Reinhold Environmental Ltd.

2009 APC Round Table & Expo Presentation

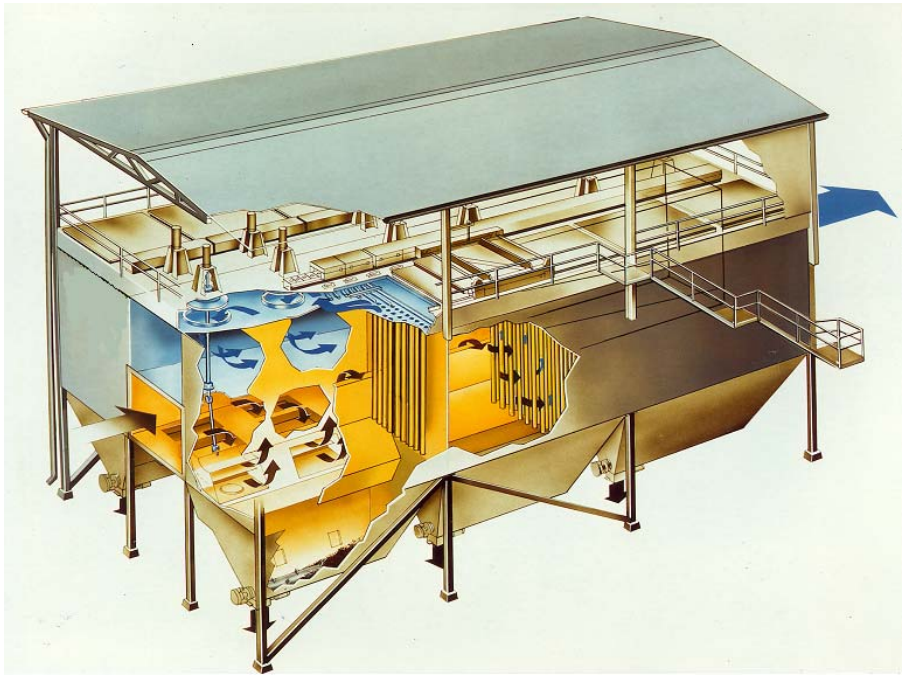
July 12-14, 2009, in The Woodlands, TX

Fabric Filter Performance Improvements

Nick Macsata & Mikael Fredriksson

Typical Fabric Filtration Operation Costs

- ID Fan Power Consumption
- Compressed Air Costs
- Bag Replacement Costs
- Sorbent Cost for DFGD'S



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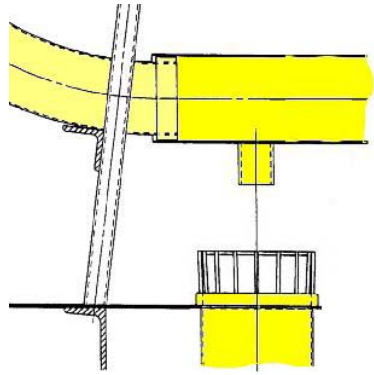
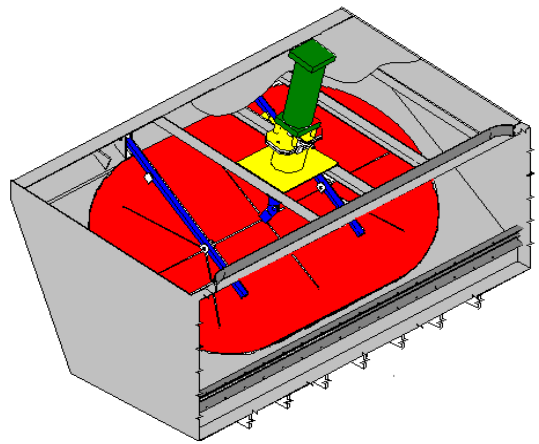
Causes of Higher Costs

- System Airflow Design
- Pulse Technology
- Improperly Functioning Cleaning Valves
- Poor Materials Selection
- Over Cleaning
- System Leaks
- Cage/Bag Fit





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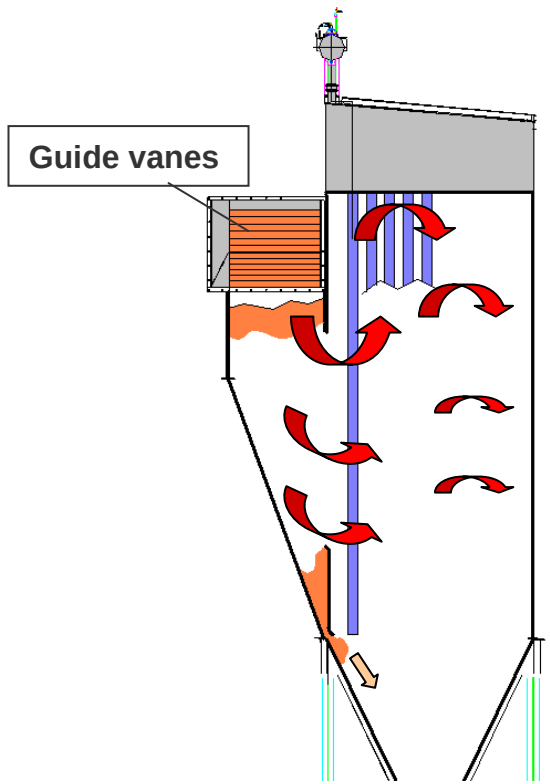
System Airflow: GOAL - Even Gas Distribution

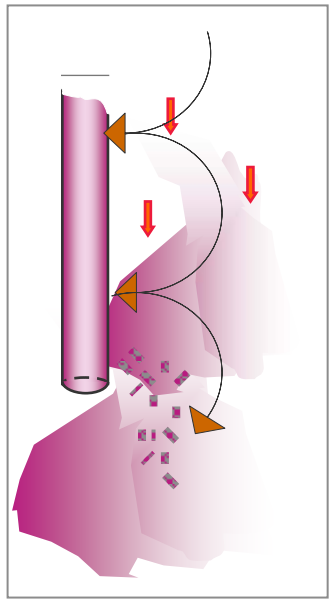
Guide vanes in inlet duct

- distributes the gas/dust evenly
- reduces gas velocity going into bag nest
- prevents wearing on bags
- allows high inlet dust concentration

Gravimetrical gas flow in bag nest

- enhances released dust flowing downwards to hopper





DOWNWARD GAS AND DUST FLOW

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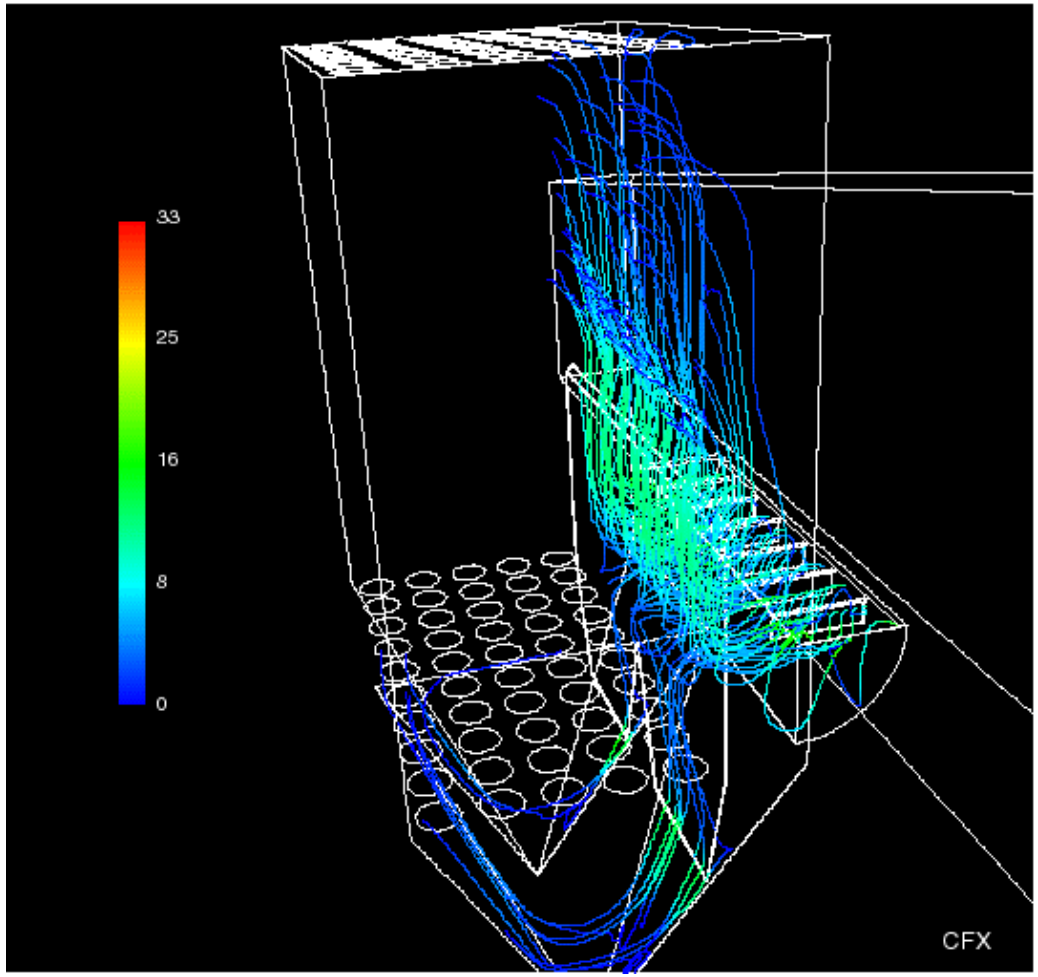
CFD Modeling



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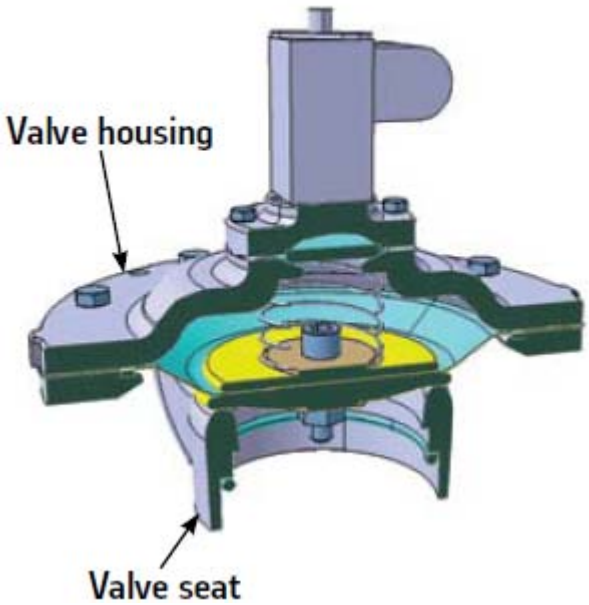
Pulse Valve Designs

Conventional



Membrane

Advanced

Plunger

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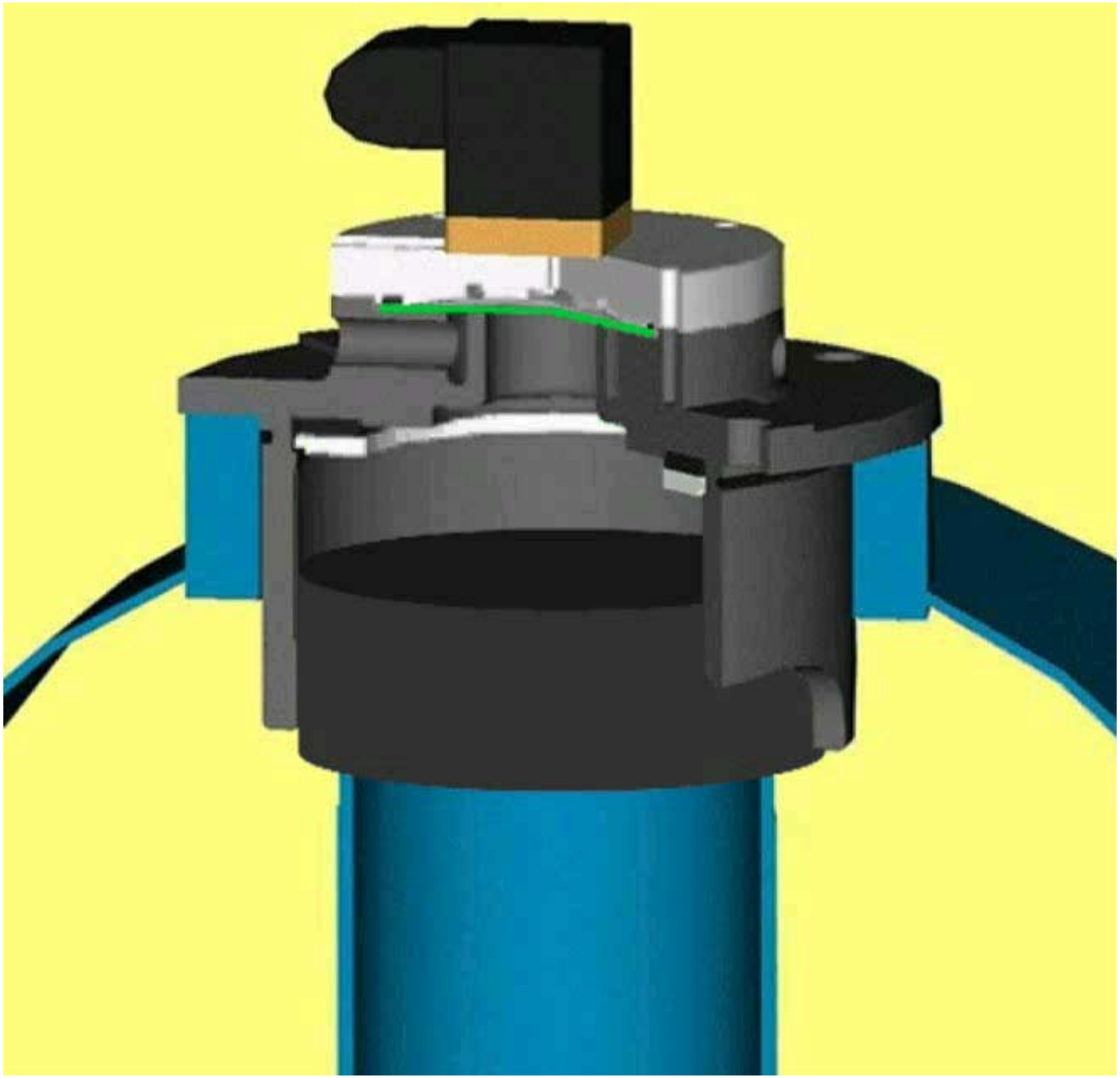

Fabric Filter Service
Conventional pulsing with venturi

Conventional method

Characteristics

Long and slow pulse

High pressure

Additional air slows the pulse even further

The pulse will not travel the full length of a long bag

Dust cake is blown to pieces

Poor cleaning of the top and bottom part of the bag

Higher residual pressure drop

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Fabric Filter Service
Cleaning method with advanced designed valve

Pulsing

Short high energy pulse at low pressure

Covers full length of >10 m bags

Dust cake is broken up

Flushing

Reduces re-deposition of fine dust

In depth cleaning of the filter media

Modulated return of filter media

Soft return to operation

Reduces dust emission

Increases bag life

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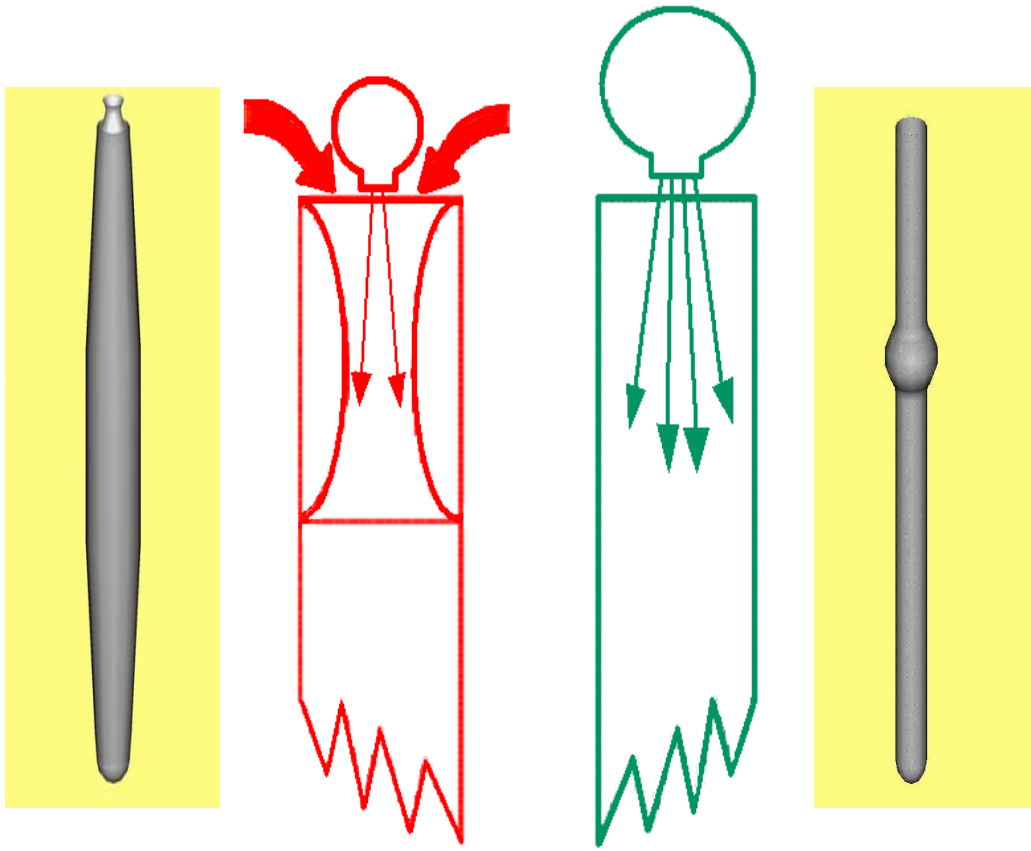
Fabric Filter Service
Pulse Cleaning Principles

Conventional
High Pressure
5 – 7 Bar

Ejected Pulse
Secondary air 6 – 7 times the Volume of primary air flow
- Long pulse
- Slow pulse
- Short bag length



Advanced
Low Pressure
≈ 2 – 3 Bar

Direct pulse
Primary air expands direct Into the bag
Secondary Air 1 – 2 times the primary Air
- Fast and short pulse
- "Deep" pulse enables longer bags

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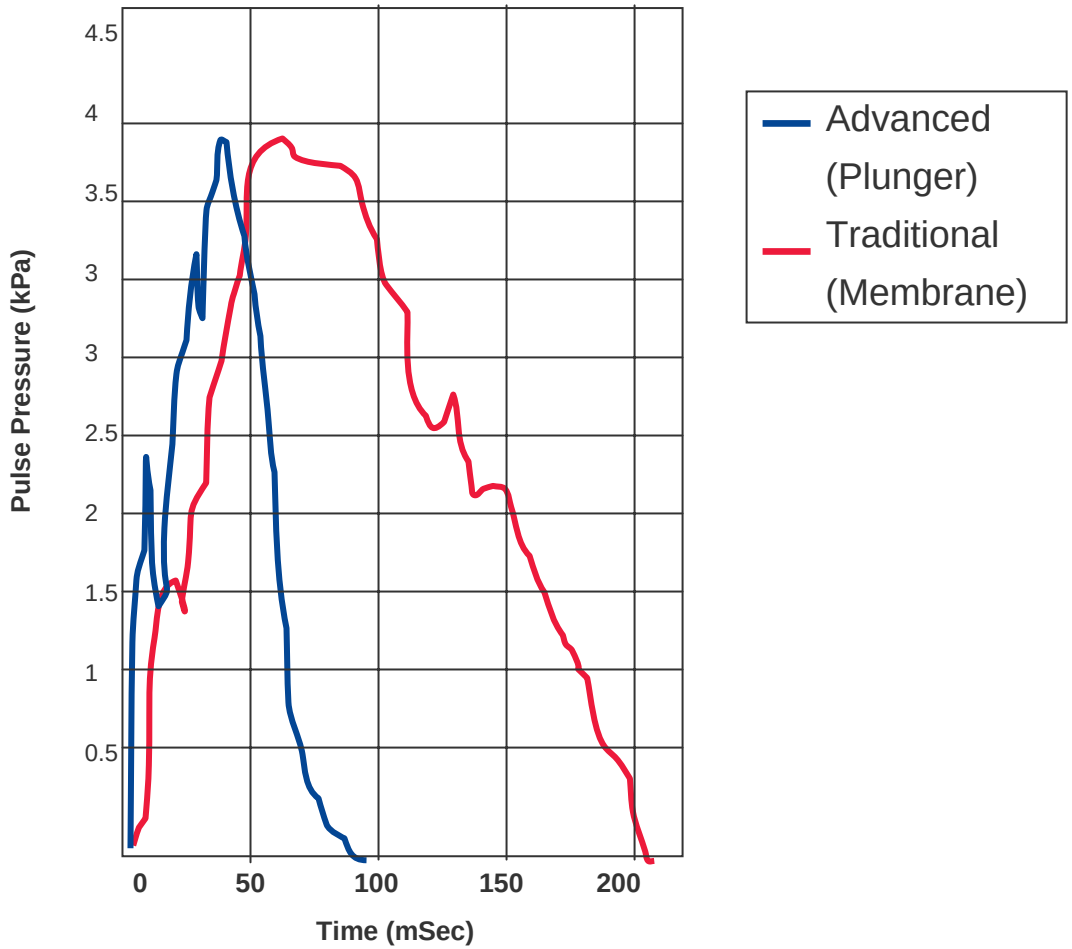
Fabric Filter Services
Efficient Pulse

Benefits:

- Cake Release
- Cleaning of Bag
- Longer Bag Life
- Less Frequent Cleaning
- Lower △Pressure



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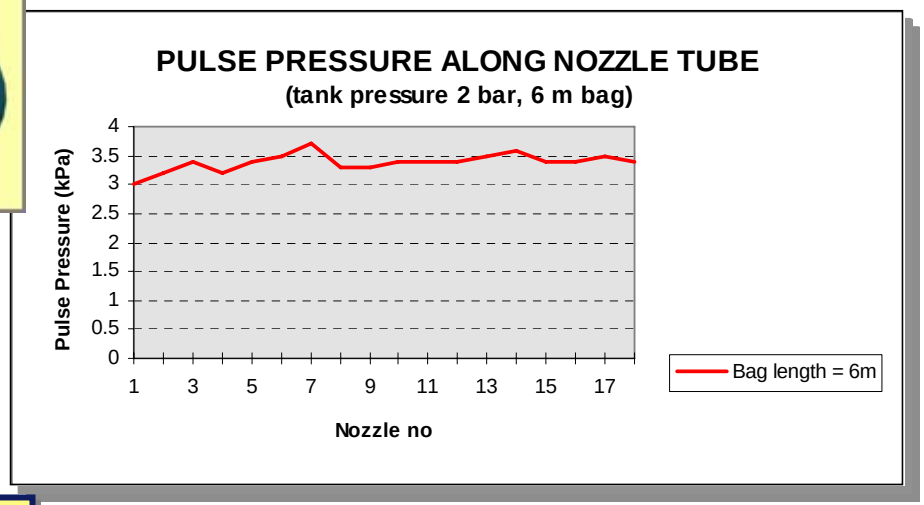
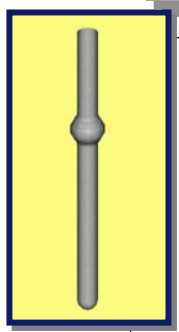
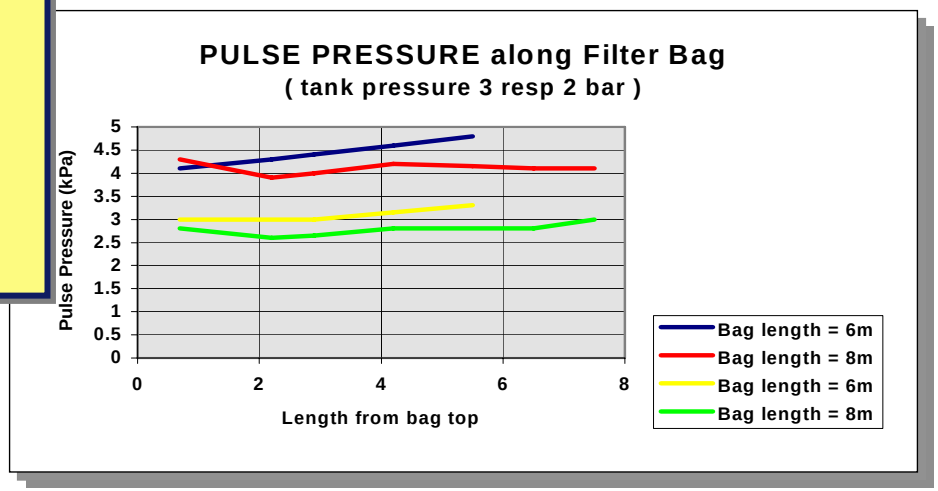
Fabric Filter Services

High efficiency pulse

- Large area system gives minimum △pressure losses
- Several long bags can be cleaned with one valve
- Quick, sharp pulse gives high acceleration to bag/dust layer
- Equal cleaning pulse to all bags in a row (standard up to 30 bags)
- Equal cleaning effect along the whole bag (up to 10 m tested)







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Fabric Filter Controller Functionality

Basic

Features:

- Pulse cleaning:
  - Time & Diff. Pressure control
- Pulse Setting
  - Time, Order & Interval Time

Advanced

Features:

- Filter Drag Control
- Bag Status Monitoring
- Valve Fault detection
- Modulated Pulse Control

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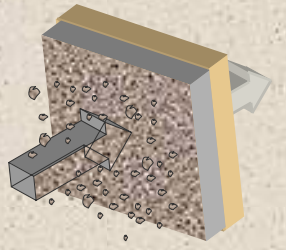
Fabric Filter Service
Advanced Fabric Filter Controller

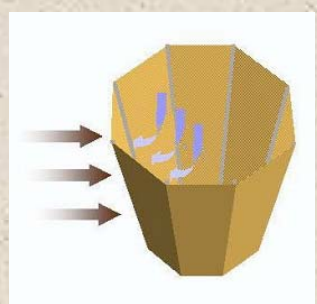
Monitoring System

Filter Drag Control



Valve Fault Detection

Modulated Pulse Control



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Fabric Filter Service
Advanced Monitoring

- **Software Package for Monitoring and Control of Fabric Filters**
- **Real-time process monitoring**
- **Automatic background alarm management**
- **Real-time and historical trending**
- **Data logging for display in graphic trends or in reports.**
- **On line diagnostics and control via modem**

Benefits

- Control becomes more accurate
- Operational reliability is improved
- Long term tuning will give an optimized operation with lower overall costs

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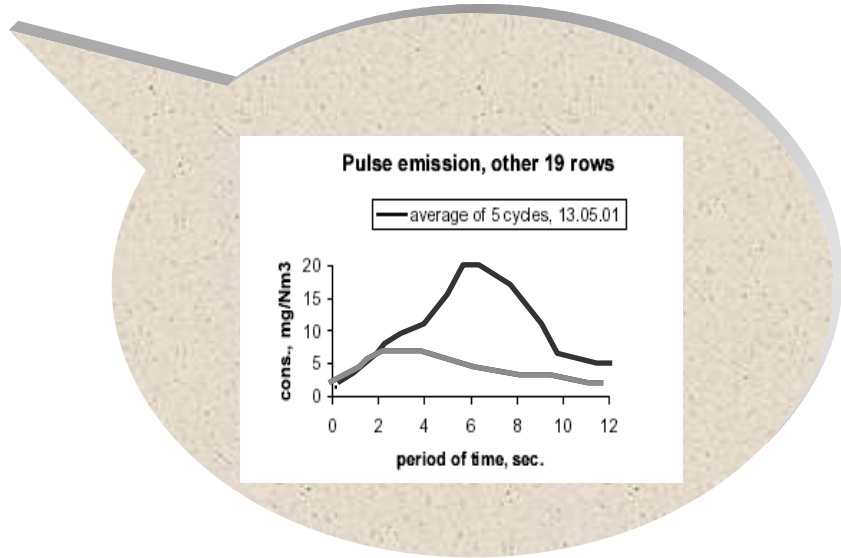
Fabric Filter Service
Bag Status Monitoring, BSM

On line Bag Status Monitoring

- Prediction of residual bag life
- Easy localisation of deteriorated bags
- Emergency shut downs are avoided
- Load limitations can be avoided



BENEFITS

- Higher availability
- Optimised bag life
- Easier maintenance
- Optimised outage planning

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Fabric Filter Service
On line Bag Status Monitoring, BSM

On line Bag Status Monitoring
- Prediction of residual bag life
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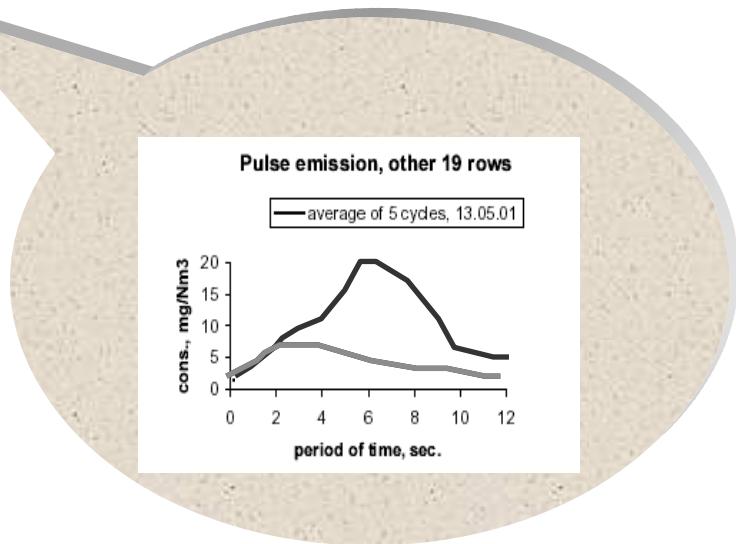

BENEFITS
- Higher availability
- Optimised bag life
- Easier maintenance
- Optimised outage planning

With Trending Systems:
- History of Diff. Pressure
- Trending of Filter Performance
- Storing of Tank Pressure data
- Storing of Opacity (emissions) data

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Fabric Filter Service
Valve Fault Detection

On line detection of faulty pulse valves

- Easy localisation of dysfunctional and leaking pulse valves
- Both Electrical and Mechanical failures are detected
- Makes maximum use of the full filter

BENEFITS

- Full performance of the filter
- Easy localisation of faulty valves
- Bag life time increase
- Loss of compressed air is avoided

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Fabric Filter Service
Valve Fault Detection

On line detection of faulty pulse valves

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- Makes maximum use of the full filter

Customer benefits

- Full performance of the filter
- Easy localisation of faulty valves
- Bag life time increase
- Loss of compressed air is avoided

Equipment needed

- Tank pressure meter

With Trending:

- Identification of Leaking Pulse Valves
- Identification of Nozzle Pipe Malfunctions

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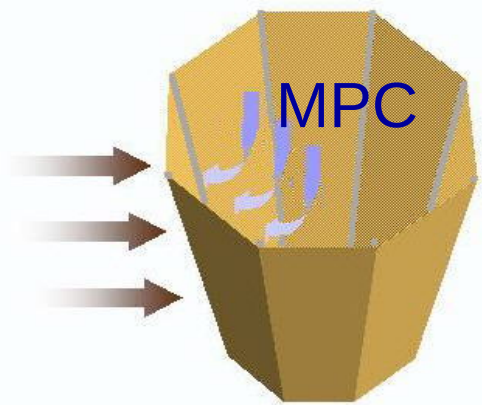
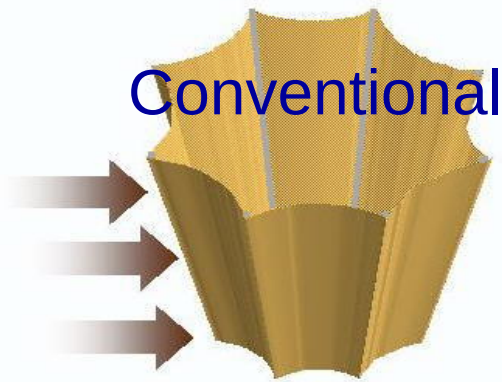
Fabric Filter Service
Modulated Pulse Cleaning

Efficient 3-phase pulsing

- Highly efficient pulse
- Flushing
- Modulated return to filtering mode





Benefits

- Increased bag life time
- Lower dust emission
- Lower Compressed air consumption
- Lower Pressure drop
- Lower additive consumption

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Fabric Filter Service
Modulated Pulse Control

Conventional Pulse Cleaning

Modulated Pulse Cleaning

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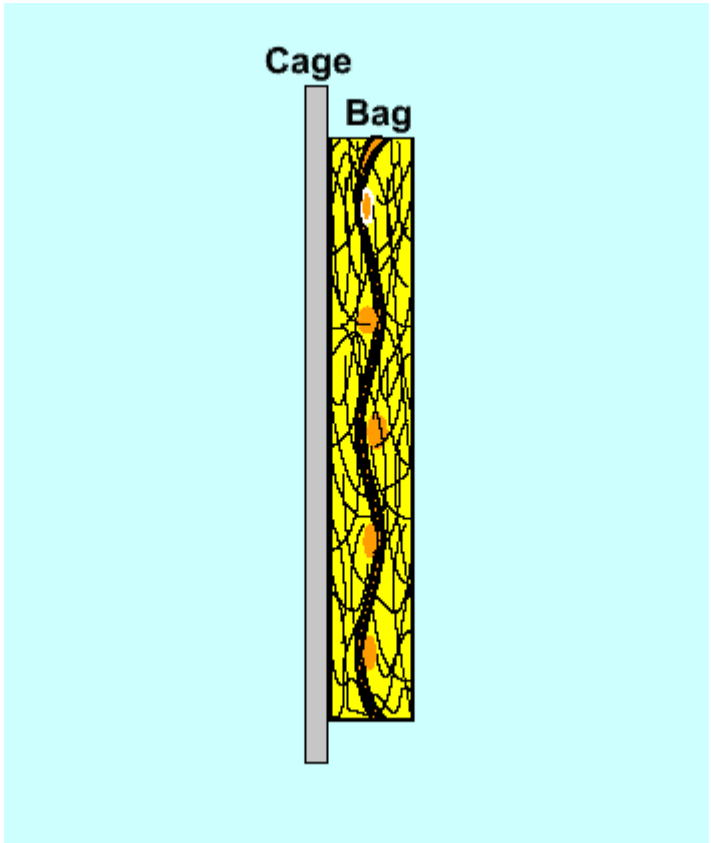
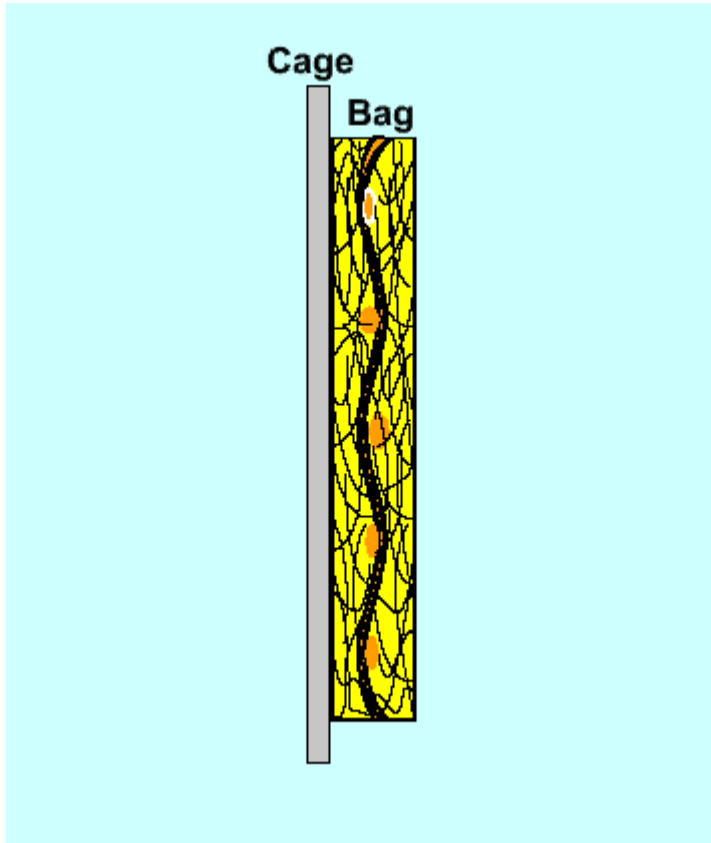
Fabric Filter Service
Modulated Pulse Control





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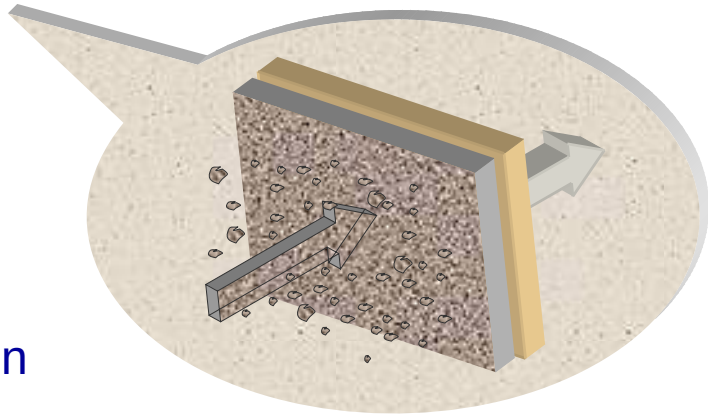
Fabric Filter Service
Filter Drag Control



Benefits
- Increased bag life time
- Lower dust emission
- Lower additive consumption
- Lower Compressed air consumption
- Lower Pressure drop

Optimised pulse cleaning adopted to filter load using Measured Filter Resistance

The Start The Resent Past TODAY

Development: Time control >>> Diff. Pressure control >>> Filter drag control

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Fabric Filter Service
Filter Drag Control

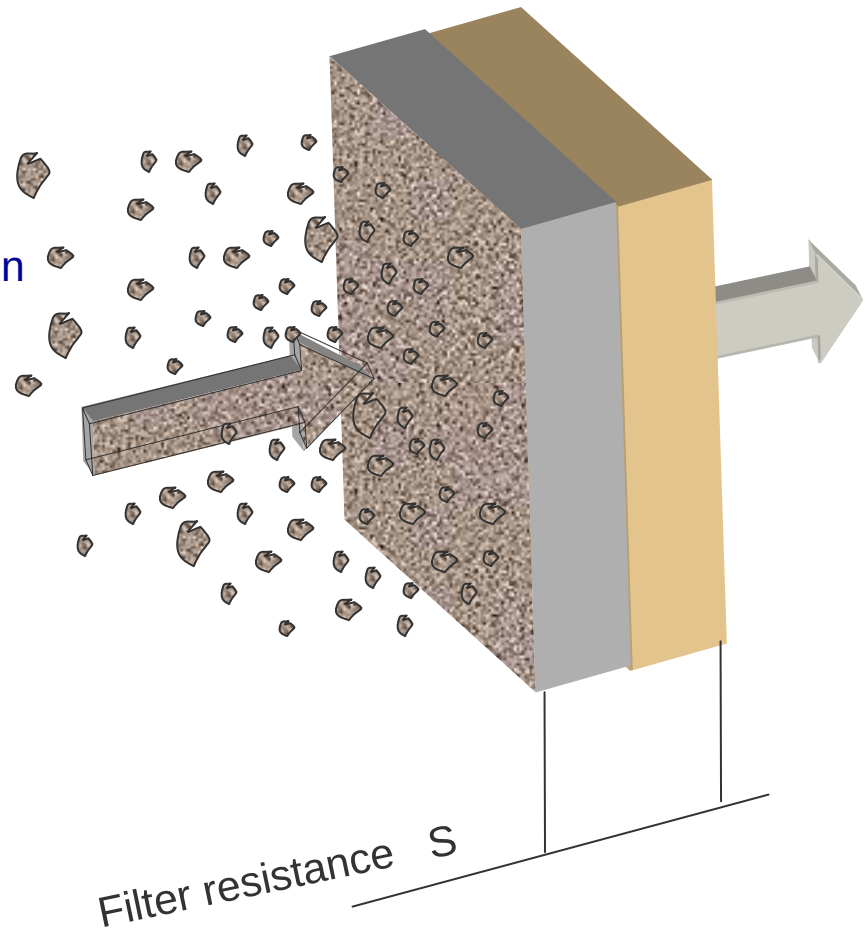
Controlled filter resistance

Controlled Filter Resistance control gives optimized filter operation.

It automatically compensates for fluctuations in the main process parameters and preserves the filtration properties at a set maximum.

A controlled filter resistance is used as a key fabric filter parameter for filter control and gives:

- Optimized pulse modes and tank pressure
- Reduced bag wear
- Improved ab/adsorbents usage
- Lower emissions
- Early warnings on sudden changes in filter media status
- Less problems in hoppers and down streams dust handling equipment and systems



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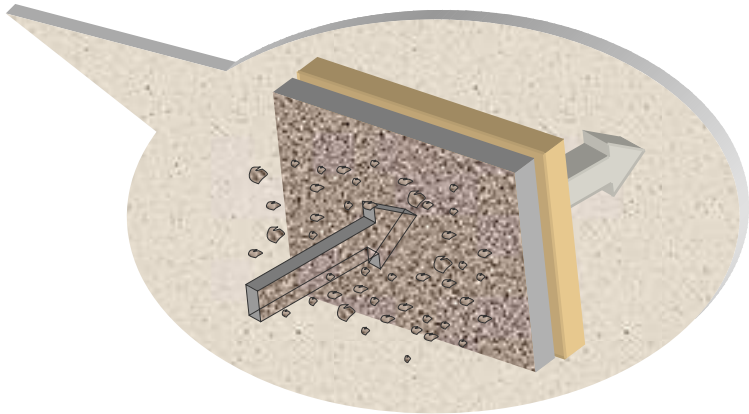
Fabric Filter Service
Filter Drag Control



Customer Benefits VS. Conventional Pulsing Control:

- Increased bag life time
- Lower dust emission
- Lower additive consumption
- Lower Compressed air consumption
- Lower Pressure drop

- **Equipment needed:**
- Gas flow sensor
- Temperature sensor

With Monitoring System:

- Automatic Ramp function
- Residual filter bag load
- Trending to determine position on load curve
- Remote Control Possibilities

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Case Study: Fabric Filter System Improvements

Swedish Waste to Energy

- Process conditions: Household waste incineration, semi-dry absorber
- P84 filter bags

Problem: Original system limited boiler capacity due to Baghouse Air to Cloth ratio

Change from conventional to advanced pulse valves

- Change enabled longer filter bags from 6 to 7 meters
- Increased air to cloth ratio by increasing cloth area in existing enclosure: 500 m^2 to 560 m^2
- Boiler load increased 7%

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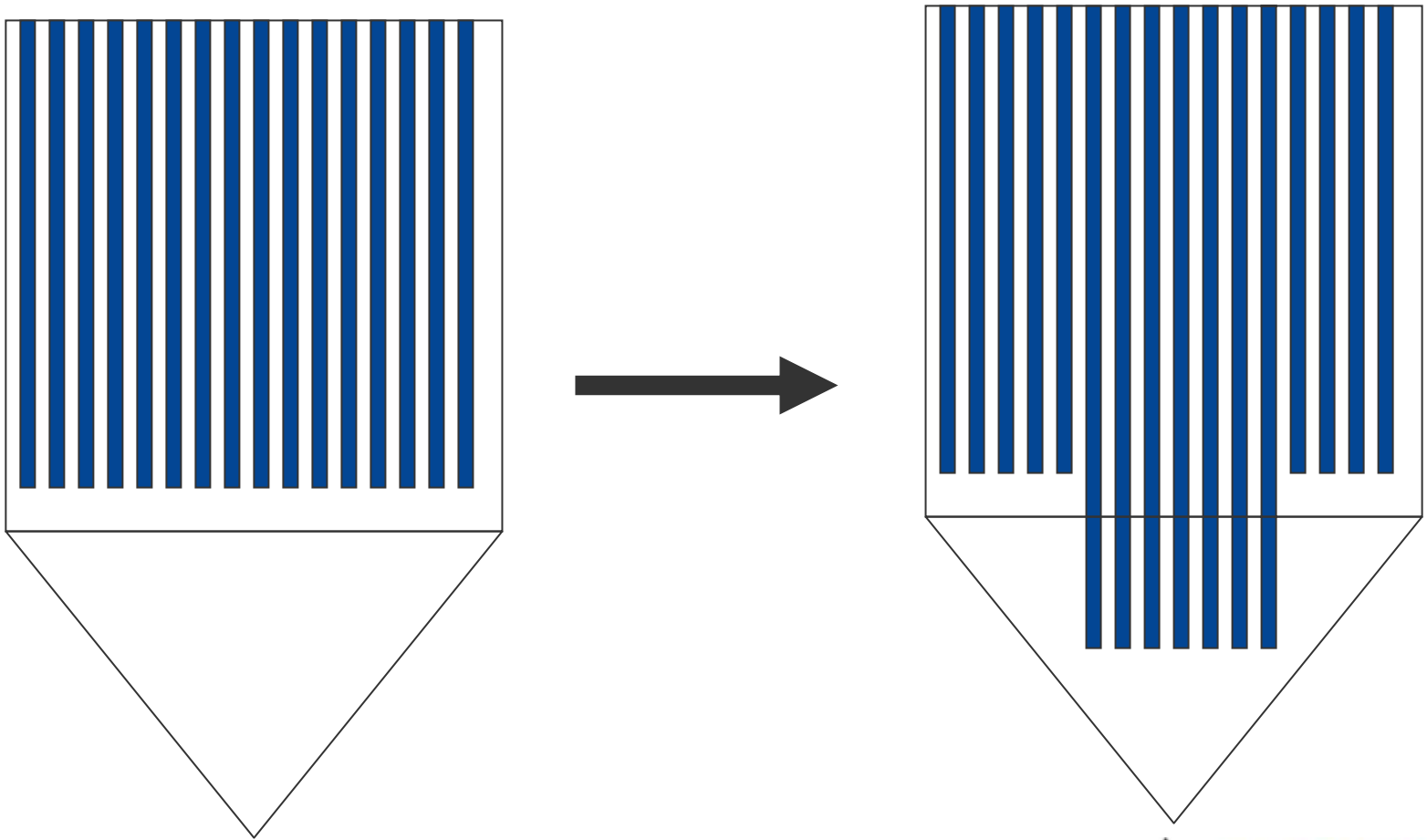
Case Study: Fabric Filter System Improvements

Swedish Waste to Energy



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Case Study: Fabric Filter System Improvements

Swedish Steel Mill

- Process conditions: Dust and water vapor → Sticky dust conditions
- PPS filter bags
- Original system had venturis with high pressure pulsing
- Original cleaning air system utilized small tanks and narrow nozzle pipes
- System choke after 5 minutes operation then taken off line for forced cleaning

Result: Severe operational problems in the production

Change to advanced 3-phase pulse valves, pressure tanks and nozzle pipes

- Filter bags were not changed
- Steady pressure drop at 1100 Pa through out the load range

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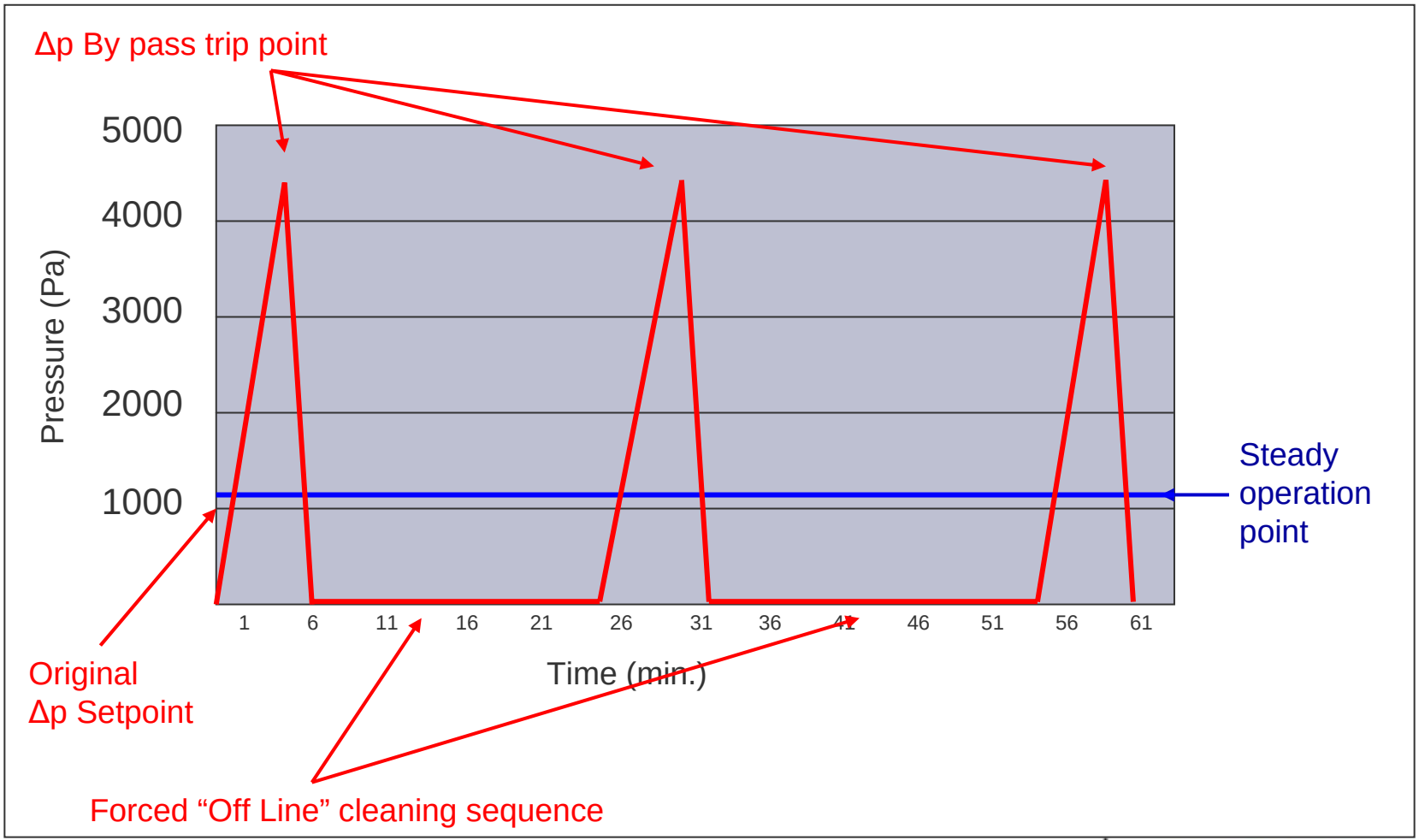
Case Study: Pulsing Improvements



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THANK YOU

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