

# SCR Catalyst Selection for NOx Control Mcilvaine Company Hot Topic Hour

**Randy Sadler**  
Director of Marketing &  
Sales



**November 29, 2012**

# CoaLogix<sup>®</sup>

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



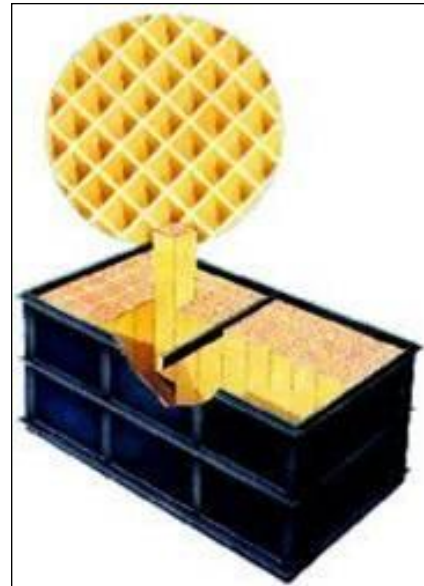
SCR-Tech, LLC provides SCR management through a number of services including a proprietary regeneration technology proven in Germany and the U.S.A. This technology can restore SCR catalyst to the original performance for 40-50% less than purchasing new catalyst.

# 3 Main Types of SCR Catalyst

**Corrugated**



**Honeycomb**



**Plate**



- Regeneration is possible for all these types of SCR catalyst. Even, SCR catalyst for natural gas plants.



# Corrugated SCR Catalyst

## Advantages

- Active surface area per unit volume ( $m^2/m^3$ )
- 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

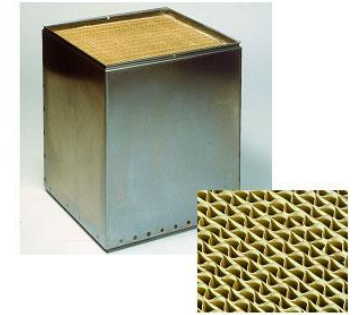
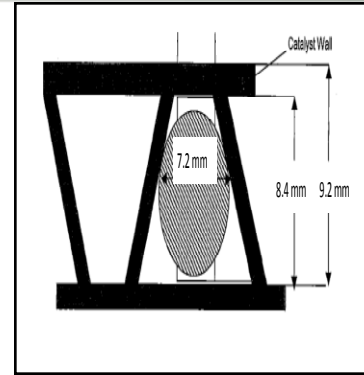
- $TiO_2$ , Vanadium, Tungsten

## 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

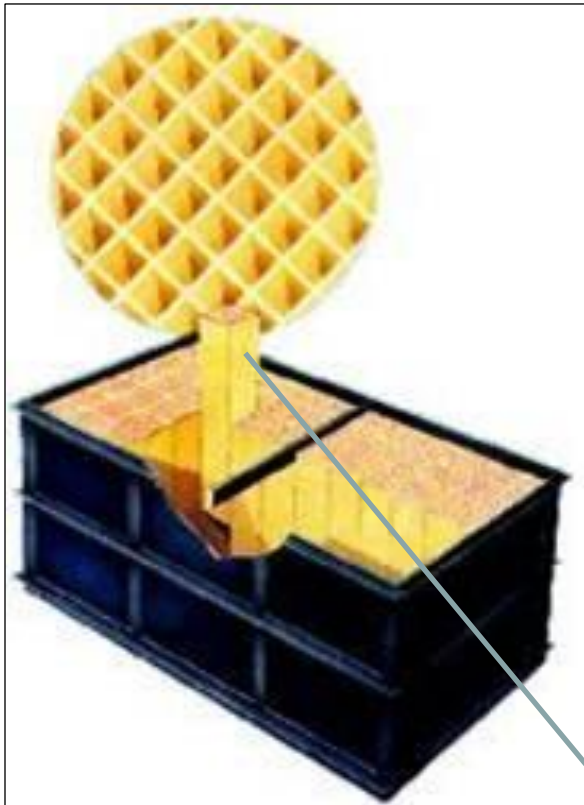
First digit V205 loading – last two, pitch



16 cassette boxes per module



# Honeycomb Catalyst



72 elements per module –  
6x12 array

## Advantages

- Ideal for both high and low dust applications
- Very active surface area per unit volume ( $m^2/m^3$ )
- Excellent regeneration product

## Composition

- Homogeneously extruded ceramic with square-openings

## Formulation

- $TiO_2$ , Vanadium, Tungsten, other

## Mechanical

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



# 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

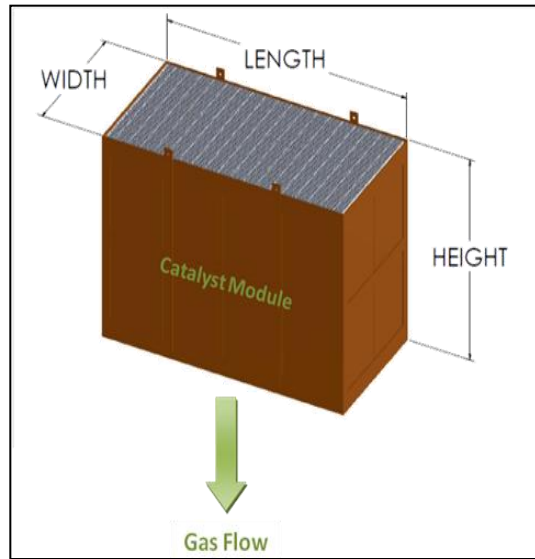
- Stainless steel mesh plate, ceramic material rolled onto plates during manufacturing
- **Formulation**  
TiO<sub>2</sub>, Vanadium, Tungsten oxide, Molybdenum oxide



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 (m<sup>3</sup>) 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 NO<sub>x</sub>
- 2) Minimize the oxidation of SO<sub>2</sub> to SO<sub>3</sub>
- 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

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

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 (NO<sub>x</sub> in / NO<sub>x</sub> out, dp, NH<sub>3</sub> usage and slip, etc.)
  - Dirty SCR Inspection – ash piling locations
  - Clean SCR Inspection – erosion of catalyst



# Catalyst Sweepers on an SCR

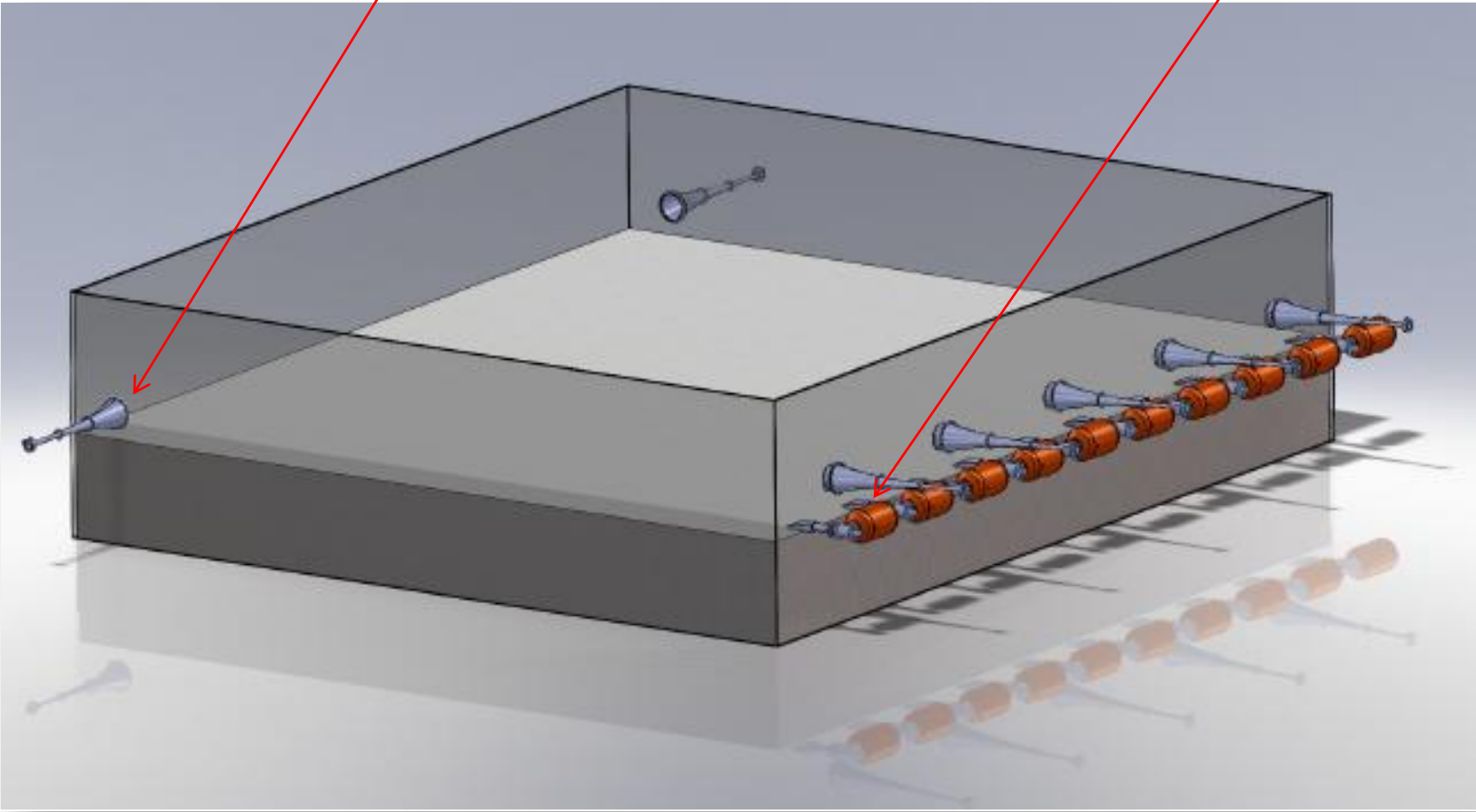
## System view



# 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

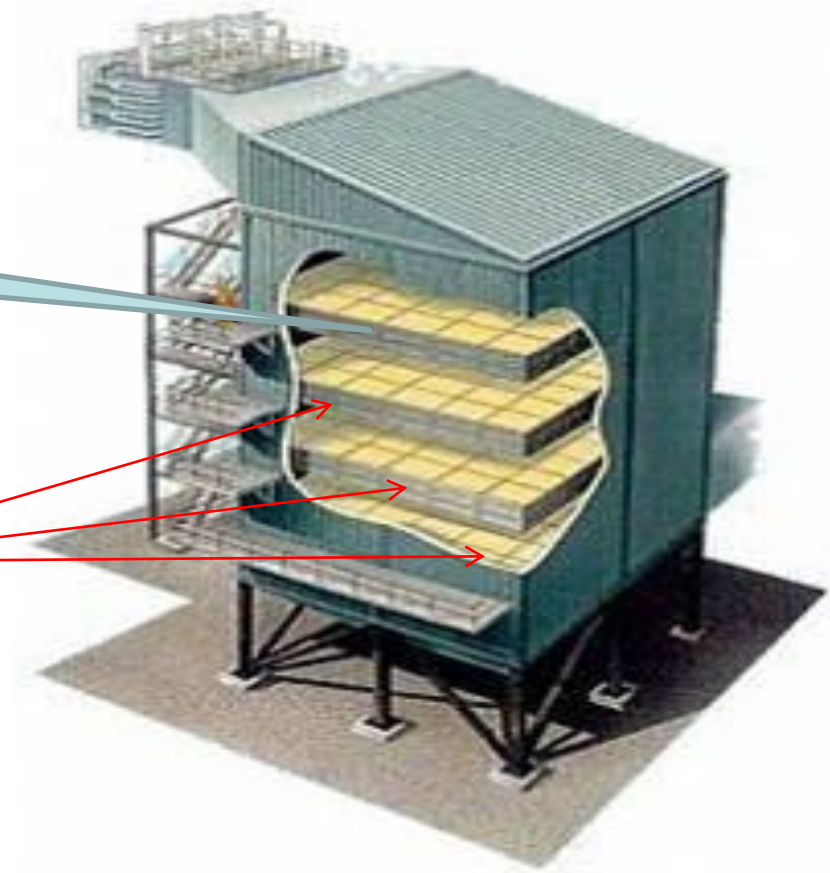


# Consider leaving the Top Layer Open

Improves flow and ash distribution

Leave  
Empty

Keep levels 2, 3 & 4 loaded

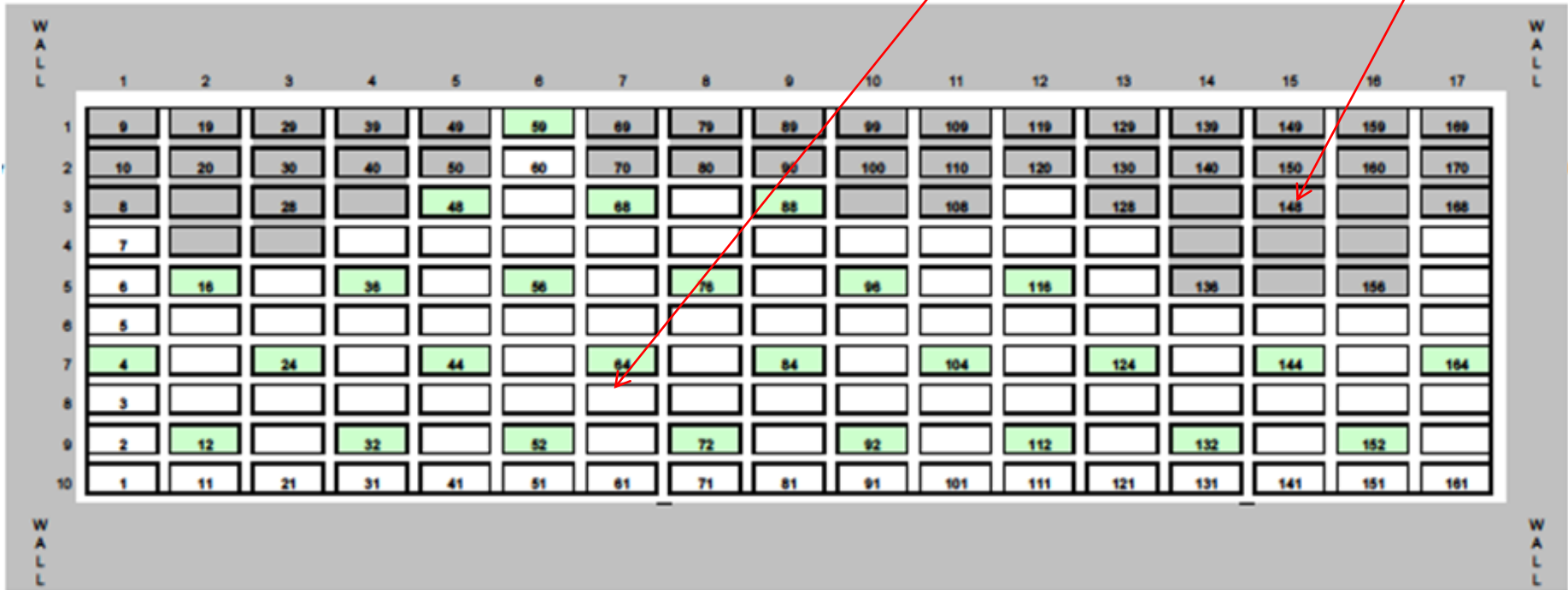


# Consider using 2 Different Catalyst Pitches in a Layer

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

Use smaller pitch catalyst in clean areas.

Use larger pitch catalyst in problems areas.



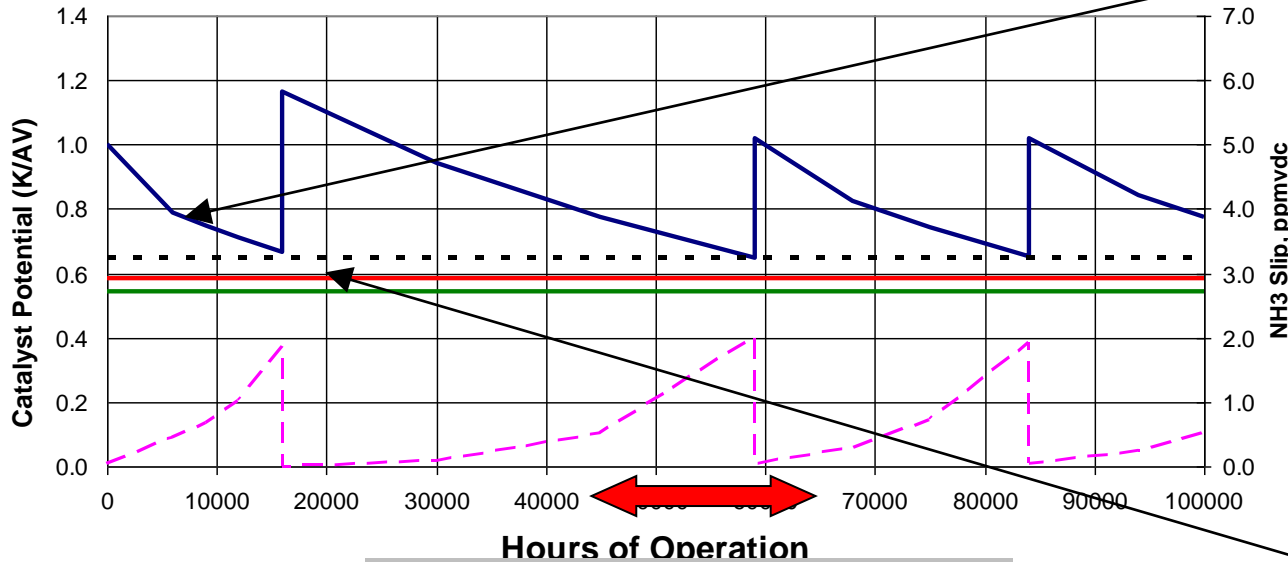
10 x 17 array = 170 modules per layer





# Catalyst Management Plan

## 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. SO<sub>2</sub> conv., higher SA, higher activity, Hg, etc.

Interaction w/ outage plan; 4 ppm Slip Threshold



# Catalyst Testing – Industry is Underserved

## Full Bench

Current industry standard  
150 mm x150mm xxx mm  
Full Element Length  
3<sup>rd</sup> Party Guarantees  
EPRI & VGB guidelines



Photo above courtesy of Cormetech

## 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





# Questions?

**Randy Sadler**  
**Director of Marketing & Sales**  
**980-213-1737**  
[rs@CoaLogix.com](mailto:rs@CoaLogix.com)

**CoaLogix**  
Meeting the World Energy Challenge

**November 29, 2012**