆ Chemical attack from flue gas contaminants coupled with acid dew point excursions
- ◆ Bag-to-bag abrasion - Low tension, too close, stretching, misaligned support racks
- ◆ Bag-to-metal abrasion - Interference with walls or support structure
- ◆ Improper bag to thimble attachment - Results in high velocity leakage path
- ◆ Process upset conditions - Fabric temperature capability is exceeded; particulate is introduced to blind or attack the fabric
- ◆ Accidents - Fires or explosions
- ◆ Improper bag fabrication or incorrect design



Premature Bag Failure

Case Study – Reverse Air Bags

Case 1:

7 bags tested, CFB, Fiberglass w/ePTFE membrane

Results:

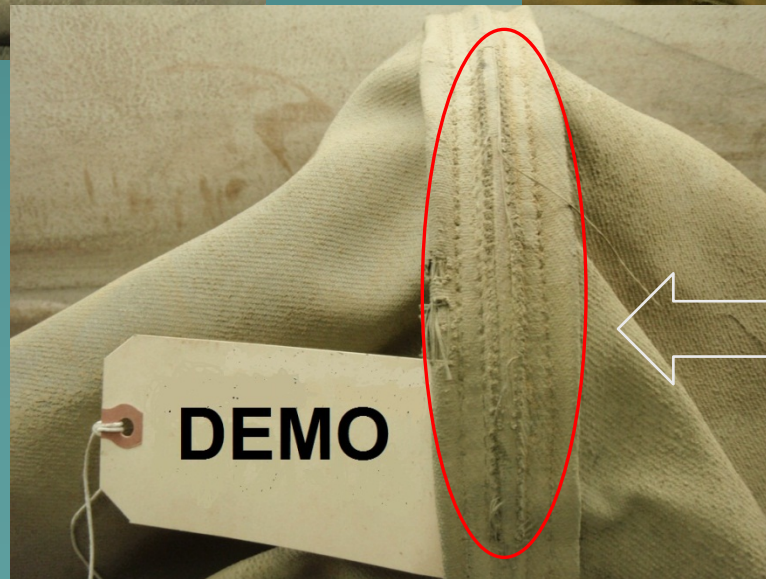
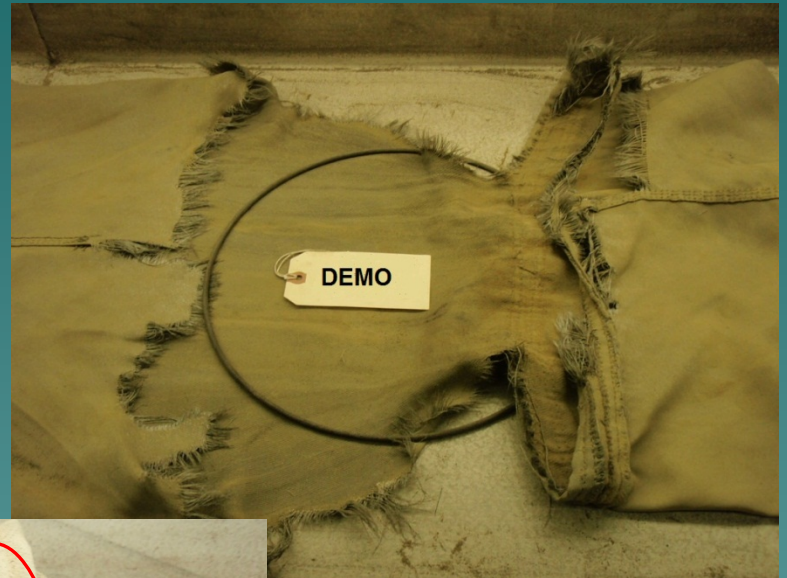
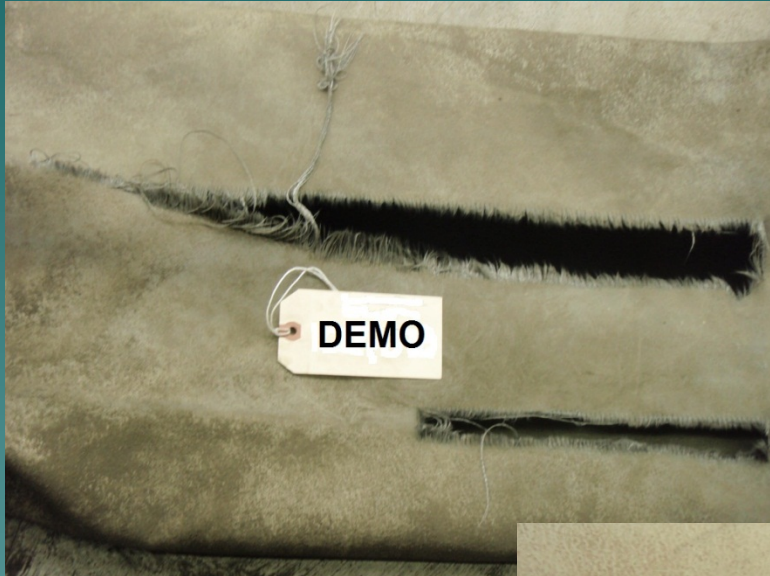
Severe abrasion, holes, perm loss, strength loss, low fill flex (leading indicator of fabric degradation)

Conclusions:

- ◆ Dust entered clean side via holes – low perms
- ◆ Under tensioning of bags – bag to bag abrasion



Premature Bag Failure: Case Study - RA Bag Photos



Ring cover
fabric
abrasion



Design Considerations & Trade-Offs

- ◆ Provide Required Filtration
- ◆ 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 Filter Categories

- ◆ Capacity
- ◆ Filtering Temperature
- ◆ Operating Duty

Needs
Dictated By
Specific
Application

- ◆ Cleaning Method
- ◆ Filter Media
- ◆ Filtering Gas Flow Direction

Options



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

- ◆ Scrim
- ◆ Coatings/Treatment
- ◆ Hardware
- ◆ Blends



Preventive Maintenance Programs

Daily PM Checks

- ◆ Opacity
- ◆ Pressure Drop(s)
- ◆ Cleaning System (and Dampers)
- ◆ Temperatures In/Out
- ◆ Dust Removal System
- ◆ Fan Temperature/Vibration



Preventive Maintenance Programs

Weekly PM Checks

- ◆ Internal Walkthrough of Clean side
- ◆ Internal Inspection of Hopper(s)
- ◆ Cleaning System
- ◆ Dust Removal System
- ◆ Access Doors Leakage
- ◆ Instrumentation Sensors/Lines/Data
- ◆ Review Daily PM Checks



Preventive Maintenance Programs

Compartment Outage Checks

- ◆ Internal Inspection of Bags, et. al.
- ◆ Internal Inspection of Hopper(s)



Preventive Maintenance Programs

Annual or Extended Outage Checks

- ◆ Same checks as Prior Slide, Plus:
 - Internal Inspection of Ducting
 - Check Expansion Joints and Turning Vanes
 - Check Dampers



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



Filter Bag Specification

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Appendix A – Baghouse Operating Data

Appendix B – Coal Analysis

Appendix C – Pulse Jet Bag And Cage Drawing

Appendix D – Fabric and Thread Specifications



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: Typical Components

- ◆ What should be done in a typical QA/QC program for BFPs?
 - Dimensional and construction inspection of prototype & production of bags to verify product specifications
 - Lab validation of mechanical & physical properties of fabric
 - Filtration performance testing



Bag Quality Control Program

◆ Fabric

- Construction
- Tensile
- Permeability
- Mullen Burst
- MIT Flex Endurance
- Finish
- Filtration Performance
- Fabric Thermal Stability (% Shrinkage)
- Organic Matter (LOI)

◆ Thread

- Material
- Strength

◆ Hardware

- Caps
- Rings
- Bands

◆ Bags

- Inspect for general quality of workmanship
- Length as fabricated
- Length under tension
- Cuff to thimble & cap mate
- Cage Fit



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 is 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 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.	2 nd Test	3 bags
18 mo.	3 rd Test	3 bags
2 yr.	4 th Test	3 bags
30 mo.	5 th 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



Short Bag Life

Physical Failure
or
Plugged Fabric



Inspection
and
Maintenance

Site Specific
or
General Problem



Inspection
and
Failure Log

Mechanical Wear
or
Chemical Attack



Lab Tests



Means of Extending Bag Life

- ◆ Quality Evaluation of New Bags
- ◆ Good Installation
- ◆ Proper Operation (Data Monitoring and Process Control)
- ◆ Regular, Responsive Maintenance
- ◆ Strong Preventive Maintenance Program Implementation
- ◆ Always Remove All Dust From Clean Side As Soon As Obvious



Review and Conclusions

- ◆ Maximize Bag Life & Minimize ΔP
- ◆ Proper Design & Detailed Specification (Rec. Low G/C)
- ◆ Sufficient QA/QC Program (Risk/Reward)
- ◆ Installation Inspection & Correction
- ◆ PM & Responsive Maintenance ASAP
- ◆ "Keep Clean Side Clean"
- ◆ Bag Set Monitoring Program and Key Data Collection & Review
- ◆ Operate Within Design Ranges (Especially Bag Cleaning Cycle)



THANK YOU FOR LISTENING

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