

**LOW PARTICULATE  
EMISSIONS - SHORT AND  
LONG TERM**

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McILVAINE HOT TOPIC HOUR  
"FILTER SELECTION"**

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# TRADITIONAL FABRIC FILTER SELECTIONS

## Reverse Gas Filters

- Large Footprints
- Low Filter Velocities
- Uses Woven Filter Media
- Membranes are applicable
- Off-Line Cleaning

## Pulse Jet Fabric Filters

- Smaller Footprints
- Higher Filter velocities
- Primarily Felted Filter Media
- Woven Filter Media is possible.
- Membranes are applicable
- Off-Line and/or On-Line Cleaning



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# TRADITIONAL FABRIC FILTER STACK EMISSIONS

## Particulate Matter

- 0.010 to 0.015 lbs/MBTU (Solid PM which excludes the condensable fraction of the front half of the EPA sampling train)
- Less than 0.010 to 0.05 lbs/MBTU (Condensable fraction from the back half of the EPA sampling train)

## Gaseous and Mist Emissions

- PM<sub>2.5</sub>, SO<sub>2</sub>/SO<sub>3</sub>, NO<sub>x</sub>, HCl, Hg, and other are dependent on quantity of pollutant, the type & quantity of additive, gas temperatures, retention times, and mixing effectiveness of additive with pollutant. (50-90% removals).
- Require additive injection systems can be: in-furnace injections, out-of-furnace dry/dry, or wet/dry injections.



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# TRADITIONAL FILTER BAG MATERIALS

- Woven Fiberglass
- Woven Fiberglass with membrane coating +++
- Felted Synthetic PPS +
- PPS with PTFE intrinsic coating ++
- Felted Synthetic P84 +
- Various denier fiber - mixed thin/thick denier fibers ++
- Felted Fiber blends PPS & P84 ++
- Membranes on synthetic media +++

(+ = somewhat lower emission levels. ++ = lower yet . +++ = step lower emissions)

# DETERMINE TYPE OF MEDIA

## Most Important Criteria:

- Type of Fabric Filter - PJ or RG
- Flue Gas Highest Operating Temperature
- Flue Gas Lowest Operating Temperature (Start-up & Low Loads)
- Coal Analysis with any start-up or load stabilization fuels
- Flue Gas analysis (CL, SO<sub>2</sub>/SO<sub>3</sub>, HF, O<sub>2</sub>, H<sub>2</sub>O, any unusual item)
- Typical Fly Ash Analysis with heavy metals, Hg, hazard wastes, etc
- All Required/ Permitted emission levels
- All required plant and maintenance operating / start-up / shut down conditions

# LOWER SOLID PM EMISSION TECHNIQUES FOR FABRIC FILTERS

## Fabric Filter Variations (at additional cost)

### Bag cleaning approaches

- Pulse Jet Fabric Filter, offline cleaning +
- Do not over clean the filter bags (minimize emission spikes after pulsing) +

### Primary and secondary

- Size the Fabric Filters with lower filter velocities +
- Two Fabric Filter in series ++

### Filter Media Selections

- Use finer (micro) denier fibers to fabricate bags +
- Use membranes on the filter surface of the fabricated bags +++

# PLANT OPERATION CONSIDERATIONS

## Boiler operation

- Base load or swing load

## Low temperature operation

- Acid dew-point is detrimental to filter life and operation

## High sulfur fuels- higher temperature acid dew point

- Mitigate with sorbent injection for SO<sub>3</sub> reduction and/or increase gas temperatures (inject lime, trona, nahcolite, etc)

## High temperature operation and excursions.

- All fabric filter bag materials have an upper operating temperature limit
- The closer the operating temperature is to the limit, the shorter the bag life

## Oil firing- oil smut- opportunity for bag blinding

- Bag pre-coat additives are available to mitigate.

# FILTER QUALITY CONTROL

## Filter Bags

- Bag fit to cages
- Tube sheet hole, bag snap band fit into tube sheet
- Installation without mechanical filter bag damage

## Shop and field seal welds

- Map of all seal welds
- Penetrant test all seal welds located at the dirty gas to clean gas side

## Pulse pipe alignment

- Misalignment can cause abrasion at top of bag from pulsing

## Start-Up dampers

- Improper setting, sealing and miss operation will allow dirty gas to bypass and increased stack emissions



# QUALITY CONTROL – INTERNAL GAS DISTRIBUTION

Design and provide even gas distribution to filter bags for PJFF

- Design for low average even bag approach velocities
- Reduce bag / ash abrasion
- Reduce bag movement and rubbing abrasion

# PREVENTIVE MAINTENANCE - BAG LIFE TESTING

## Bag testing program

- After a few months of operation, pull a few bag & run a base line test.
- Annually remove sample bags
- Log bag locations
- Send for testing to determine condition of the bags
- Compare these bag tests against the original base line test bags
- Check ash deposit, wear, strength, ash penetration, and prediction of useful life remaining

# BAG CHANGE PLANNING

- Filter bags will ultimately fail
- Plan ahead for filter bag change-outs based on annual bag testing
- A complete change out is a major initiative for plant staff
- Proper bag testing, maintenance, and planned replacements will maintain low emissions

# SUMMARY – LOWER EMISSION - FUTURE

- Be sure there is an accurate understanding of the permitted emissions
- Be sure there is an understanding of all plant operating conditions
- Design the filter for all constituents at its inlet and required emissions
- If “to near detectable” solid emissions are required, select the filter media most applicable and utilize all QA/QC processes herein.
- When “to near detectable” PM<sub>2.5</sub>, condensable / gaseous emissions are required, additional injection systems will be required.
- In the future the APC industry needs to continue to research all available data that will assist in the calibration of the different filter medias, coatings, and membranes.
- Future data collection and research is needed to upgrade the injection systems that control PM<sub>2.5</sub>, gaseous, and mist emissions.
- Future review of EPA test methods by the APC industry will be required so that such low emissions can be accurately verified.