REINHOLD ENVIRONMENTAL Ltd.

2017 APC & Wastewater Round Table & Expo Presentation

July 17 & 18, 2017 in Charlotte, NC / Hosted by Duke Energy

Fabric Filters – Principles, Process and Best Practices

One Source

APC & Wastewater Round Table
July 17-18, 2017

Today's presentation

- Principles of Fabric Filtration Technology
- Coal-Fired EGU Process Effects on Flue Gas
- Operation and Maintenance Best Practices
- Product Development

Principles of Fabric Filtration

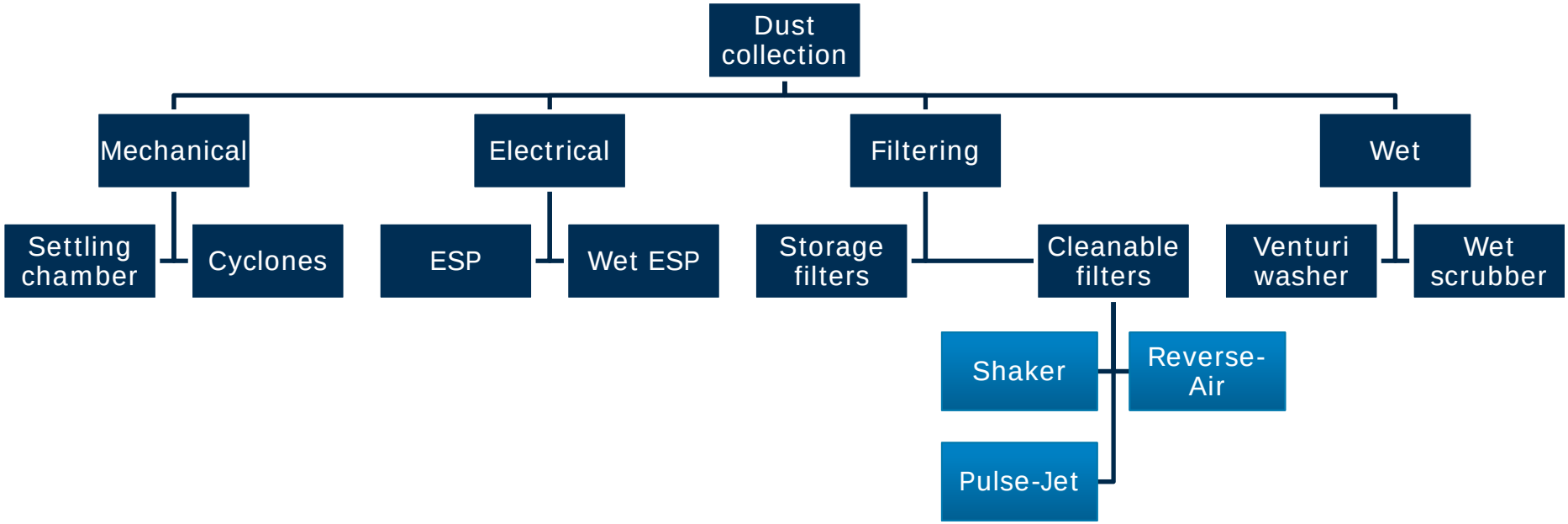
Baghouses (why)

Safety

Production and process control

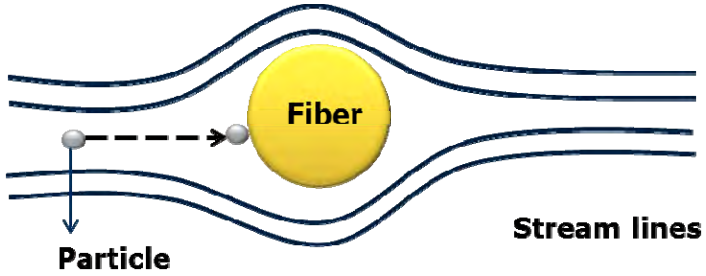
Emission control (Environmental)

Dust collection systems

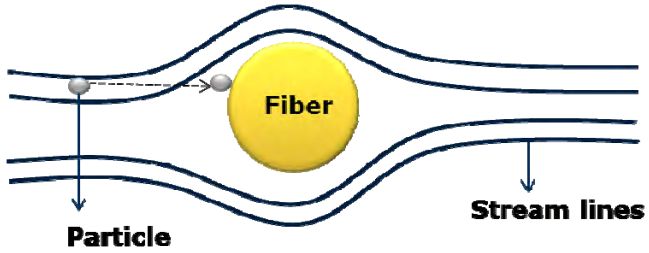


Particle Capture Behavior

- Impaction (Interception)



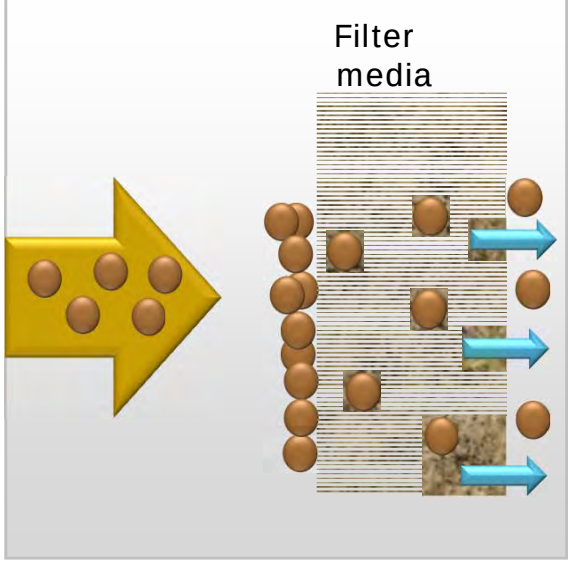
- Inertial



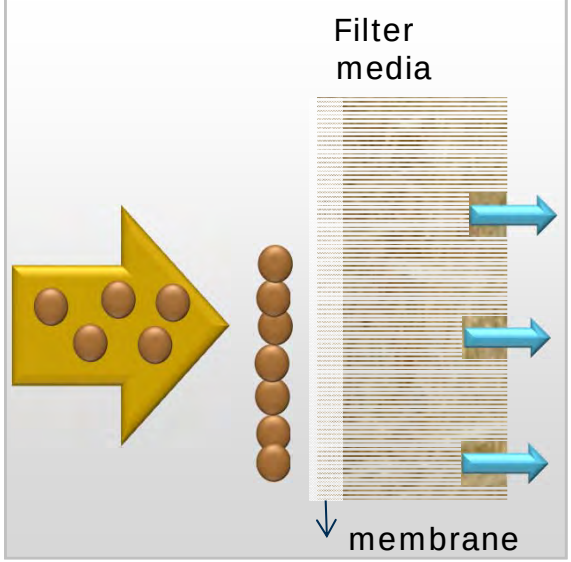
- Diffusion

Filter bag – types of filtration

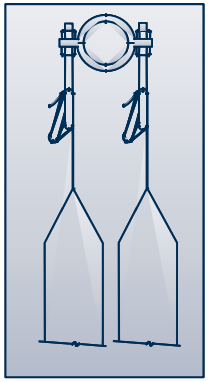
Cake filtration

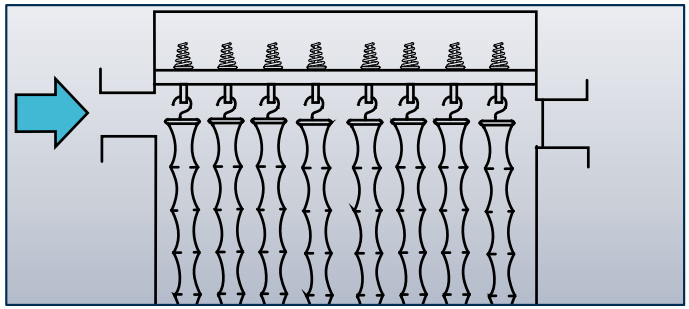


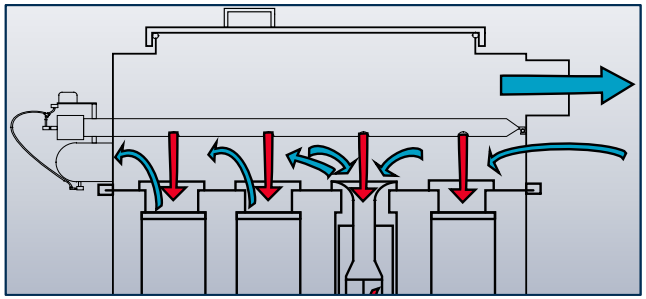
Surface filtration



The Evolution of Bag Cleaning







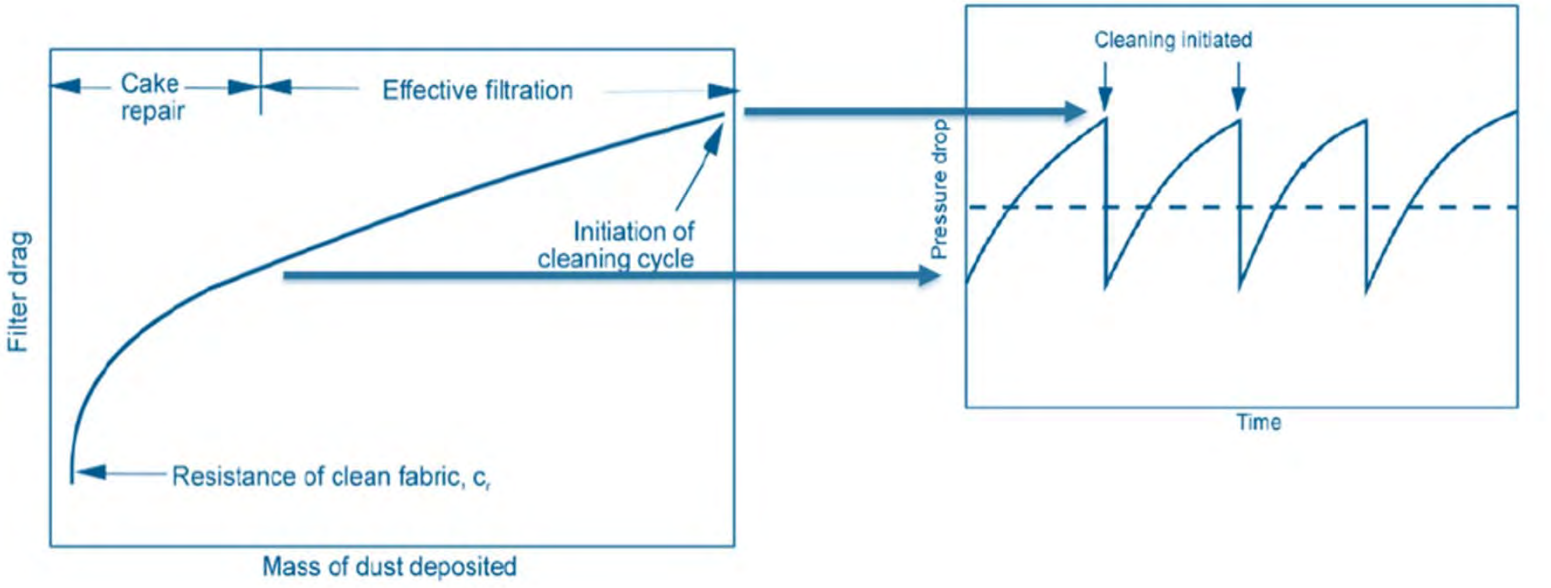
Shaker
1st Generation
1920s-1980s

Reverse air
2nd Generation
1950-2000

Pulse-jet
3rd Generation
1970-Today

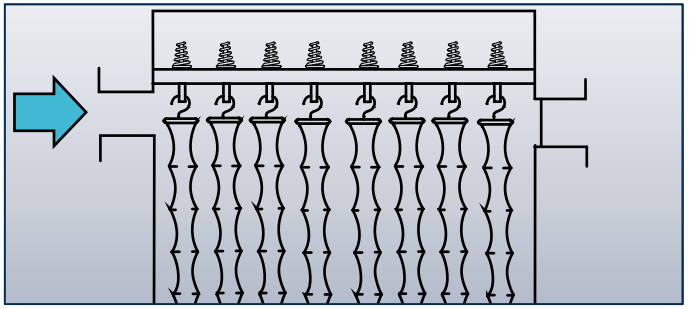
Effective filtration

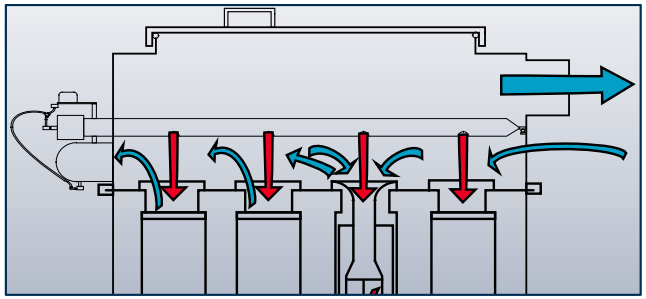
Pressure across baghouse = ΔPf + ΔPc + ΔPl



Process Effects on Flue Gas Properties

Fabric Filters in Power





Historically
Reverse Air
with
Fiberglass
Bags

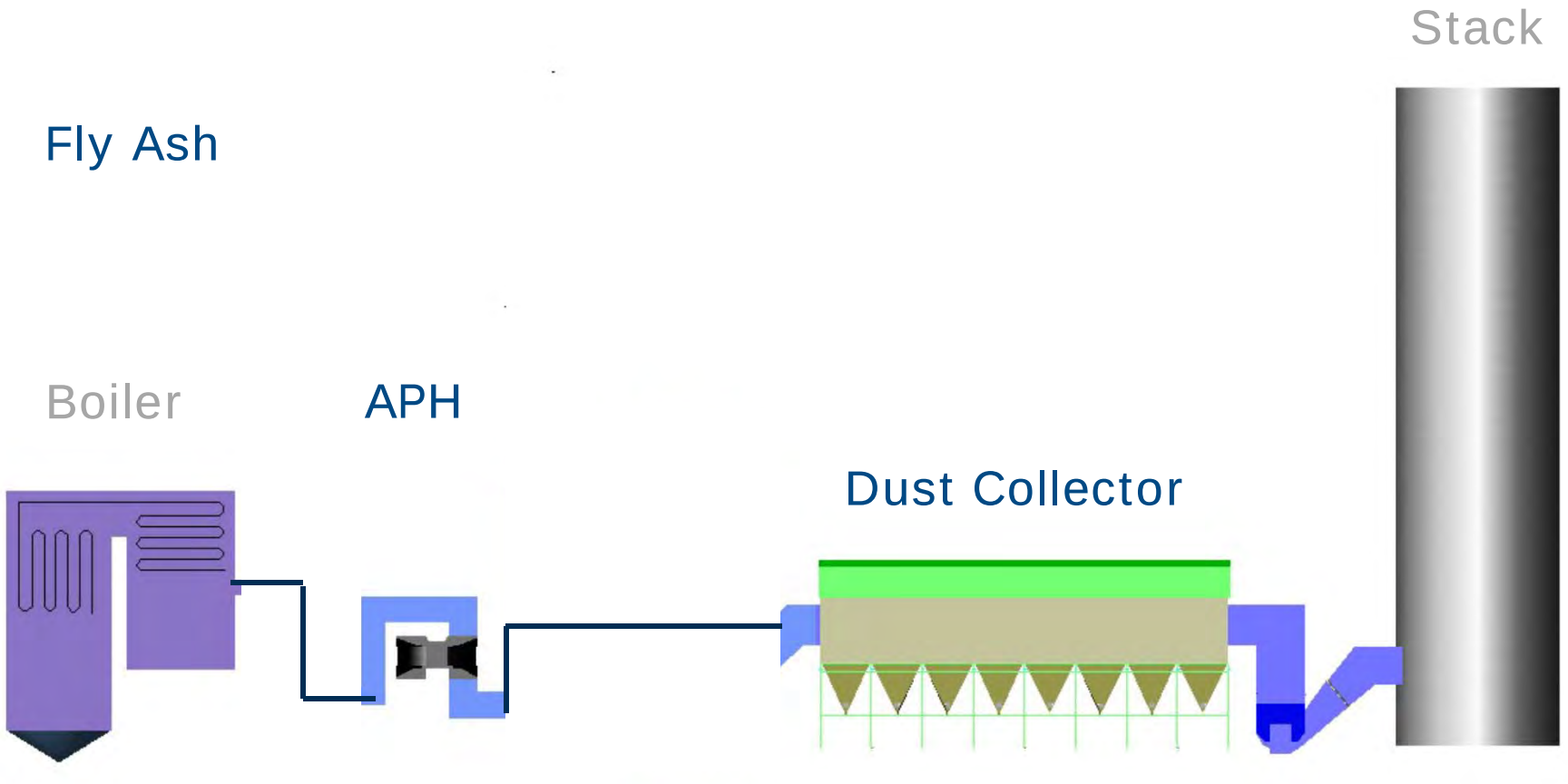
In the last 10-15 years
Pulse Jet with felts (PPS, PI, acrylic, with ePTFE)
or Fiberglass/ePTFE for high-temperature applications

Baghouse Design

- FF will work well if properly sized and designed for the application:
  - Volume
  - Cloth Area
  - Temperature
  - Pressure Drop
  - Type of Dust
- FF will require low maintenance if designed for the application
- FF will fail if not designed and maintained properly

Flue Gas Path

Flue Gas Path



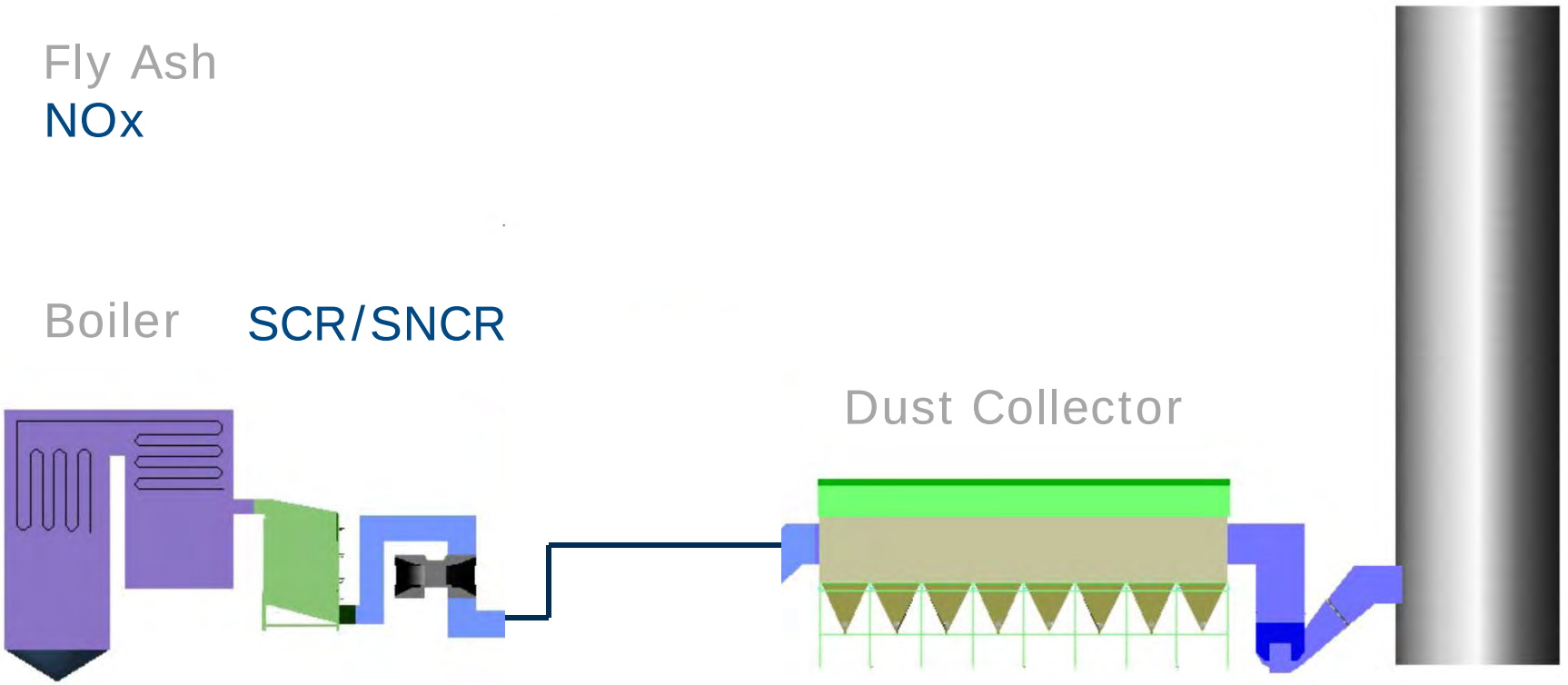
Flue Gas Path

Stack

Fly Ash
NOx

Boiler SCR/SNCR

Dust Collector



Flue Gas Path

Stack

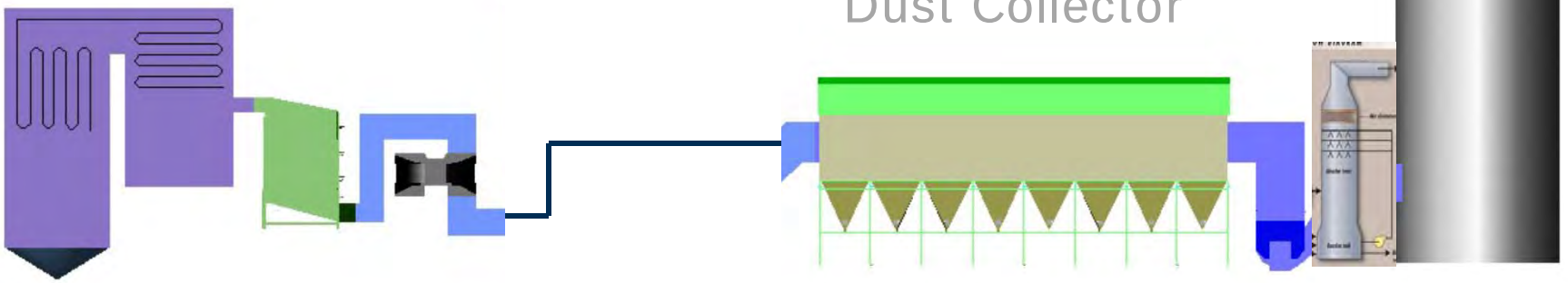
Fly Ash
NOx
SOx

Boiler

SCR/SNCR

WFGD

Dust Collector



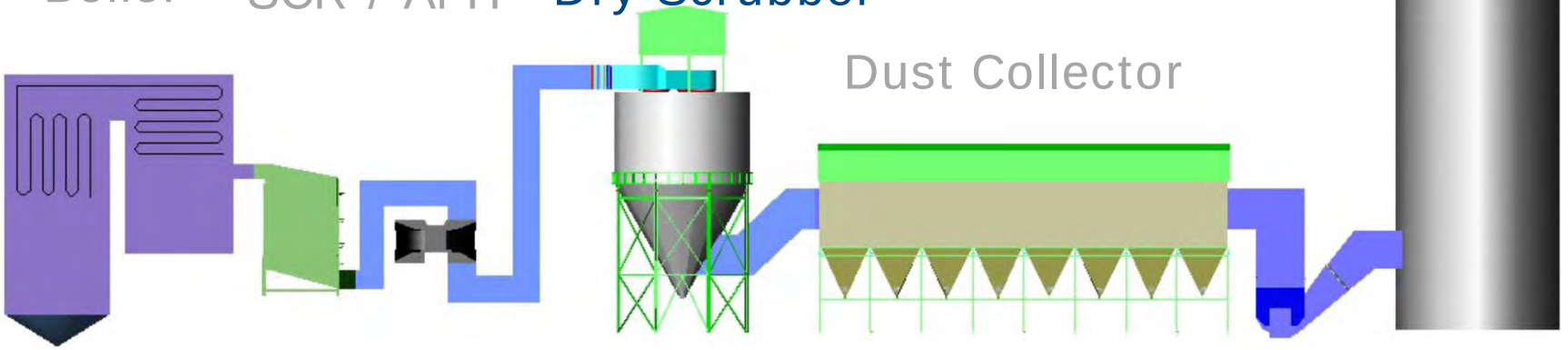
Flue Gas Path

Stack

Fly Ash
NOx
SOx

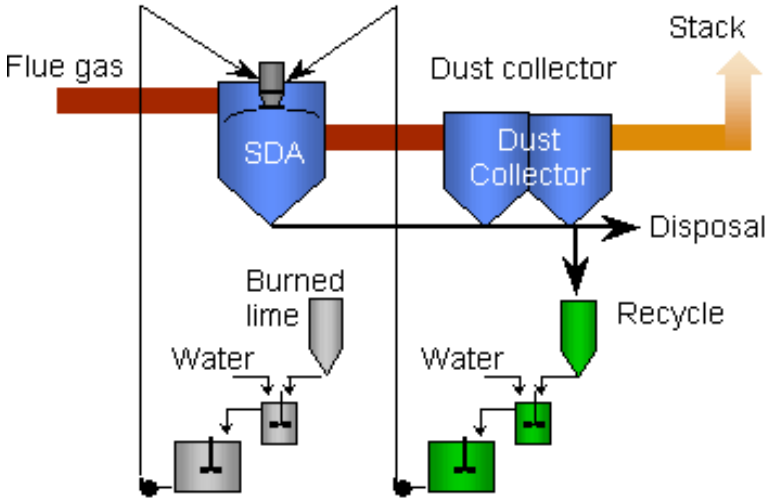
Boiler SCR / APH Dry Scrubber

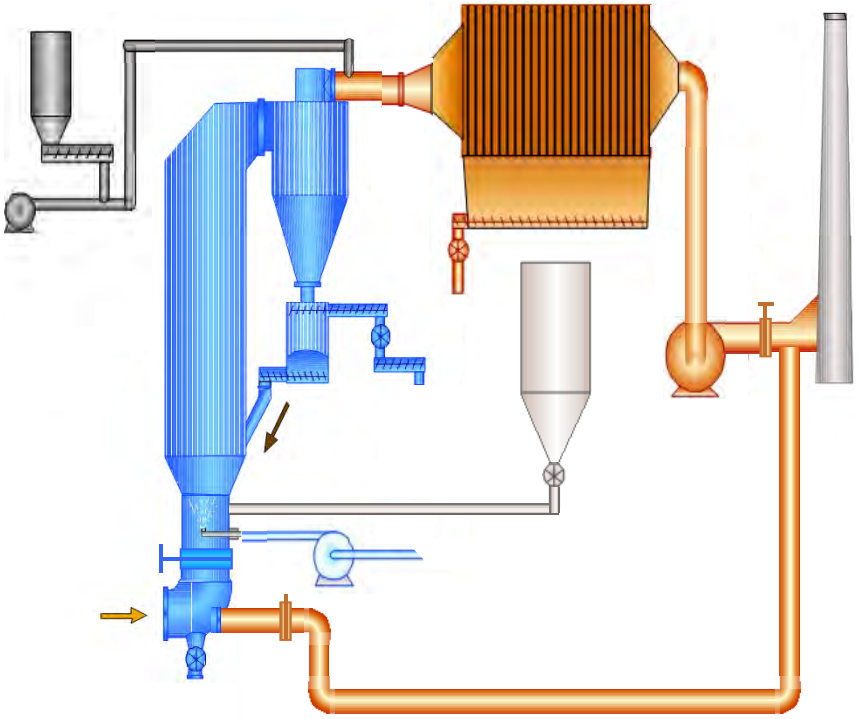
Dust Collector



Dry Scrubbers – SDA and CDS

- SO_2/SO_3/HCl removal
- High dust loading due to recirculation
- Approach AST (+20-30°F) for optimum scrubbing
- Balance scrubbing efficiency with potential back-end issues





Dry Reagent/Sorbent Injection

- Reduce SO_3 and sulfuric acid attack
- Higher temperatures, less moisture
- Higher injection rates
- Cake capture
- Cake densification
- NO_2 oxidation?

Activated Carbon Injection for Mercury Mitigation

- PAC flows very low
- PAC is very fine
- Cake capture is critical to mercury mitigation
- Cake densification
- Avoid re-emission of Hg as a function of time/temperature
- Bromine (from CaBr2) is a strong oxidizing agent

- Potential for smoldering/combustion – keep it moving once bags are cleaned

Fabric Filters in Power

- With SCR/SNCR – ammonia slip can create sticky dust (Ammonium Bisulfate – ABS)
- Wet Scrubbers – downstream of FF but allow for use of higher sulfur coals and SO_3 attack and more ABS
- Dry Scrubbers
  - Very high inlet loading due to recirculation
  - Watch for mud approaching adiabatic saturation temperature
  - Watch for poor SDA atomization

Fabric Filters in Power

- Dry Sorbent Injection
  - Filter cake aids acid removal
  - Cake densification in polishing filters
- Activated Carbon Injection
  - Activated carbon is very fine (like smoke)
  - Cake densification
  - Bromine can create oxidizing environment
  - Hg re-emission is possible
  - Carbon is low-volatile but flammable
    - Keep carbon on bags for mercury capture
    - Do NOT store high-carbon ash in hoppers
    - Do NOT overheat with hopper heaters

Best Practices

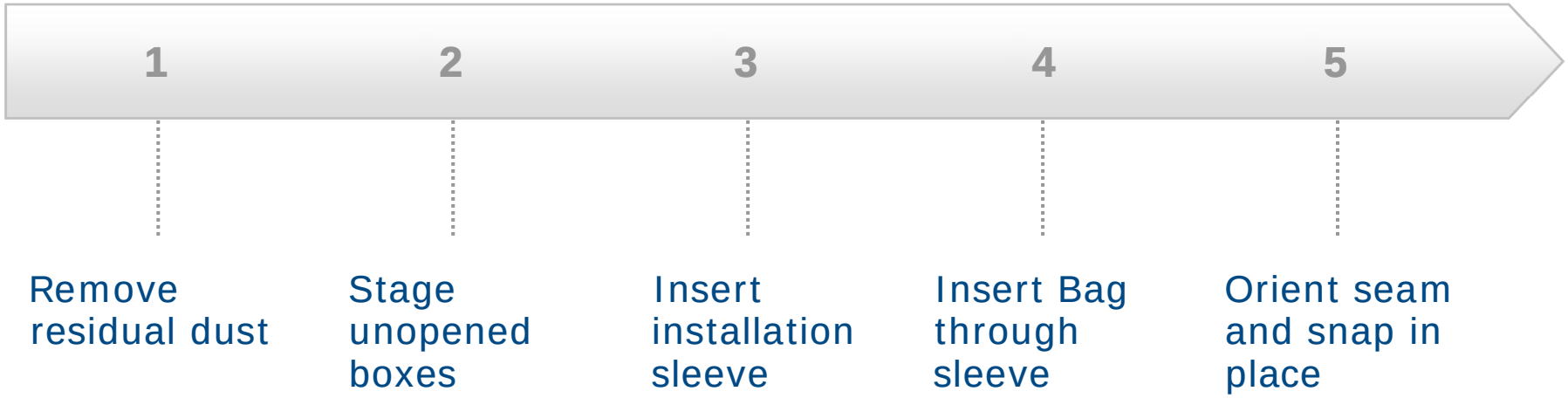
Best Practices – O&M

- Protect the filter media
- Install the bags correctly
- Clean the bags well
- Distribute the gas and material well
- Remove the ash and co-products
- Avoid infiltration

Fiber Properties

Fiber	Temp	Acid Resistance	Alkali Resistance	Abrasion Resistance	Flex Resistance	Hydrolyzation	Oxidation
Acrylic	260˚F	Good	Average	Good	Very Good	Excellent	Very Good
Polyester	275˚F	Fair	Fair	Excellent	Very Good	Poor	Very Good
PPS	374˚F	Good	Very Good	Very Good	Very Good	Good	Poor
Aramid	392˚F	Fair/Poor	Good	Excellent	Excellent	Good	Good
PI	473˚F	Fair	Fair	Good	Good	Good	Very Good
PTFE/Teflon®	500˚F	Excellent	Excellent	Fair/Poor	Good	Excellent	Excellent
Fiberglass	500˚F	Good	Fair	Average	Average	Excellent	Excellent

Bag installation guidelines



Cage installation guidelines

Best Practices to Consider - Installation

Pulse Jet

- Snapband Installation
- Bag/Cage Fit
- Pulse air system components and alignment

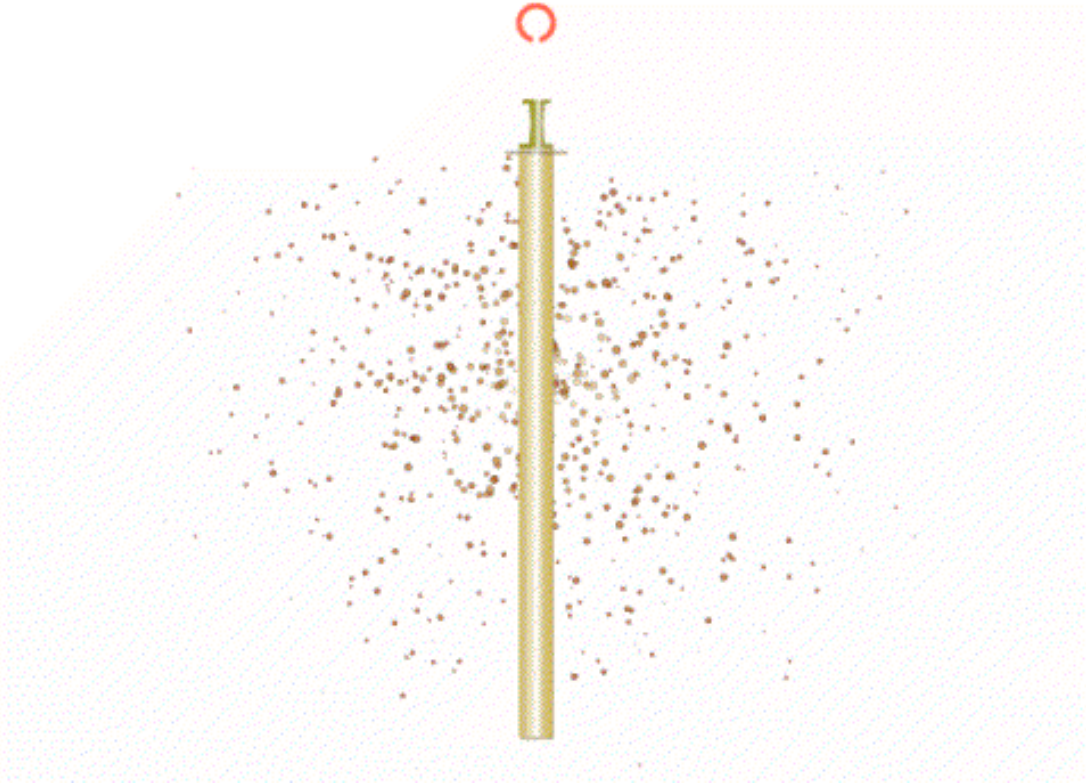
Reverse Air

- Proper Tensioning
- Tube sheet fit
- Seams at 45° Orientation to Walkway

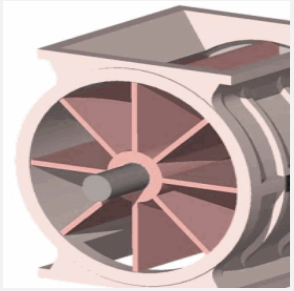
Best Practices to Consider - Cleaning

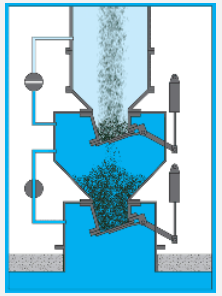
- De-rating ESP
- Avoid re-emission
- Avoid re-entrainment

- Cleaning Controls
- On Demand Cleaning
- Bag cleaning sequence
- Cleaning Air moisture, pressure



Best Practices to Consider





Gas Distribution / Velocities

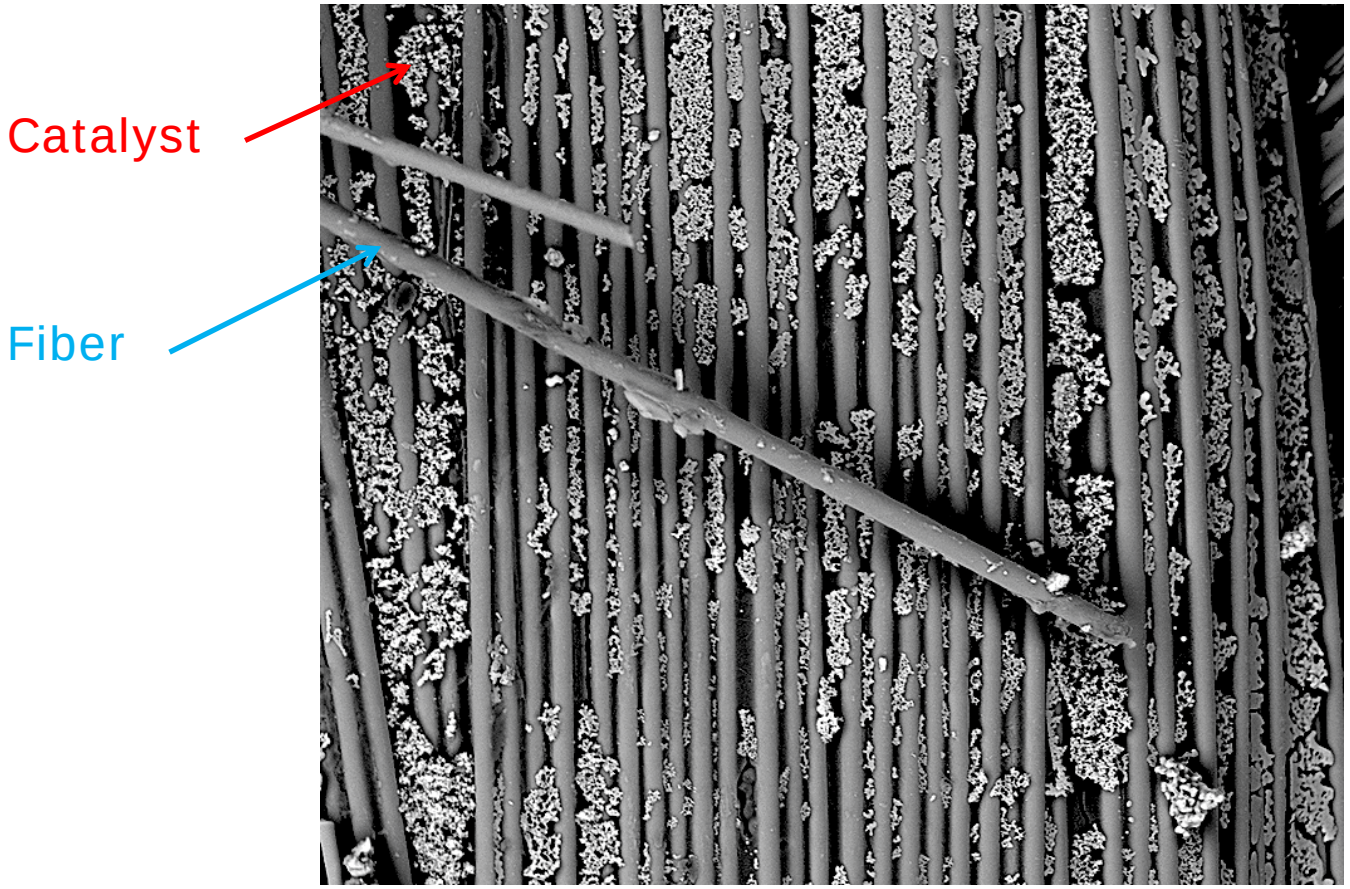
Avoid infiltration

Avoid moisture condensation

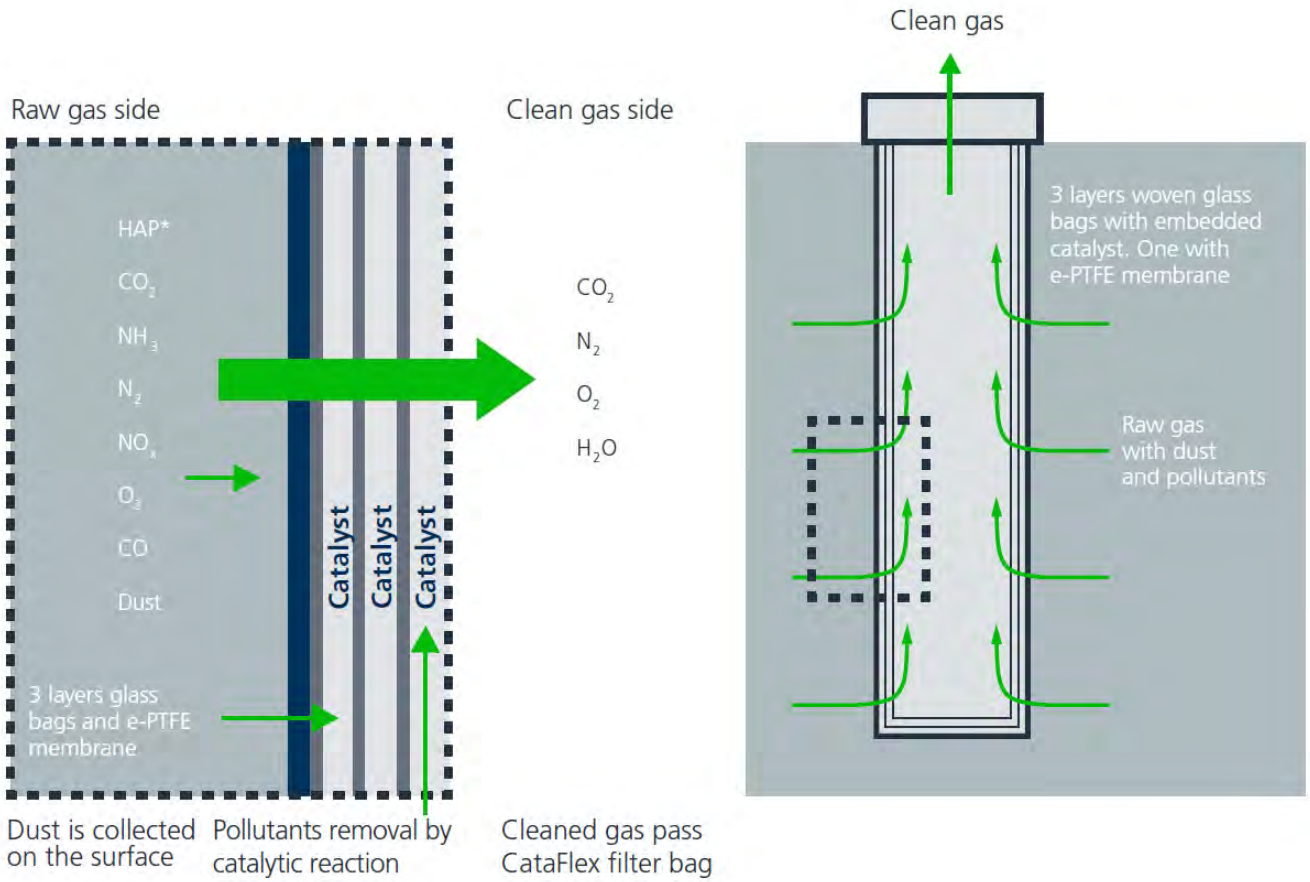
Airlock/ Product Conveying

Product Development

CataFlex™ catalytic filter bag



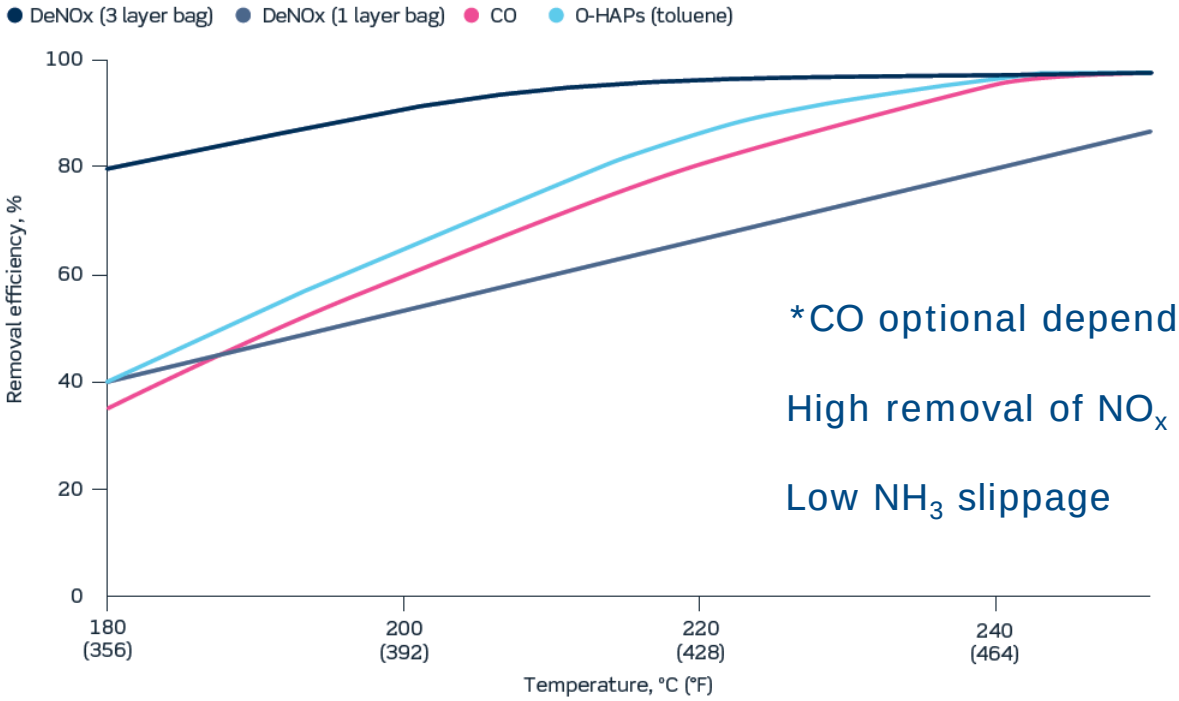
The cleaning principle



** Organic HAP includes formaldehyde, benzene, toluene, styrene, xylene (m-, p-, o-), acetaldehyde and naphtalene.*

CataFlex™

NOx VOC/o-HAP/CO* removal CCF



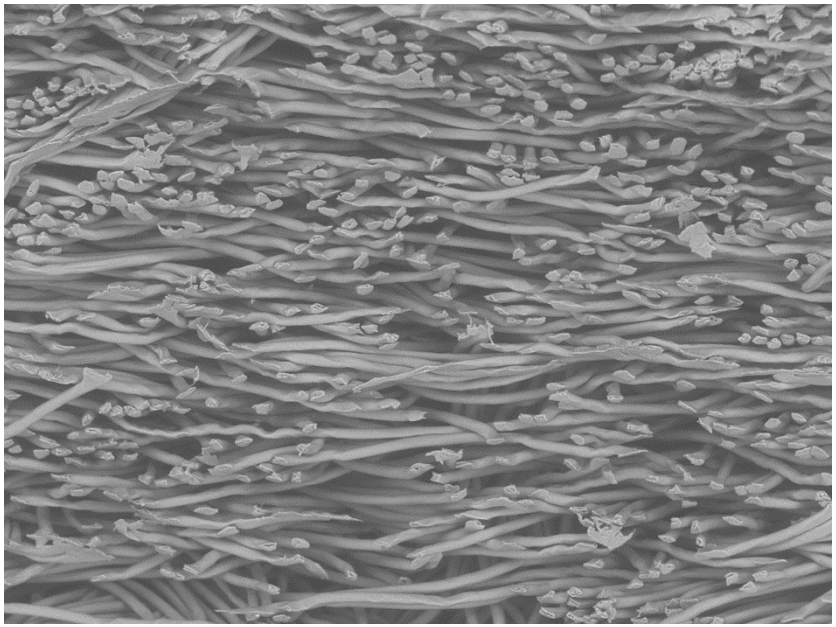
*CO optional depending on catalyst formulation

High removal of NO_x

Low NH_3 slippage

SST – Sorbent Surface Treatment

- Improved reactive surface area for reagents and sorbents
- Better capture of acid gases/mercury
- Reduced DP and power consumption
- Longer life -> Reduced maintenance
- Closely approaches membrane performance



Questions