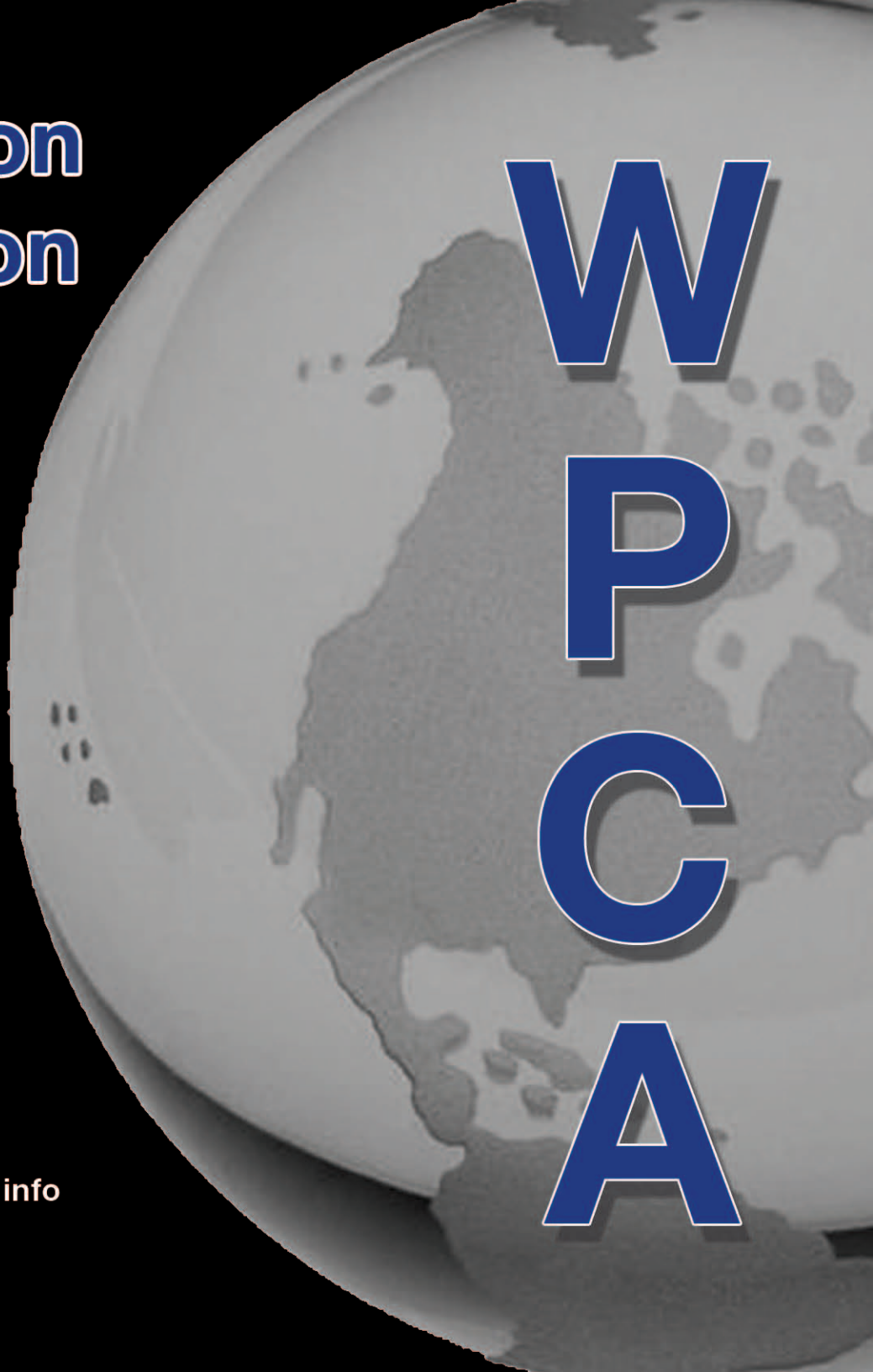
Worldwide Pollution Control Association



Dry Scrubbing O&M Training

APC/PCUG Conference
July 12-16, 2009
The Woodlands, TX

WPCA

Visit our website at www.wpca.info

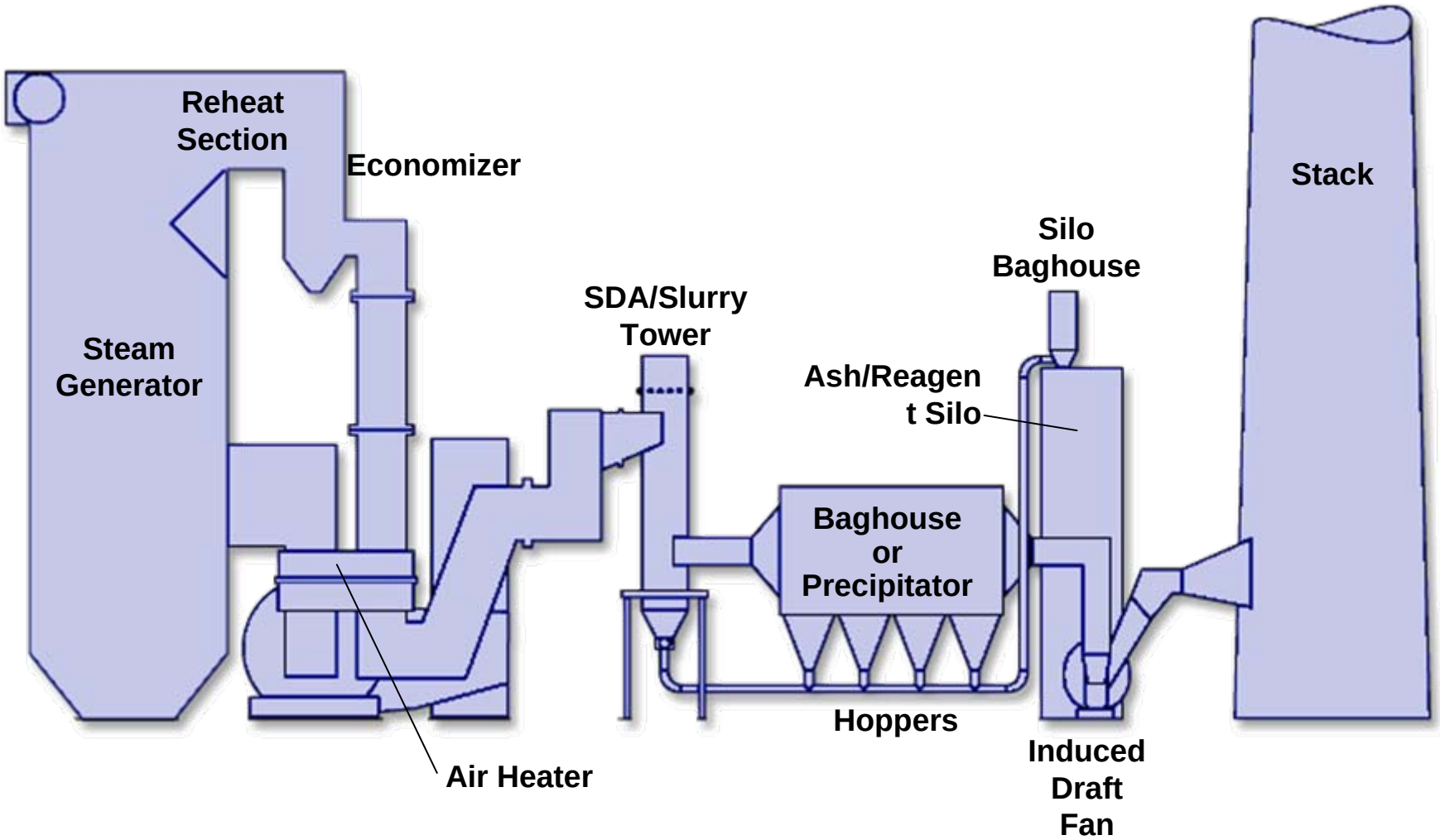
Fabric Selection and Pressure Drop Management-Pulse Jet Style Baghouses

Tim Stark

GE Energy

imagination at work

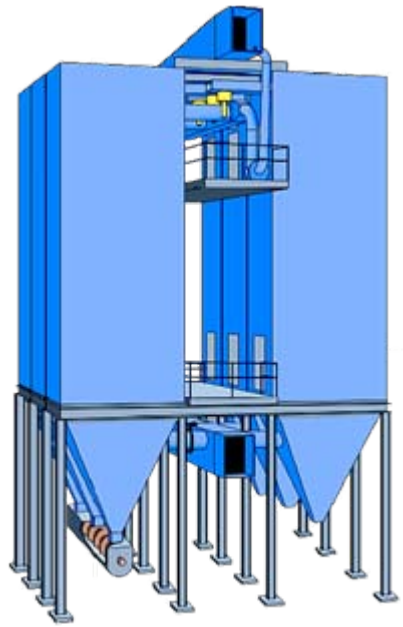
Typical SDA System Schematic

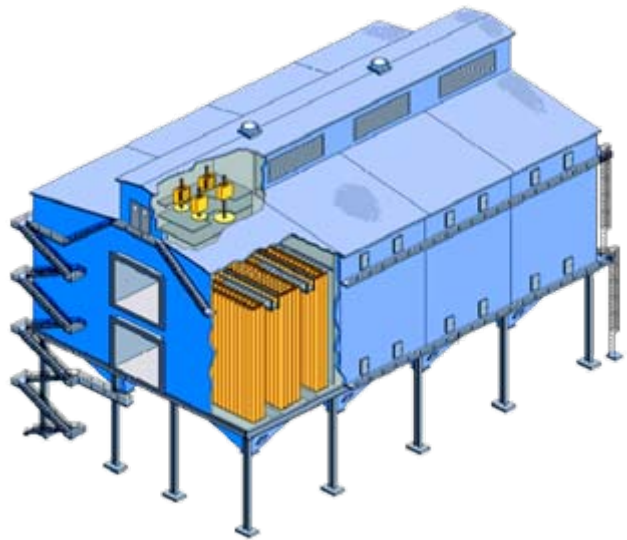


Utility Hot Gas Market APC Trends

Historically, 95% of applications utilized Reverse Air collector designs:

- > Woven Fiberglass bags
- > Woven Fiberglass with PTFE
- > 2:1 air-to-cloth ratio
- > 11.5" x 30' filters (29cm x 9m)
- > 4 – 8 year filter life
- > Large footprint housing





Utility Hot Gas Market APC Trends

In the past 10 years, the trend is moving to Pulse Jet collectors (approximately 90% of applications):

- > Felt used for under 400°F (205°C)
- > 3:1 - 4:1 Air-to-Cloth ratio
- > 3 – 6 year filter life
- > Smaller housing footprint

Municipal Solid Waste Incineration
16 MW – 65,000 ACFM

Coal-fired Industrial Boiler
110,000 ACFM

Utility Boiler
500,000+ ACFM

Hot Gas Pulse Jet Design Trends

	Pulse Pressure	Cage Type	Maximum Length	Issues
Traditional PJ High Pressure / Low Volume	60 - 100 PSI (4.1 – 6.9 Bar)	One-Piece	16 – 19 feet (4.9- 5.8m)	Housing Footprint
Medium Pressure / Medium Volume	25 – 50 PSI (1.7 – 3.4 Bar)	Multi-Piece	22 – 32 feet (6.7 – 10.0 m)	Cage wear; Penthouse restrictions
High Volume / Low Pressure	< 15 PSI < 1 Bar)	Multi-Piece	22 – 27 feet (6.7 – 8.2 m)	Cage wear; Penthouse restrictions

Factors Affecting Design

1. Pressure Drop Management
2. Emissions Control

Factors Affecting Design

Pressure Drop Management

- Essentially – Dust Cake Management

Factors Affecting Dust Cake Management

Inlet Grain Loading

- SDA – Lime Injection or other alkali
- Coals with higher ash content/lower heating value
- High volatile coals that create fine ash – form denser dust cakes
- Type of Boiler (CFB vs.. Stoker vs. PC)

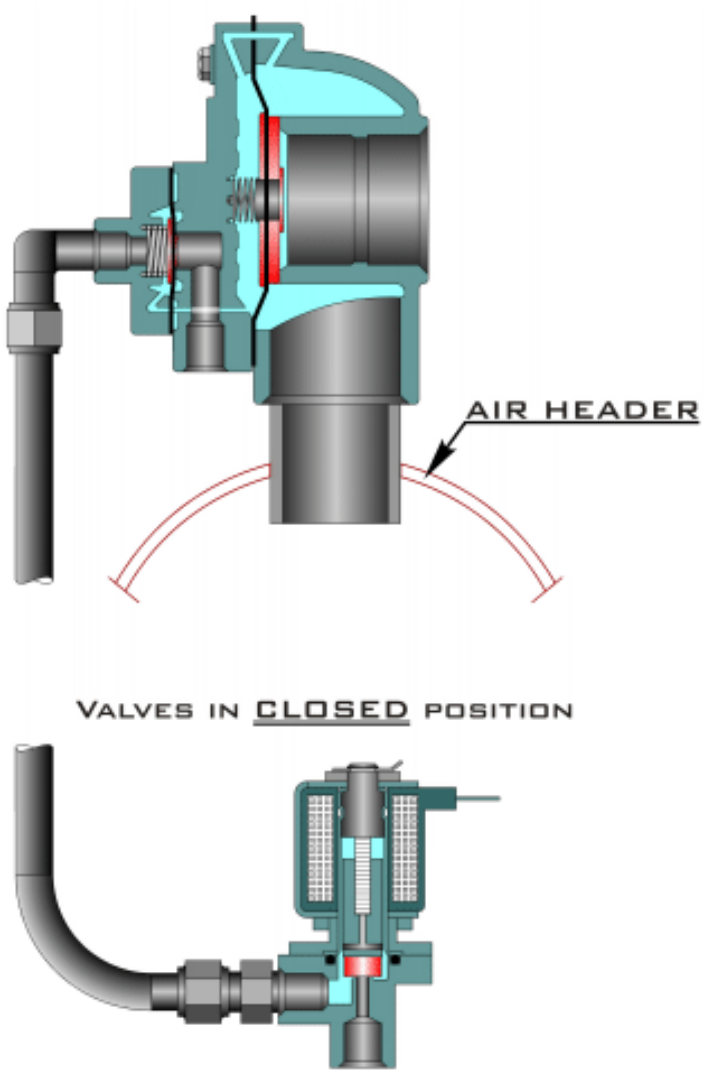
Will typically cause increase in cleaning frequency

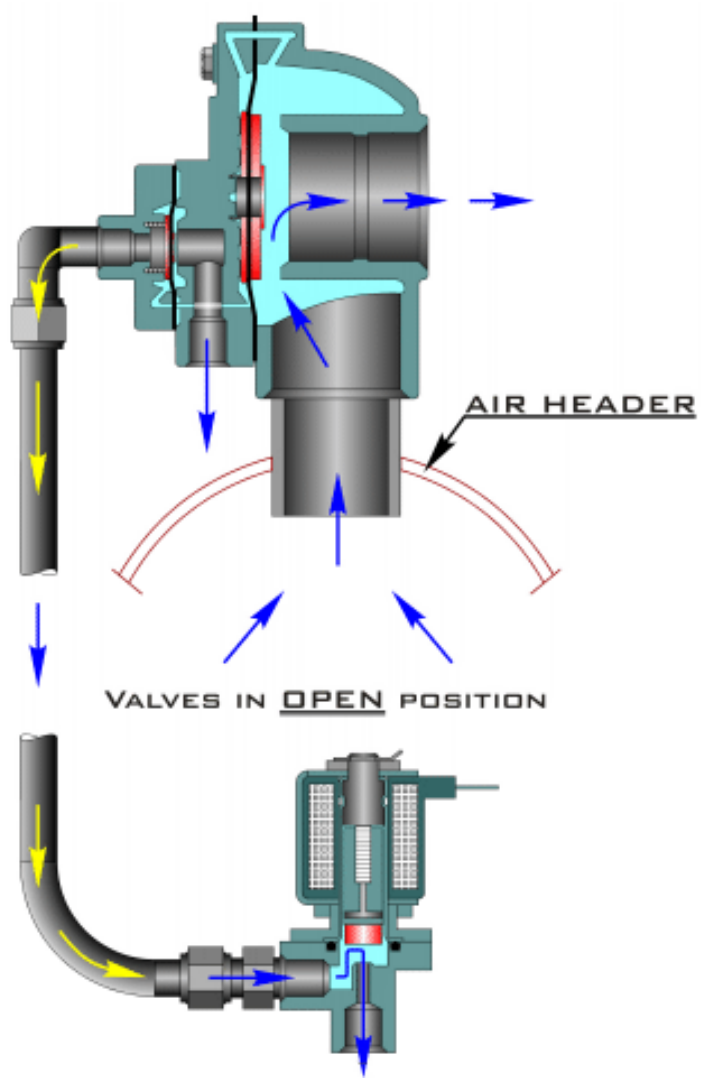
Factors Affecting Dust Cake Management

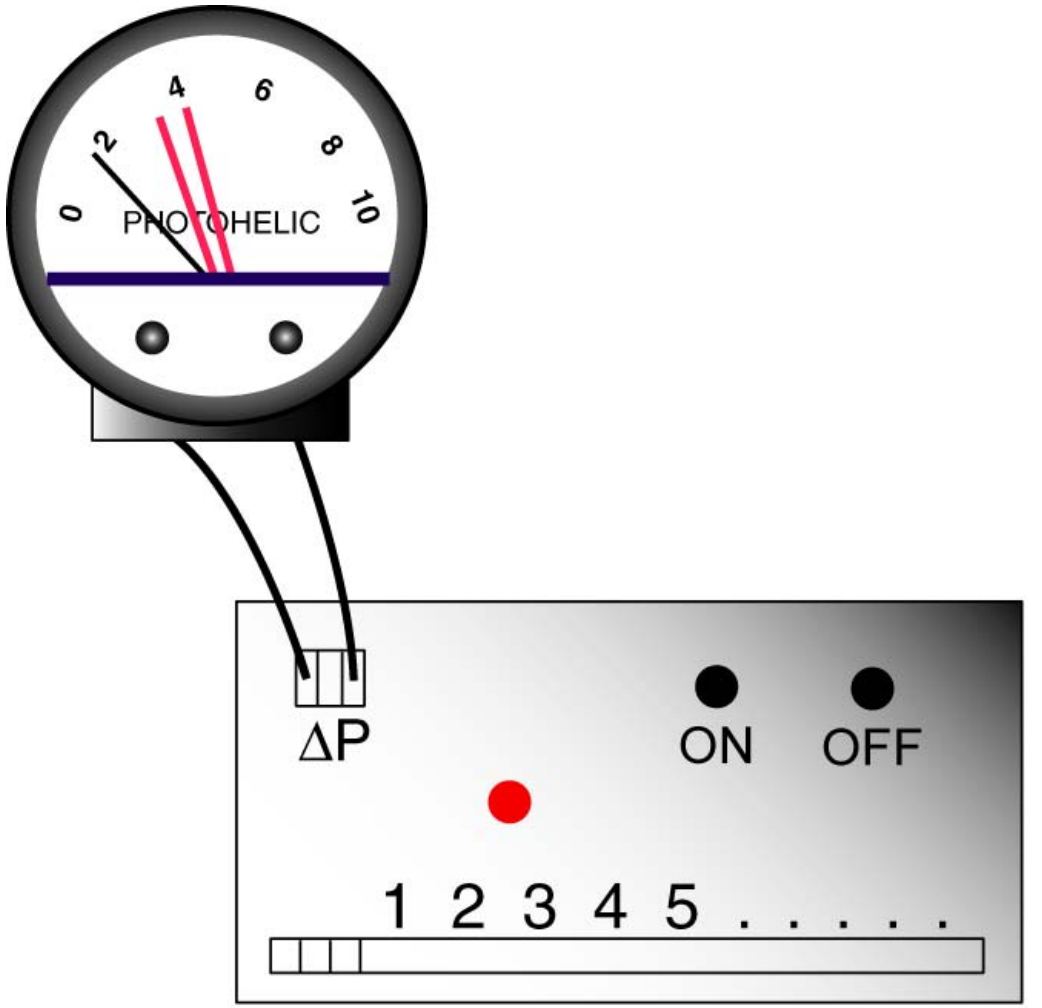
Scrubbing

- NOx – SCR or SNCR
  - » Ammonia slip can cause sticky dust (ammonium bisulfate)
- SOx – Dry FGD / SDA / Lime Injection
  - » Operating near dewpoint – possibility of condensation, mudding of bags.
- Hg – Injection of Powdered Activated Carbon
  - » Potential for fires with carbon in ash

Valve / solenoid operation



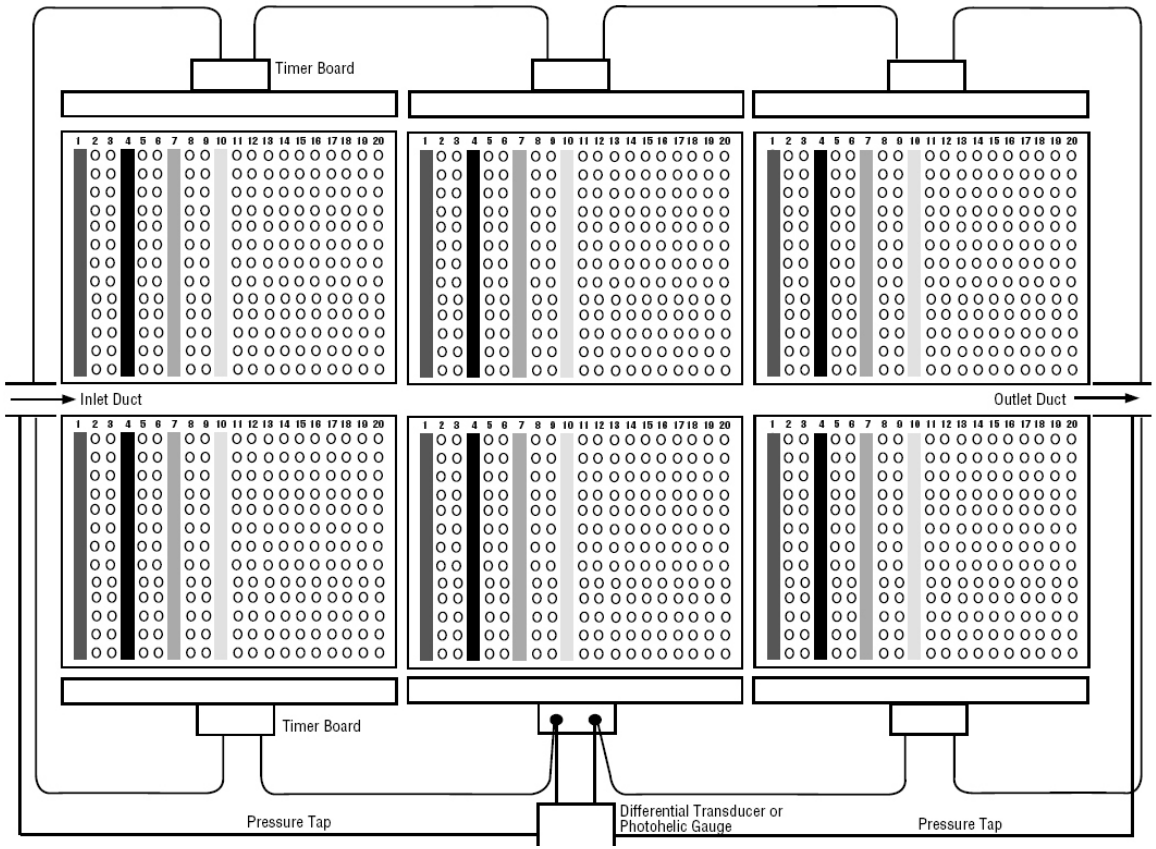




1 4 7 10 2 5 8 3 6 9

Cleaning sequence

Multi-Compartment Cleaning



Factors Affecting Design

Air To Cloth Ratio (ACR)

- Generally 2.8 to 3.5 fpm. (Net/Net)

Low Inlet and Interstitial Velocities

- <1000 fpm Inlet
- <300 fpm Interstitial

Clean-On-Demand (only when necessary)

- As load and pressure drop requires – extends filter life.

Commonly Used Filtration Fabrics
Pulse Jet & Low Pressure - High Volume

- Woven fiberglass – 25% (Industrial Boilers, IPP)
- PPS (Polyphenylene Sulfide) – 60%
- Acrylic – 10%
- P-84 – 5%
- Other
  - Fiber Blends, Coatings/Treatments & ePTFE Membrane applied to the above substrates
  - Pleated Filter Elements (PFEs)

Fabric Selection Considerations

> Baghouse Operating Temperature
> Resistance to Cleaning Energy
> Gas Stream Chemistry (Oxidizing Agents)
> Air-to-Cloth Ratio

Fabric Characteristics & Suitability for Power Generation Applications

	Polypropylene	Polyester	Acrylic	Fiberglass	Aramid	PPS	P84 ***	Teflon® ***
Max. Continuous Operating Temp.	170° F (77° C)	275° F (135° C)	265° F (130° C)	500° F (260° C)	400° F (204° C)	375° F (190° C)	500° F (260° C)	500° F (260° C)
Abrasion	Excellent	Excellent	Good	Fair*	Excellent	Good	Fair	Good
Energy Absorption	Good	Excellent	Good	Fair	Good	Good	Good*	Good
Filtration Properties	Good	Excellent	Good	Fair	Excellent	Excellent	Excellent	Fair
Moist Heat	Excellent	Poor	Excellent	Excellent	Good	Good	Good	Excellent
Alkaline Dust	Excellent	Fair	Fair	Fair	Good	Excellent	Fair	Excellent
Mineral Acids	Excellent	Fair	Good	Poor**	Fair	Excellent	Good	Excellent
Oxygen (>15%)	Excellent	Excellent	Excellent	Excellent	Excellent	Poor	Excellent	Excellent
Relative Cost	$	$	$$	$$$	$$$$	$$$$$$	$$$$$$	$$$$$$$

* *Sensitive bag-to-cage fit*

** *Fair with chemical or acid-resistant finishes*

*** *Must oversize bag for shrinkage for temperatures above 450°F (232°C)*

Filtration Application Conditions Where PPS Excels

> Continuous temperature is 375°F (190°C) or less.

> Oxygen content is 15% or less.

> Sulfur is present in the fuel, and/or oxides of sulfur are present in the flue gas.

> Moisture is present in the flue gas.

> Dew-point excursions take place

Fabric Innovations and Improvements

Fiber Blends
- PPS & P-84 – Improved efficiency

Fiber Size & Shape
- Micro-Denier fibers, etc. – Improved Efficiency

Coatings/Treatments – Release characteristics
- Teflon Baths – Coats fibers, reduces pore size

ePTFE Membrane
- Release / Recoverability, Improved Efficiency

Thank you.