

REINHOLD ENVIRONMENTAL Ltd.



2019 NO_x-Combustion-CCR Round Table Presentation

February 11 & 12, 2019, in Salt Lake City, Utah / Hosted by PacifiCorp

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SCR O&M 101

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Senior Consultants
RE Consulting

Selective Catalytic Reduction

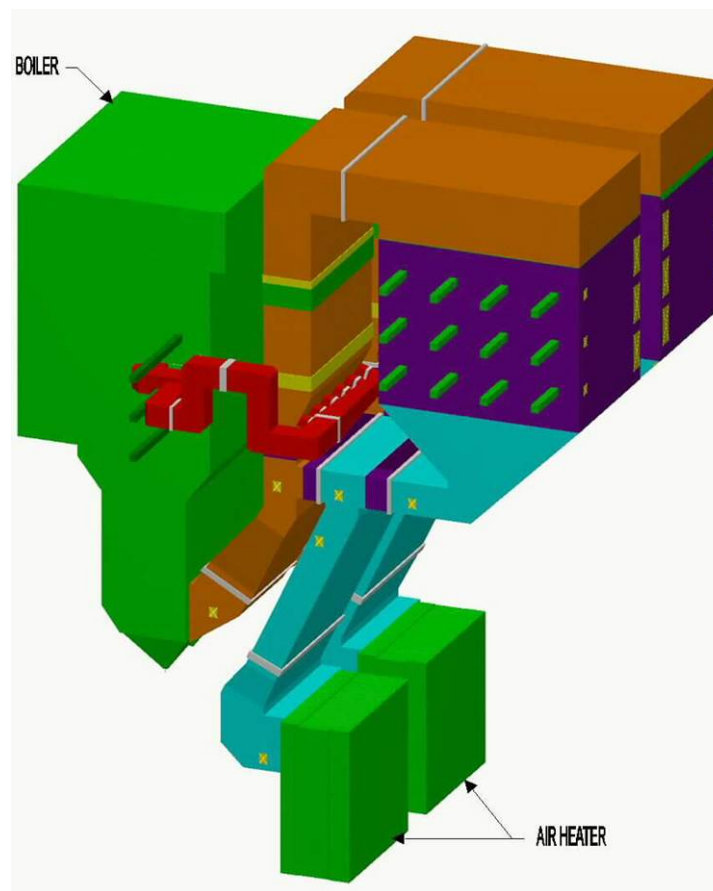
Chemical Reactions in SCR



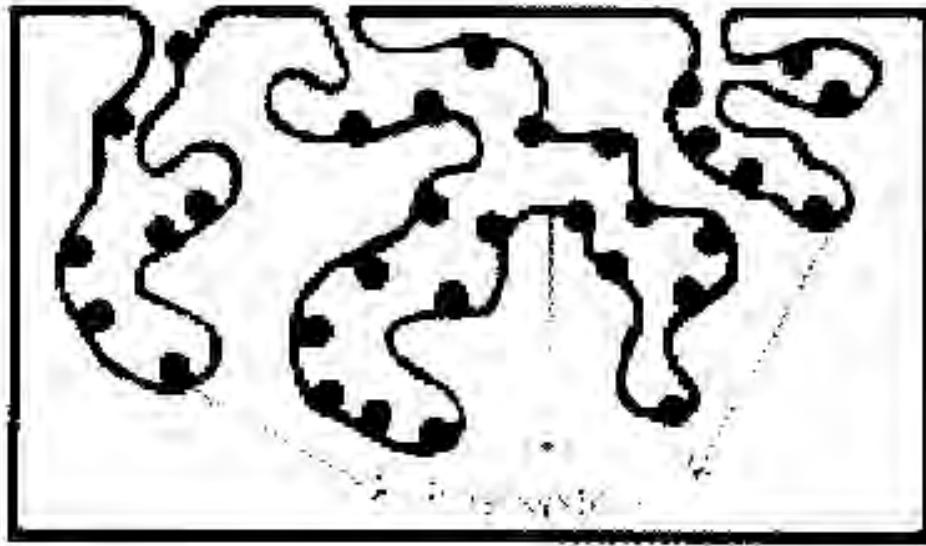
With several secondary reactions:



Typical SCR Layout



The SCR Catalyst



Catalyst Poisons

- Arsenic
- Phosphorus
- Sodium
- Lead
- HCl

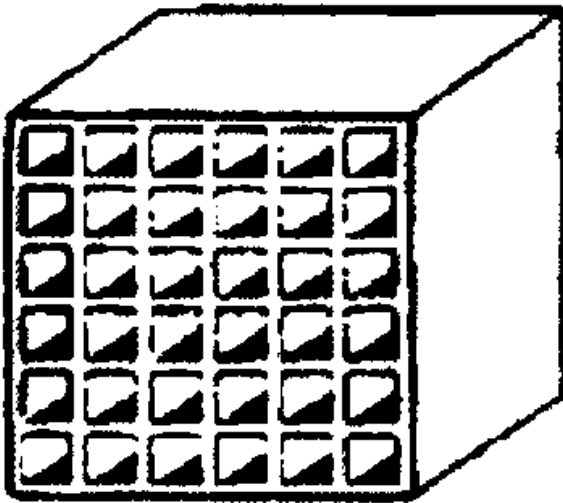
Temporary Ammonia Blinding

- If one operates below the minimum catalyst operating temperature, ammonium sulfate and ammonium bisulfate can plug the catalyst pores. Once one operates above this temperature these compounds can bake out and the pores will be reopened.

Catalyst Masking (PRB Coal)

- The calcium oxide in the PRB coal reacts with SO_2 and SO_3 to form a layer on the catalyst surface which blocks the pores.

Two Types of SCR Catalyst



Honeycomb

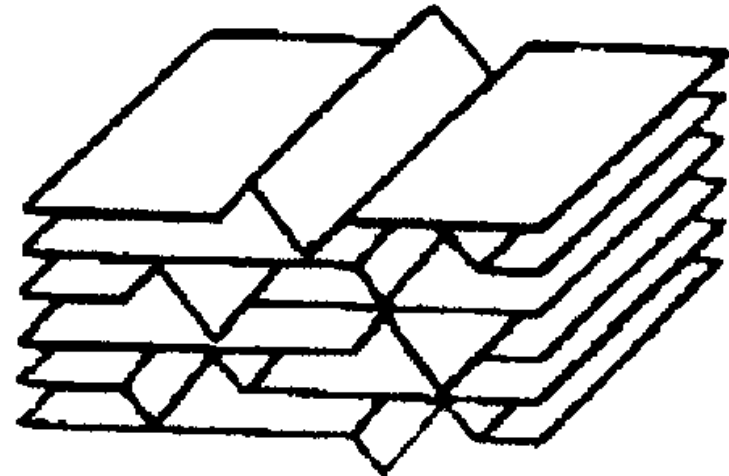
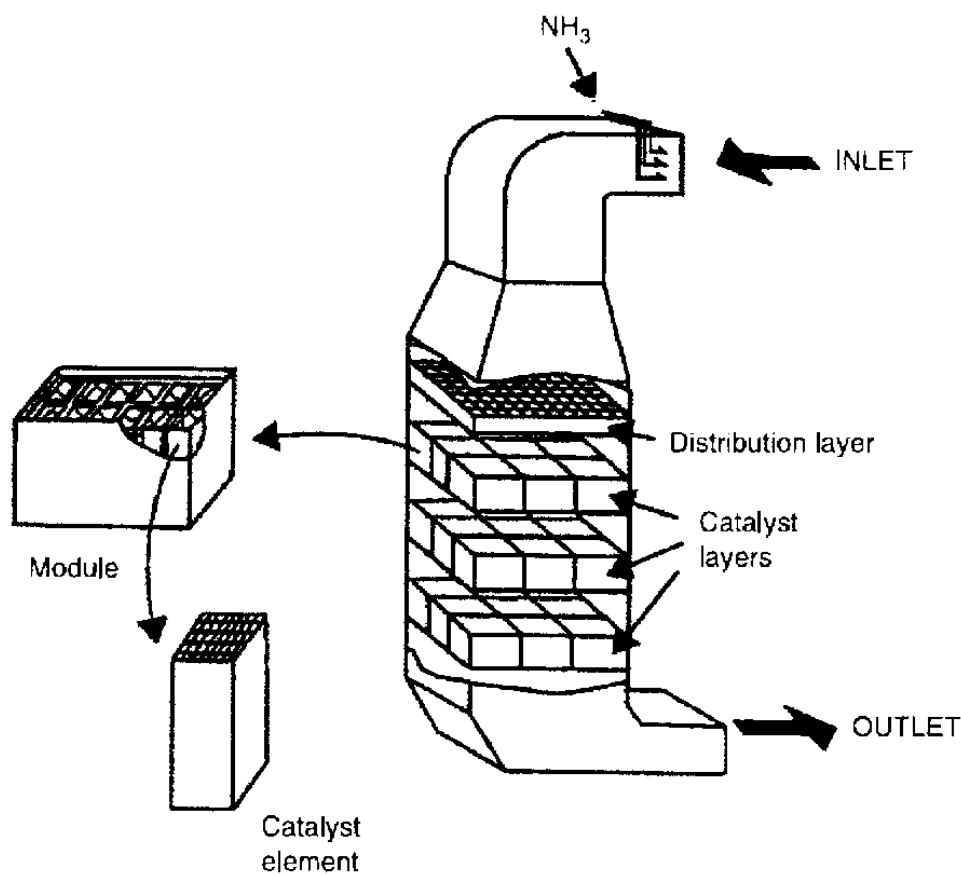


Plate type

How Catalyst Goes In SCR



Hoisting Catalyst



Pushing it into SCR

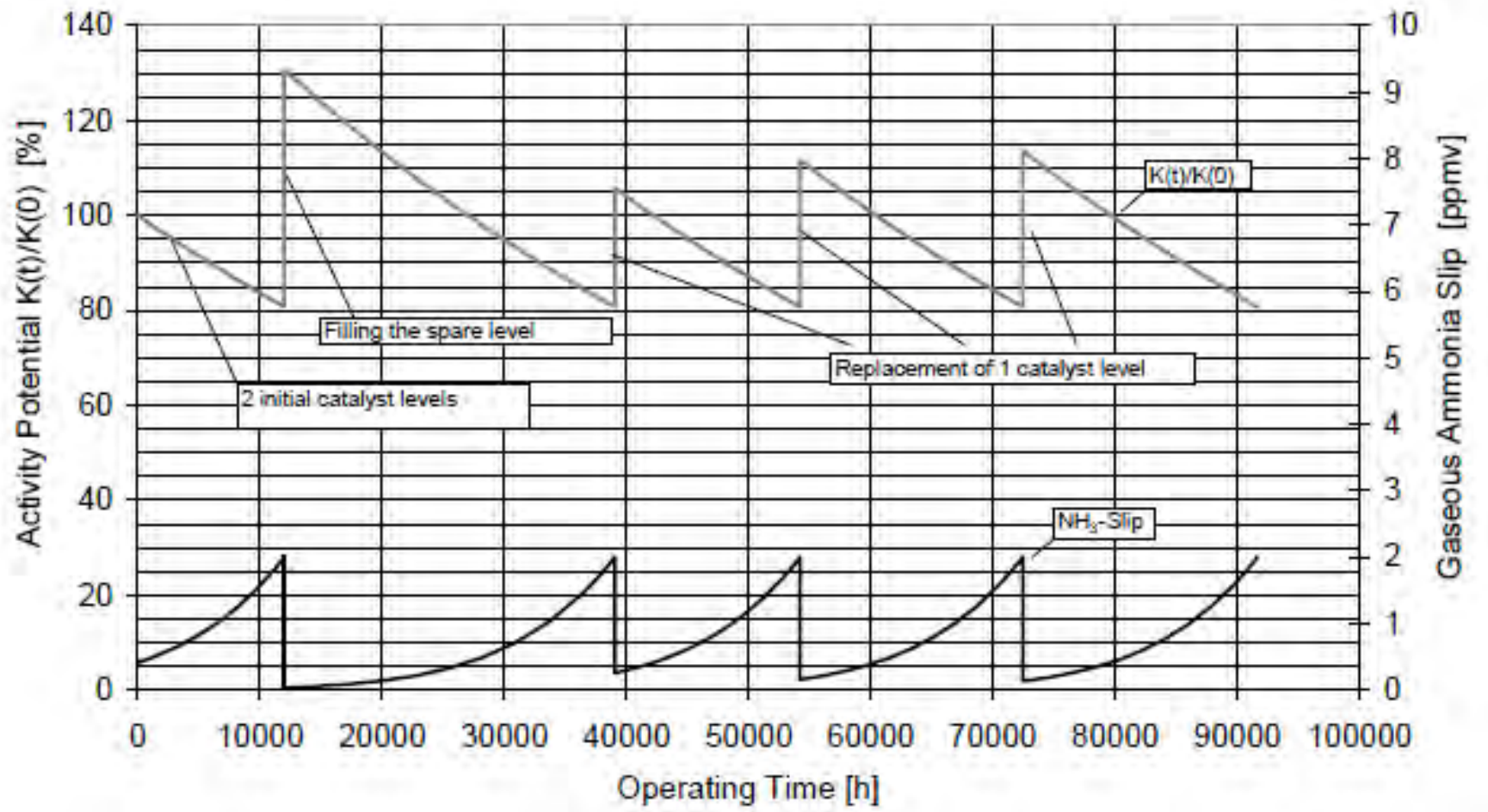


Moving it into Position



Catalyst Sampling

- The more catalyst sampling points that can be plotted on the catalyst activity graph, the more accurate the catalyst replacement needs can be predicted.
- Catalyst may have to be changed early in order to take advantage of a longer planned outage.



What if you don't sample?

- If one doesn't have enough data points to make a good catalyst life prediction, one may have an unpleasant surprise that will either:
 - Cause a several week unplanned outage to replace catalyst or
 - Cause operating the unit for an extended time with higher than allowed NOx emissions or
 - Cause operating the unit for an extended time at higher than desired ammonia slip

Sampling Plate Catalyst



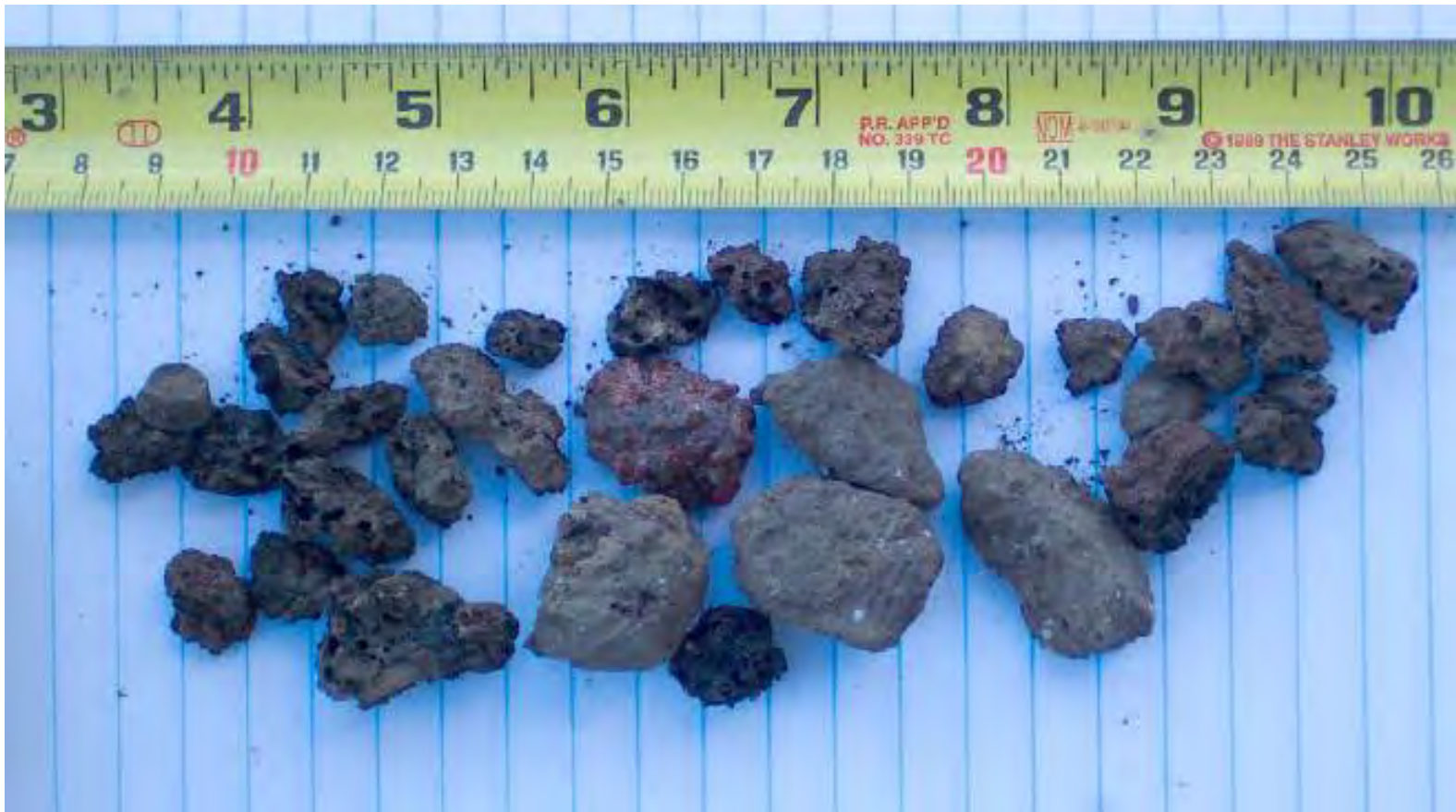
Source: Argillon

Honeycomb Test Element



Problems Experienced

LPA (Popcorn Ash)



Dirty Catalyst Station X



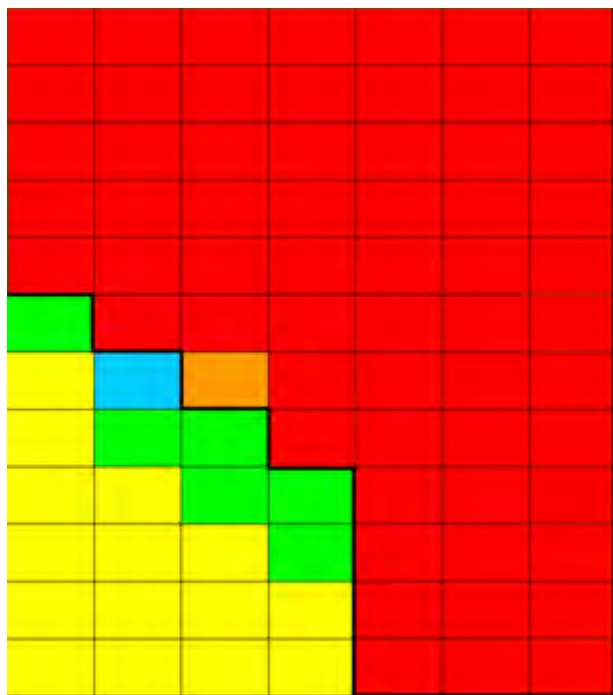
Color Codes on Diagrams

% Blockage

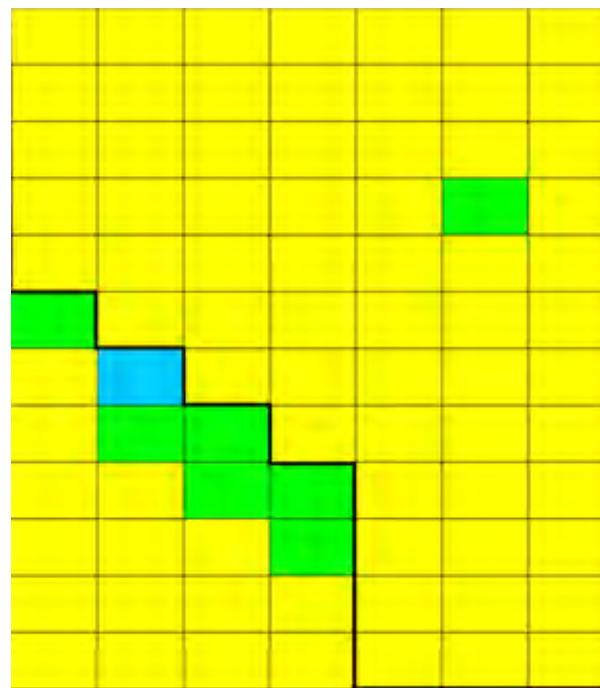
		>20%	
		15 - 20%	
		10 - 15%	
		5 - 10%	
		<5%	

Station X Top Layer

Before Cleaning

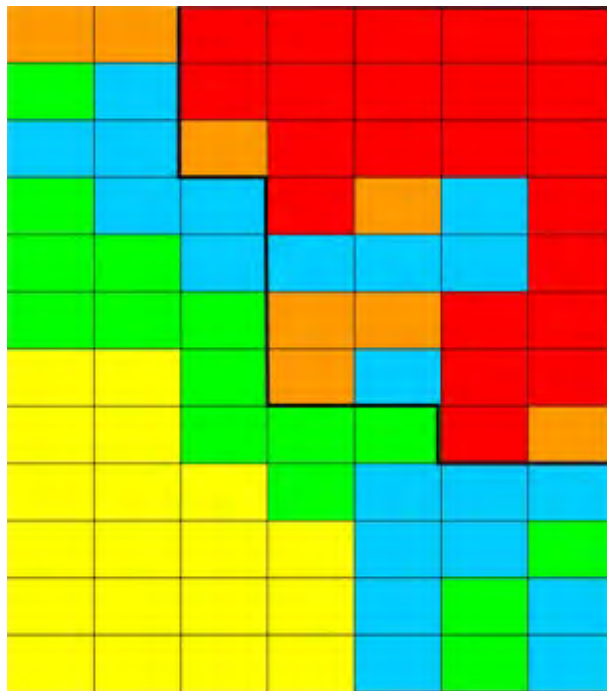


After Cleaning

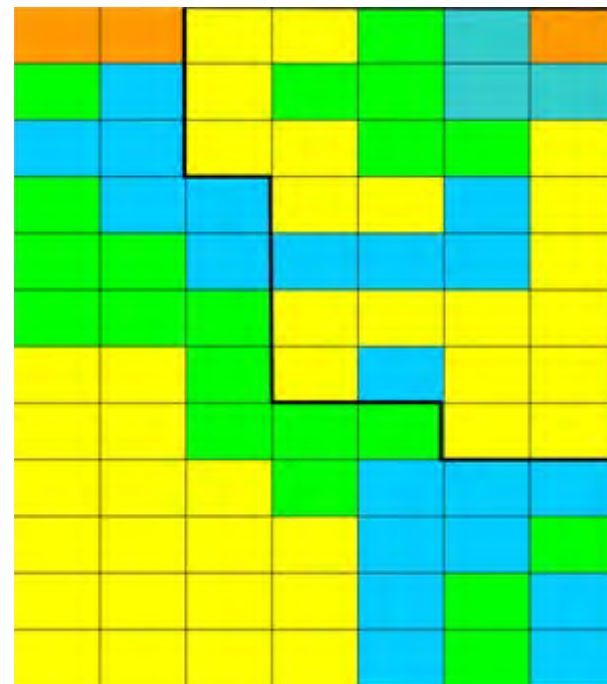


Station X Middle Layer

Before Cleaning

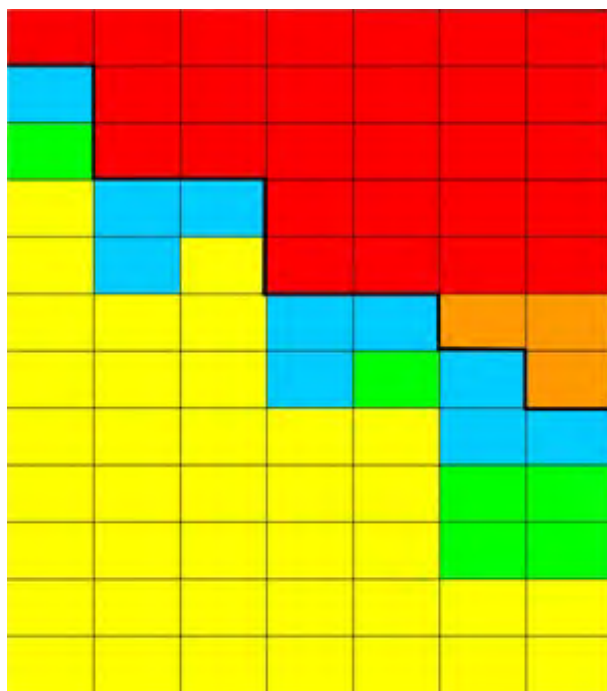


After Cleaning

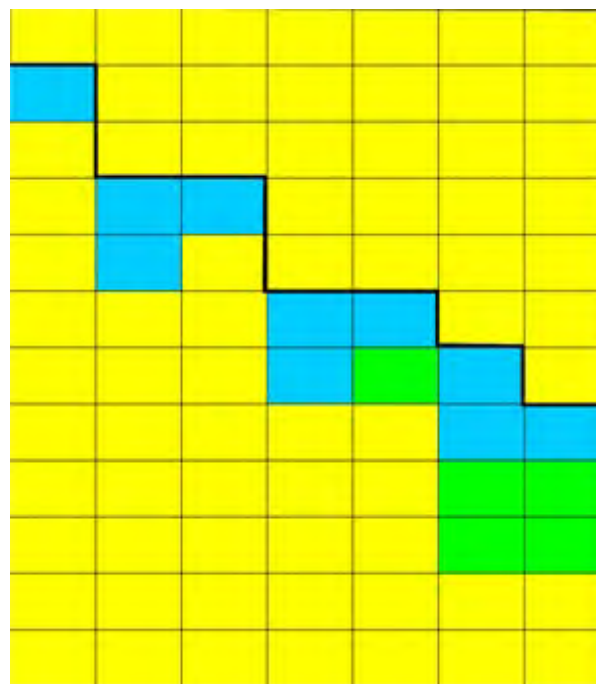


Station X Bottom Layer

Before Cleaning



After Cleaning

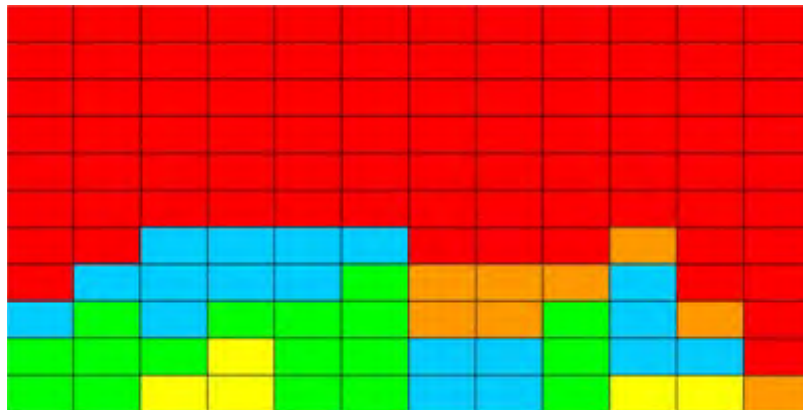


Dirty Catalyst Station Y

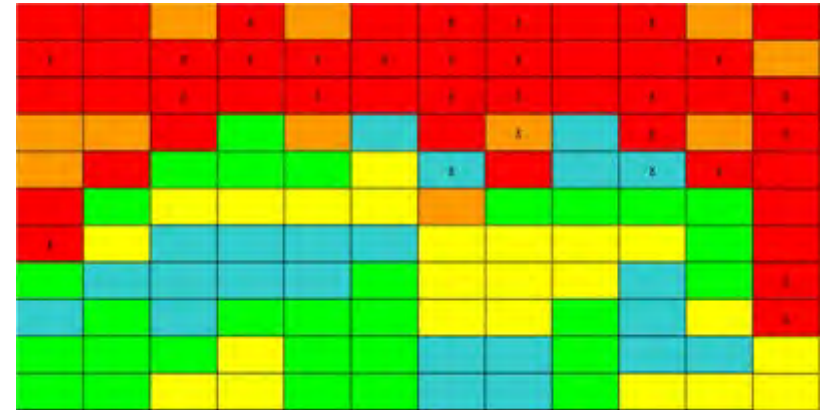


Station Y Top Layer

Before Cleaning

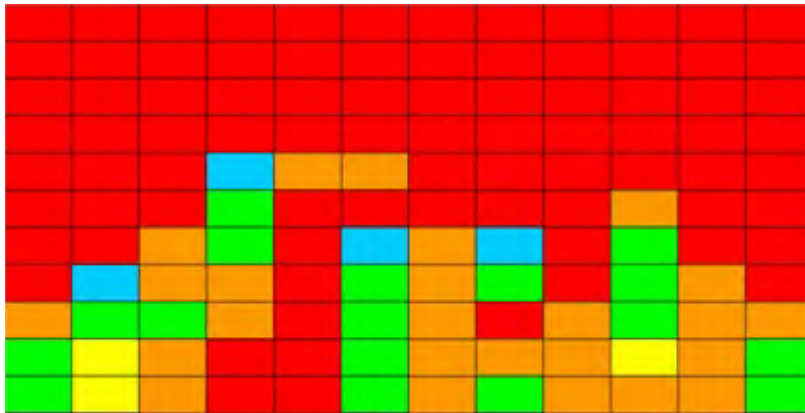


After Cleaning

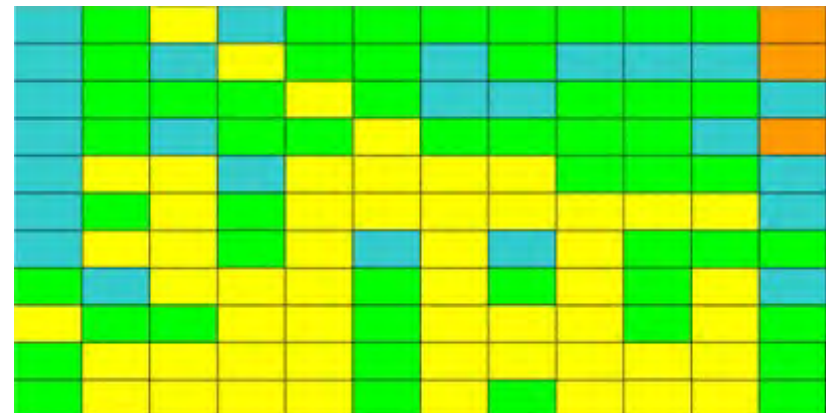


Station Y Middle Layer

Before Cleaning



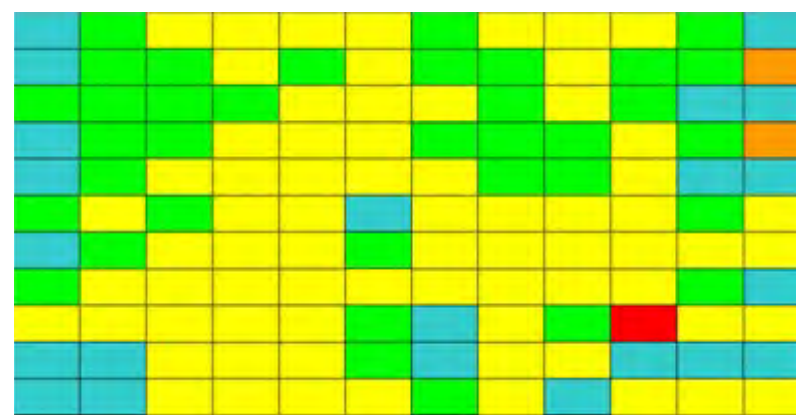
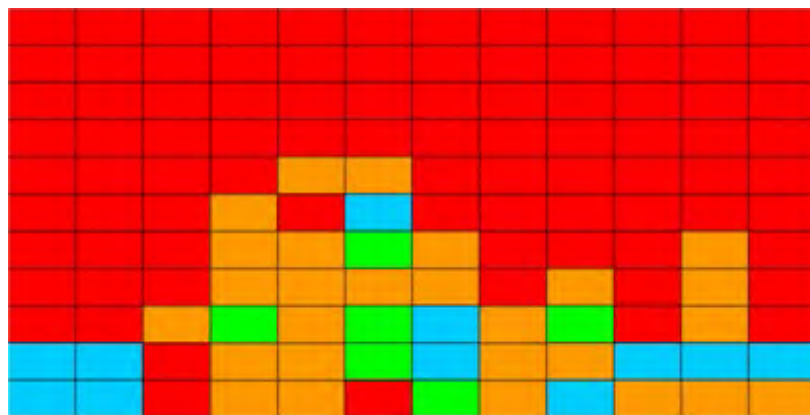
After Cleaning



Station Y Bottom Layer

Before Cleaning

After Cleaning



One Vendor's LPA Screen



Rake Type Soot Blower



Sonic Horn



Economizer Leak



Ash Issues

- One won't have as much opportunity to remove ash deposits off catalyst layers. The soot blower operation must be optimized.
- If there are any signs of LPA, then LPA screens will need to be installed or repaired.

Ash Issues

- Any signs of ash build-up in ducts and on turning vanes may be signs of poor gas distribution. One won't have the opportunity to remove ash deposits.
 - Revisit the original flow model results.
 - Take flow data to verify if anything has changed.
 - Do CFD analysis to identify solutions.

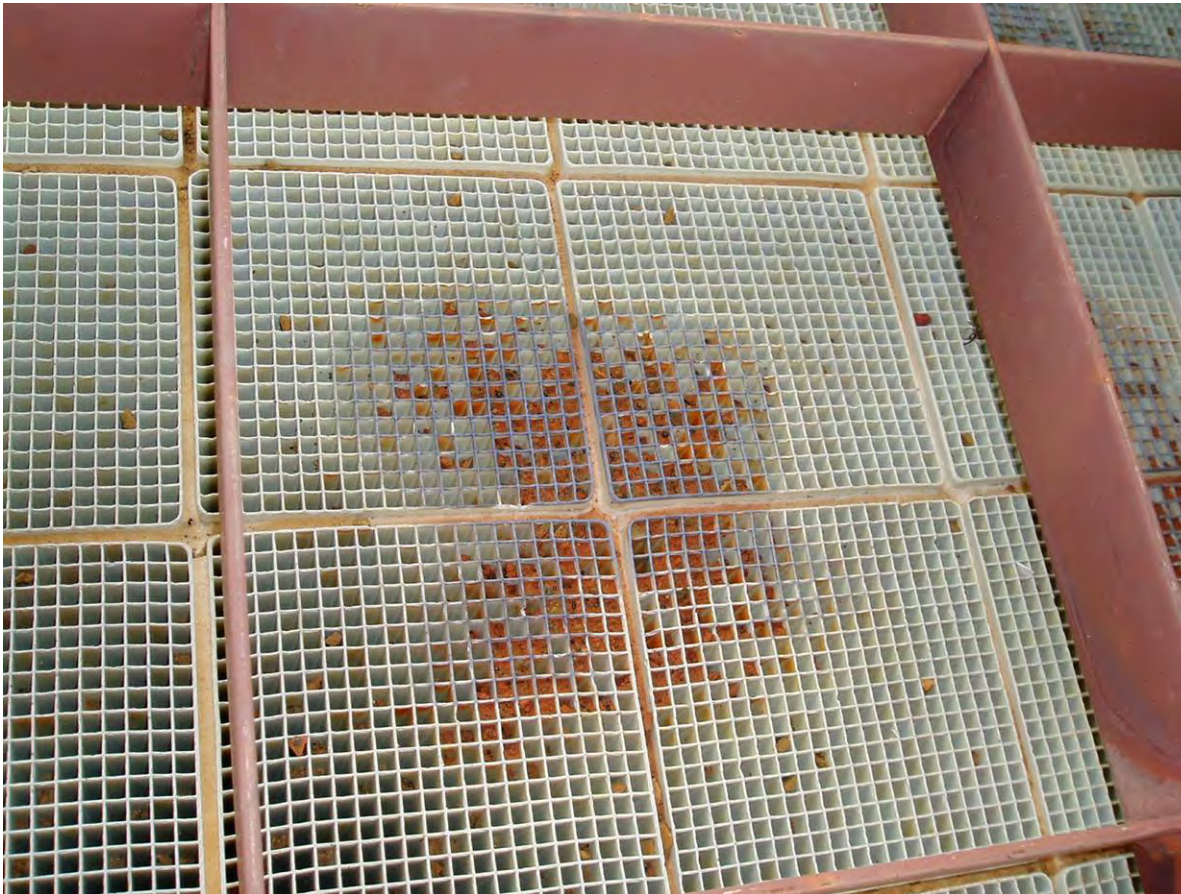
Ash Deposits on Vanes



Unburned Carbon

- One needs to minimize the amount of unburned carbon that accumulates on the catalyst since there will be less opportunity to remove it.
- Large accumulations can lead to smoldering deposits or catalyst fires.

Charred Deposit in Catalyst



Ammonia Injection

Ammonia Injection Nozzles



Ammonia Injection Nozzles



Ammonia Injection Piping



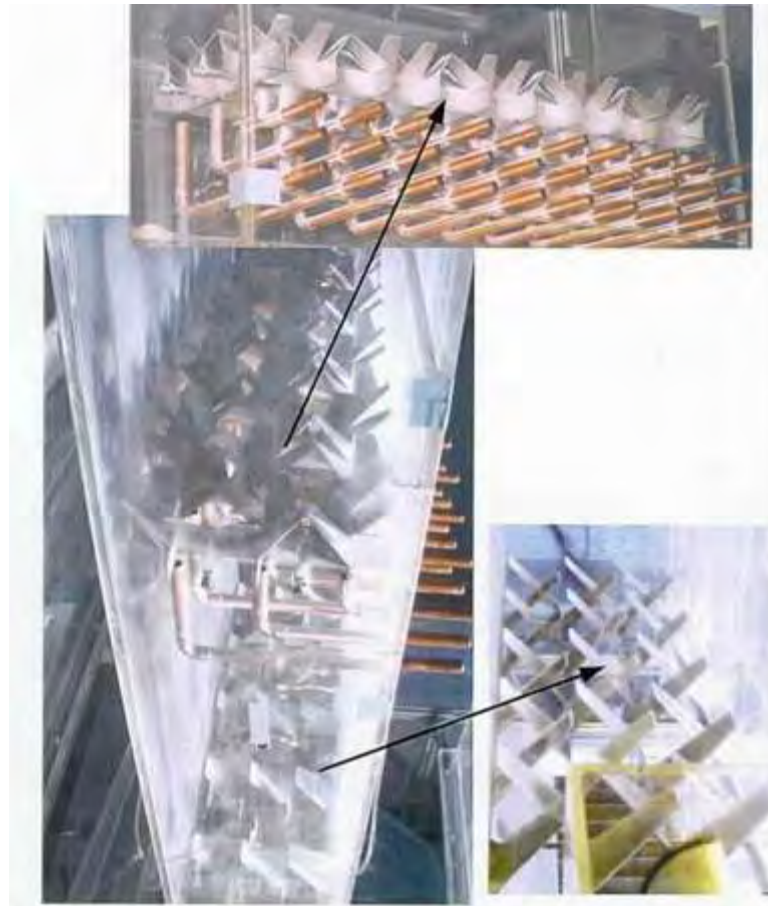
Static Mixer Ammonia Feed



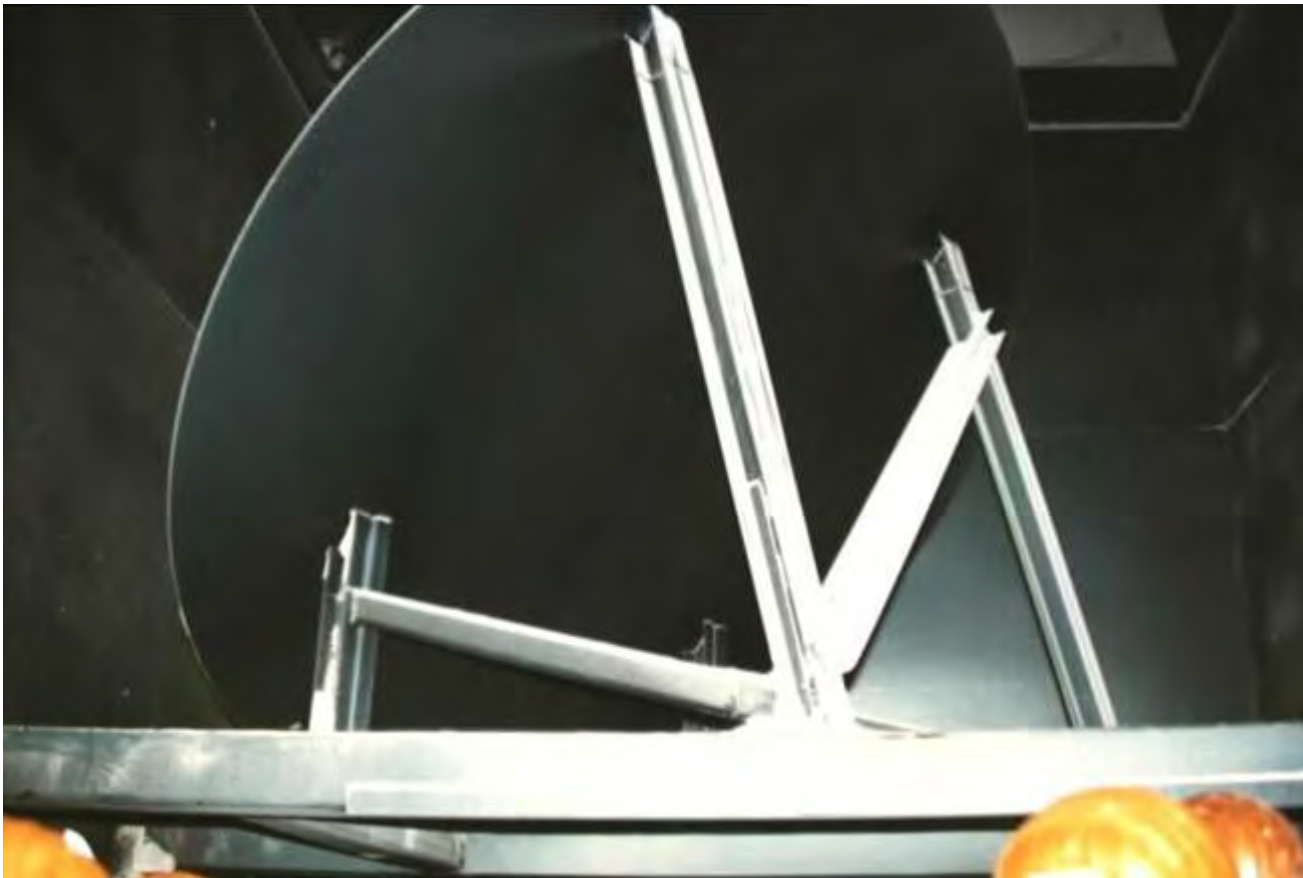
Static Mixer Injector



Static Mixer Ammonia Feed



Delta Wing Ammonia Feed

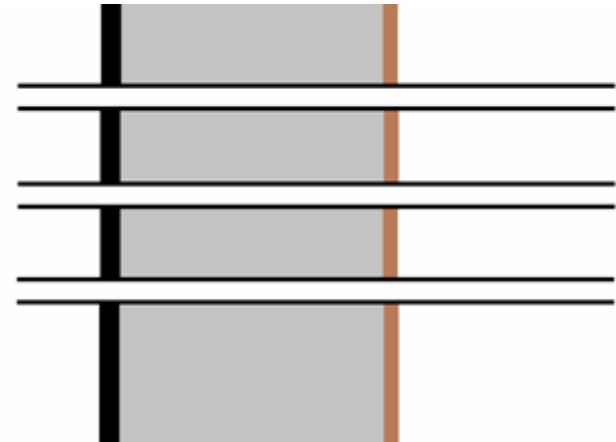


Delta Wing Ammonia Feed



Sampling Grid

- Check that the sample lines are firmly attached and terminate in the correct location
- Look for holes in the lines
- The sample lines tend to plug or corrode holes through the tube wall at the hot/cold interface



Questions?