Filter Media Options for Coal Fired Boilers

Acrylic – PPS – Polyimide – PTFE – Blends

January 8, 2014
Testori Group

- 100+ year old manufacturer of technical textiles for dust collection and liquid filtration, both process and pollution control
- Five operations in Italy (2), France, UAE and USA
- Manufactures woven fabrics and needle felts to produce dust bags and liquid filter cloths; sales of roll goods to bag fabricators (USA)
- Full lab and technical support; VDI testing; failed bag media analysis
- US warehouse and sales office; full converting in Italy, France and UAE
# Selecting Media

<table>
<thead>
<tr>
<th>FIBER TYPE</th>
<th>COMMON BRAND NAMES</th>
<th>TEMP LIMITS* F/C</th>
<th>RESISTANCE TO ACIDS</th>
<th>RESISTANCE TO ALKALIS</th>
<th>RESISTANCE TO HYDROLYSIS</th>
<th>RESISTANCE TO OXIDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>COTTON</td>
<td>NA</td>
<td>180°/85°</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>PVC</td>
<td>Rhovyl, Clevyl</td>
<td>150°/65°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>POLYPROPYLENE</td>
<td>Herculon</td>
<td>190°/90°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Poor</td>
</tr>
<tr>
<td>NYLON</td>
<td>Enka, Antron</td>
<td>230°/110°</td>
<td>Poor</td>
<td>Excellent</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>HOMOPOLYMER ACRYLIC</td>
<td>Dolanit, Aksa</td>
<td>257°/125°</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>POLYESTER</td>
<td>Fortrel, Dacron, et al.</td>
<td>300°/150°</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>PPS</td>
<td>Torcon, Procon, et al.</td>
<td>375°/190°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Fair</td>
</tr>
<tr>
<td>ARAMID</td>
<td>Nomex, Conex, et al.</td>
<td>400°/205°</td>
<td>Poor</td>
<td>Excellent</td>
<td>Poor</td>
<td>Fair</td>
</tr>
<tr>
<td>POLYIMIDE</td>
<td>P84</td>
<td>450°/235°</td>
<td>Fair</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>PTFE</td>
<td>Profilen, Toyoflon, et al.</td>
<td>500°/260°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>FIBERGLASS</td>
<td>NA</td>
<td>550°/285°</td>
<td>Good</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

*Dry heat only

Testori USA, Inc.
www.testori-usa.com
## Selecting Media

<table>
<thead>
<tr>
<th>FIBER TYPE</th>
<th>COMMON BRAND NAMES</th>
<th>TEMP LIMITS* F/C</th>
<th>RESISTANCE TO ACIDS</th>
<th>RESISTANCE TO ALKALIS</th>
<th>RESISTANCE TO HYDROLYSIS</th>
<th>RESISTANCE TO OXIDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOMOPOLYMER ACRYLIC</td>
<td>Dolanit, Aksa</td>
<td>257°/125°</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>PPS</td>
<td>Torcon, Procon, et al.</td>
<td>375°/190°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Fair</td>
</tr>
<tr>
<td>POLYIMIDE</td>
<td>P84</td>
<td>450°/235°</td>
<td>Fair</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>PTFE</td>
<td>Profilen, Toyoflon, et al.</td>
<td>500°/260°</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>FIBERGLASS</td>
<td>NA</td>
<td>550°/285°</td>
<td>Good</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

*Dry heat only

Testori USA, Inc.
www.testori-usa.com
Typical fibers for CFB: cross section shapes

- **ROUND PPS / PTFE**
- **DOG BONE PAN**
- **STANDARD SHAPED FIBERS**
- **TRILOBAL PPS**
- **MULTILOBAL P84°**

**MORE SURFACE AREA = INCREASED FILTRATION EFFICIENCY IN SAME BASIS WEIGHT FELT**

**HIGHER FILTERING SURFACE** (considering the same titre)
Expressed in denier or decitex (dtex)

Denier is weight in grams of 9,000 lin meters of one filament

The higher the number, the coarser the fiber

- Standard denier fibers: 2 – 3 denier
- Fine denier fibers: 1 – 2 denier
- Microfibers < 1 denier (PP, PE, ACR, PPS, P84)

**Example:**

1 d fiber = 1/10 size of human hair

9,000 lin meters weighs 1 gram (or less)
Main Fiber Blends for Coal Fired Boilers

**Testori code**
- PAN/P84 (DX)
- PPS/P84 (SX)
- PPS/PTFE (SF)
- P84/PTFE (XF)

Blends are designed to be:
- combination of different fibers in the batt
- combination of batt and scrim made with different polymers
Supported vs Unsupported Felts

- Virtually all CFB Baghouse felts are scrim supported because:
  - More dimensionally stable/stronger
  - Able to resist pulse pressures better/minimize dust penetration
  - Able to support heavy filter cake on long bags (up to 10 meter) without stretching (40-60 lbs of dust on 10 m bag)
Scrim fiber may be same as fleece fiber or better (temperature, chemically stable, etc.); weights may vary; filament or spun
Needlefelt Production Line

Staple fiber opening and blending
Staple fibers feed
Scrim introduction
Carding
Needling
To finishing

* Heat setting
Calendaring
Singe & glaze
Chemical treatment
Needled Felt Constructions

1. Same Fiber Both Sides

   ![Diagram of Same Fiber Both Sides](image_url)

   - Cake Side
   - Scrim
   - Clean Side

2. Dual Density – Finer Fiber Cake Side

   ![Diagram of Dual Density – Finer Fiber Cake Side](image_url)

   - Cake Side
   - Scrim
   - Clean Side
Needled Felt Constructions

3. Multi-Layer

Standard Fiber or Finer Fiber Blend Clean Side
## Needlefelts: Finishing and Treatments for CFB

<table>
<thead>
<tr>
<th>Description</th>
<th>Fibers</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| Expanded PTFE membrane laminate on the dust side | PAN, PPS, P84, GLASS, PTFE | - Controlled low emissions
- Better efficiency
- Cleanability

- Disadvantage: abrasion, oils, special install, tight fit |

- Fluorinated resins for bath impregnation of the felt | PAN | - Water repellency
- Better cake release
- Suitable for sticky dust |

- PTFE resins for bath impregnation of the felt | PAN, PPS, P84, PTFE | - Water and oil repellency
- Very good cake release
- Increased bag lifetime
- Adds surface area |

- Fluorinated and PTFE resins (high concentration) for bath impregnation of the felt | PAN, PPS, P84 | - Water and oil repellency
- Better cake release
- Suitable for sticky dust |

- Copolymer foam deep coating suitable for temperature up to 200°C | PPS | - Better filtration efficiency
- Very low emissions below 5mg/Nm³ |
Needling

- Almost infinite variety possible
- No fixed media designs
- No “micron rating” system
- “Chinese Menu” approach to media design

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber: type, size, blend</td>
<td>Basis Weight</td>
<td>Heat Stabilization</td>
</tr>
<tr>
<td>Scrim: type, count, weight, strength</td>
<td>Layering</td>
<td>Calendering</td>
</tr>
<tr>
<td></td>
<td>Needle size &amp; Design</td>
<td>Mechanical Finishes: singe or glaze</td>
</tr>
<tr>
<td></td>
<td>Needling Density</td>
<td>Chemical Finishes: fluorocarbon, PTFE, surface coating</td>
</tr>
</tbody>
</table>
## Variables to Consider When Selecting Filter Media for a CFB Dust Collector

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>EQUIPMENT</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Temperature (normal and peak)</td>
<td>Neutralizing Agents (deNOx, deSOx, Br)</td>
<td>Outlet Emission Limits</td>
</tr>
<tr>
<td>Moisture/Hydrolysis</td>
<td>Grain Loading</td>
<td>Bag Life and dp Warranties</td>
</tr>
<tr>
<td>Potential Chemistry</td>
<td>Air to Cloth Radio</td>
<td></td>
</tr>
<tr>
<td>Oxidizers</td>
<td>System Design</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons (oil)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust &amp; Dust Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Shape, Size &amp; Distribution, Agglomeration Tendency, Static)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
General Flue Gas Treatment Layout in CFB Plant

- Gas filtration: Removal of dust and solid precipitates (from DeNOx or DeSOx dry systems)
- Liquid filtration: Gypsum dewatering (in Wet FGD systems)
DeNOx flue gas treatment – Fiber suitability guidelines

Temperature vs. NO₂ content

- **High dust SCR/SNCR**
  - Parallel Plate catalyst
- **Low dust SCR**
  - Honeycomb catalyst

**Fiber Suitability Guidelines**

- **P84**: 500°F (260°C)
- **PPS**: 375°F (190°C)
- **PPS + PTFE scrim**: 257°F (125°C)
- **PTFE 100%**: 25°F (13°C)

**Fibers**

- **P84**
- **PPS + PTFE scrim**
- **PTFE 100%**
- **PAN**
Filter Media Application
(Based on Air to Cloth Ratio and Outlet Emission Objectives)

Solid particles emission [mg/Nm³]

A/C ratio [m/min]
(CFM:Ft² Media Area)

- ePTFE membrane on fiberglass fabric
- Microfiber multi-layer needlefelts coatings
- Standard needlefelts

- ePTFE membrane on needlefelt
- Behavior in case of membrane damage
DeSOx – Removal of sulfur based acid gases

- Risk of chemical degradation of P84® fiber when dosing Na-based sorbents.

Dry Sorbent Injection
- Ca-based
- Na-based
- Typical Media: PAN, PPS, Glass

Semi-Dry Spray-Drying
- Atomized lime slurry spraying
- Drying with a part of the inlet flue gases in counter current
- Typical Media: PAN, PPS

NID™
- Removal of acidic components of flue gas by reacting with hydrated lime
- Recirculation of reagents; additional gas absorption
  - PAC injections
  - Typical Media: PAN, PPS, Glass, P84

Wet FGD
- Gypsum dewatering
- Liquid filtration with PA, PP or PES fabric depending on filtering equipment

- High dust load due to recirculation of reagents
- High weight needlefelt
- Surface finishing for abrasion, with high efficiency of separation

- Risk of degradation for P84® due to residual SO² and moisture
- Chemical treatment for water repellency.
## Selecting Filter Media for CFB Dust Collection

### Wide Range of Options
- Multiple fiber, scrim, felt and finish options available

### Varied Applications
- No “One Size Fits All” media possible

### Determining Outcomes
- Process conditions, equipment designs and performance outcomes dictate media recommendations and solutions

### Optimum results
- Favorable emissions and bag life result from a thorough understanding of filter media, process conditions and dust characteristics.
Thank You

Testori USA, Inc.

Clint Scoble

Cell 513-720-9063
Office 513-528-0172
Fax 513-528-0506

email: cscoble@testori-usa.com

Please visit our US website at www.testori-usa.com