SCR Catalyst Selection for NOx Control
Mcilvaine Company Hot Topic Hour

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CoaLogix®

CoaLogix Inc. is a company formed to find, acquire, integrate and optimize technologies to improve the environmental footprint of coal fired power plants.

SCR-Tech, LLC provides SCR management through a number of services including a proprietary regeneration technology proven in Germany and the U.S.A. This technology can restore SCR catalyst to the original performance for 40-50% less than purchasing new catalyst.
3 Main Types of SCR Catalyst

- Regeneration is possible for all these types of SCR catalyst. Even, SCR catalyst for natural gas plants.
Advantages
• Active surface area per unit volume (m²/m³)
• Good for high or low dust loading applications
• Plugging resistance

Mechanical
• Channel size 6.4mm – 9mm (5-10 CPSI)
• 0.8mm to 1.0mm wall thickness
• Variable element lengths

Composition
• TiO₂, Vanadium, Tungsten

Formulation
They are custom formulated with nine different vanadium levels to balance DeNOx activity and SO₂ oxidation rate to a specified level.

e.g. DNX-774

First digit V205 loading – last two, pitch
Honeycomb Catalyst

Advantages

• Ideal for both high and low dust applications
• Very active surface area per unit volume (m2/m3)
• Excellent regeneration product

Composition

• Homogeneously extruded ceramic with square-openings

Formulation

• TiO2, Vanadium, Tungsten, other

Mechanical

• Extruded variable element length to 1350mm long
• 6.9 – 9.2 mm pitch, smaller is available

72 elements per module – 6x12 array
Plate-type SCR Catalyst

Advantages

• Low pressure loss per layer/reactor
• Good for high dust loading applications
• Plugging resistance

Mechanical

• Plates inserted in cassette boxes with variable pitches ~ 60 to 90 plates per box
• Variable plate length from ~ 400mm to 700mm
• Notches are formed into the plates to provide separation and determines the pitch

Composition

• Stainless steel mesh plate, ceramic material rolled onto plates during manufacturing
• Formulation
  TIO2, Vanadium, Tungsten oxide, Molybdenum oxide

16 cassette boxes per module
SCR Catalyst Modules

- All types have the same general footprint (2M Length x 1M Wide) for standardized cross-section

- Catalyst elements arranged in steel frames
  - Corrugated & Plate – 2 levels of 8 element boxes
  - Honeycomb – 72 elements (6x12 array)

- Each SCR module type varies in height with element height depending on catalyst volume (m3) per module

- Possible to interchange catalyst module types within SCR reactor
- Even different pitches in same layer (e.g. large along boiler wall and smaller other areas)
SCR Catalyst Design Considerations

The SCR Catalyst is Designed to:

1) Reduce NOx
2) Minimize the oxidation of SO2 to SO3
3) Oxidize Mercury (Hg) – co-benefit
4) Allow the passage of fly-ash
5) Limit ammonia slip
6) Stay charged enough until next planned outage, while meeting emissions requirements
### General Guidelines – Catalyst Pitch Selection vs. Dust Loading

<table>
<thead>
<tr>
<th>Dust Loading: Grains per Dry Standard Cubic Feet (gr/dscf)</th>
<th>Corrugated Pitch</th>
<th>Plate Pitch</th>
<th>Honeycomb Pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>5mm</td>
<td>5.0 mm</td>
<td>6.9 mm (22 Cell)</td>
</tr>
<tr>
<td>2 – 5</td>
<td>6.4mm</td>
<td>5.6 mm</td>
<td>7.1 mm (21 Cell)</td>
</tr>
<tr>
<td>5 – 8</td>
<td>7.4mm</td>
<td>6.0 mm</td>
<td>7.4 mm (20 Cell)</td>
</tr>
<tr>
<td>8 – 11</td>
<td>8.4mm</td>
<td>6.5 mm</td>
<td>8.2 mm (18 Cell)</td>
</tr>
<tr>
<td>&gt;12</td>
<td>9mm</td>
<td>7.0 mm</td>
<td>9.2mm (16 Cell)</td>
</tr>
</tbody>
</table>

Each application needs to be verified with your supplier.
SCR Catalyst Poisons

- Sodium (Na)
- Potassium (K)
- Phosphorous (P)
- Arsenic (As)

Reversible in Regeneration Process
Most Catalyst Events Today are: Replacements or Regeneration, limited Additions

• Document your SCR Reactor performance
  – DCS data (NOx in / NOx out, dp, NH3 usage and slip, etc.)

  – Dirty SCR Inspection – ash piling locations

  – Clean SCR Inspection – erosion of catalyst
Catalyst Sweepers on an SCR

System view
Catalyst Sweepers on an SCR

Acoustic Cleaners (aka sonic horns)

Catalyst Sweepers – Orange Tanks
Catalyst Sweeper inside SCR above Layer of Catalyst

Nozzle from Catalyst Sweeper to burst air across problem areas
Consider leaving the Top Layer Open

Improves flow and ash distribution

Leave Empty

Keep levels 2, 3 & 4 loaded
Consider using 2 Different Catalyst Pitches in a Layer

- Dark grey modules – heavy ash
- Light green modules – medium ash
- White modules – little ash

Use larger pitch catalyst in problems areas.
Use smaller pitch catalyst in clean areas.

10 x 17 array = 170 modules per layer
Catalyst Management Plan

2 Initial Plus 1 Spare Layer

Rate of catalyst deactivation depends on fuels, position of layers, plugging

Threshold moves based on performance requirement and system capability

Level of performance increase depends on needs and methods i.e. SO2 conv., higher SA, higher activity, Hg, etc.

Interaction w/ outage plan

Catalyst Potential (K/AV)

Rate of catalyst deactivation depends on fuels, position of layers, plugging

Threshold moves based on performance requirement and system capability

Level of performance increase depends on needs and methods i.e. SO2 conv., higher SA, higher activity, Hg, etc.
Catalyst Testing – Industry is Underserved

Full Bench
- Current industry standard
- 150 mm x 150 mm xxx mm
- Full Element Length
- 3rd Party Guarantees
- EPRI & VGB guidelines

Micro-Scale
- Multi Channel approach for Cat Management, QA/QC, and R&D.
- 25mm X 25mm X 500mm
- Test more at simultaneously

SCR-Tech utilizes both approaches

Photo above courtesy of Cormetech
Questions?

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