REINHOLD ENVIRONMENTAL ®

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Demanding Greater Catalyst Life

By Jeff L Shelton and Nate White

Dracyon Corp

- **REINHOLD ENVIRONMENTAL®**
  2025 REINHOLD/PCUG Conference
  Monday, June 23, 2025 - Thursday, June 26, 2025
  Hilton Columbus/Polaris, Columbus, Ohio

Demand more operational life from your catalyst!

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Yesterday's Catalyst World

Today's Catalyst World

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New standards are possible

Get a good catalyst that is guaranteed to live 3 years. This is already been offered and meet. Place the burden of the extra years on a 3rd party if necessary!

Keep your catalyst clean. This ensure greater possible amount of surface area!

Keep LPA from your catalyst

Purchase and maintain good Online Cleaning System

Ensure you have a good Mixing system that avoids ammonia mal-distribution

Commit to a rigorous and effective Offline catalyst cleaning program. In fact, don't clean your catalyst reinvigorate it.

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How to Achieve 5 Years of Life

- Maintain good flow and ammonia distribution. Good ammonia distribution is key to reducing operational cost.
- Install catalyst with sufficient surface area and activity level to meet emission requirements.
- Practice good catalyst management (outage inspections, annual cleaning, catalyst testing, LPA Screen, online data evaluation, etc.).
- KEEP THE CATALYST CLEAN. A clean catalyst is necessary to maintain an optimal changeout schedule. Even if the other conditions are met, a dirty catalyst will not achieve 5 years of life.

What happens in a coal SCR?

General Trends

- Catalyst builds up every year and lose activity.
- Activity loss is greatest Year 1. It levels out thereafter.
- Buildup get worse each year of operation.
- As the buildup increases, plants lose, DeNOx, get high pressure drop, and ammonia flow.
- You replace your Catalyst to regain operational cost and DeNOx.

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If you take care of your catalyst, then your catalyst will take care of you!

- Nothing here is revolutionary. Everything has already been done.
- Some plants are already meeting or exceeding the specifications outlined here.
- The question is not "does this work?"
- The question is, "are you ready to improve SCR performance and save millions of dollars?"

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Maintain good online and offline cleaning systems

- Prevent buildup in catalyst, which generates high operational cost.
- Never allow buildup to impact DeNOx. Place burden on catalyst
- All online cleaning will allow the catalyst to become coated

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Yesterday, Air Cannon! They helped but, in many applications, proved to not be enough!

This plant addressed short cleaning by adding new air cannons in the center of SCR.

- Tradition Air cannons cleaning one row

- Buildup in the Center

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This is before vacuuming. Well-mainntained online cleaning system eliminated the need.

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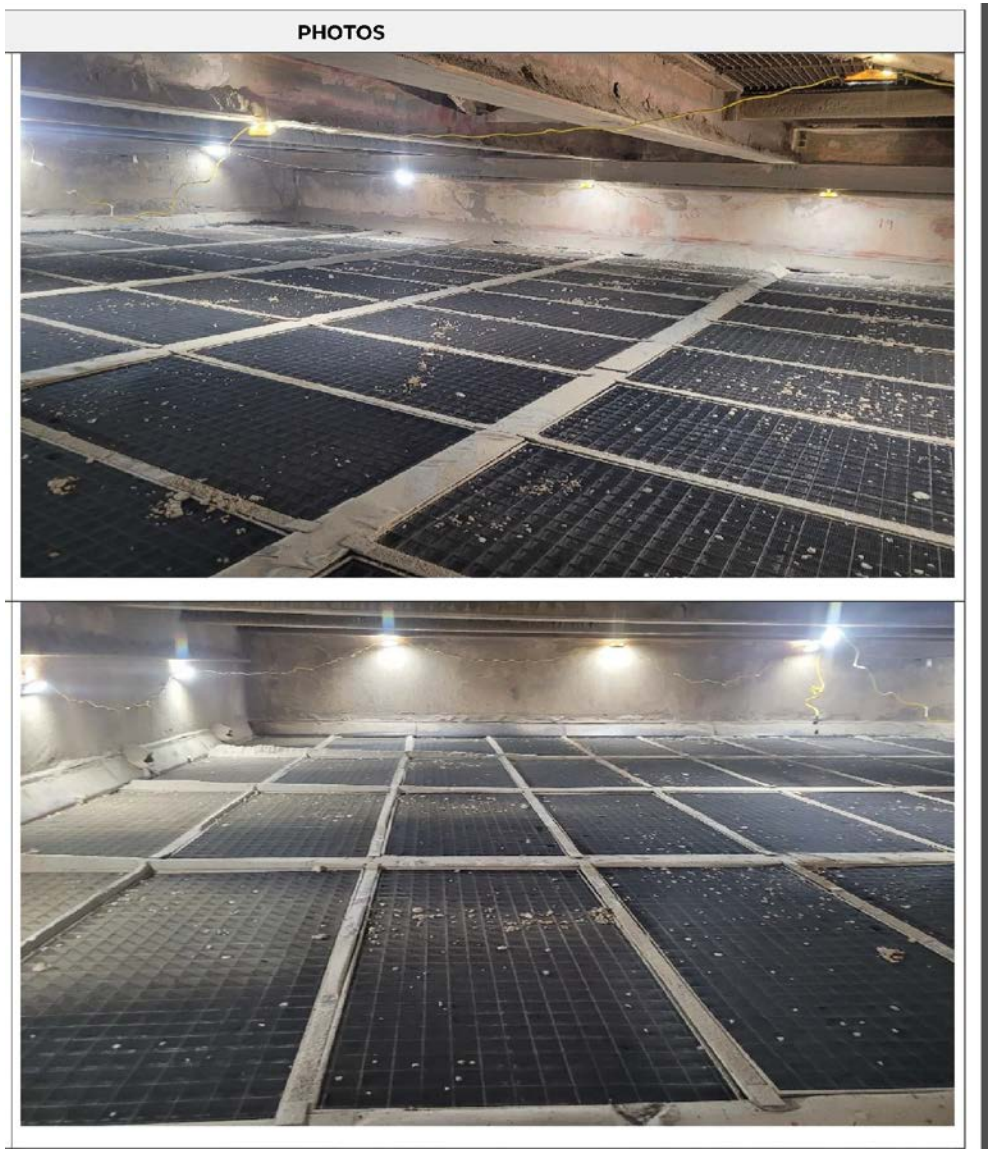
Todays, Air Cannon! They 100% solved the buildup issue. This photo was taken pre-vacuuming!



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Do not overlook Offline cleaning. Get your reactor as close to 100% clean every outage

Many catalyst OEM believe that 10% buildup after one year of operation is acceptable. This is true if you want short catalyst life!

At one plant we cleaned an 80% blocked(buildup) layer of catalyst to flashlight clean!

Most blocked catalyst has greater activity than open catalyst, similar to a battery. Think of the extended catalyst life!

WOW!!

Yesterday's world!

- “I am tired of replacing catalyst because of buildup instead of activity”

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Today's world!

- What happens after you stop replacing catalyst because of buildup?
- You can more than double your catalyst life.
- You save money based on reduced pressure drop and ammonia flow.

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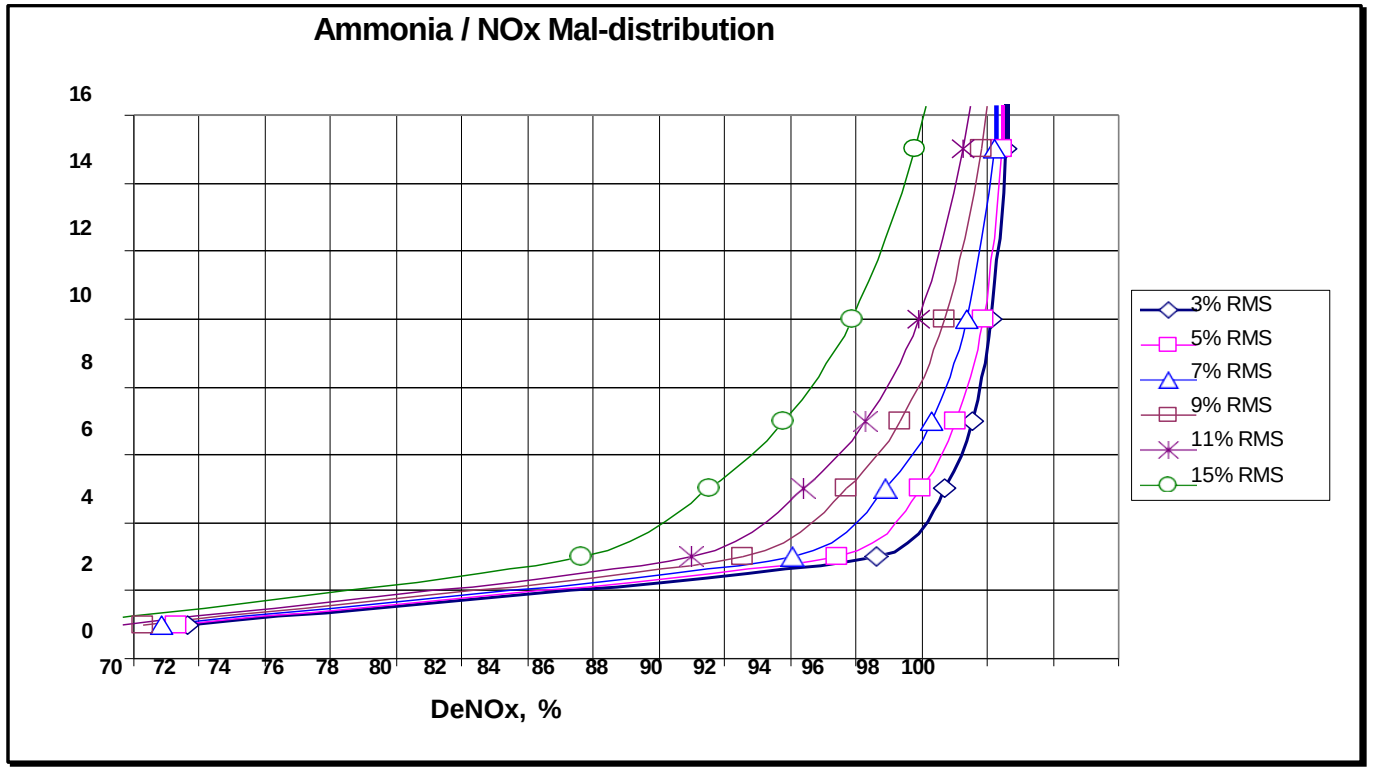
Distribution is very important to SCR performance. It's simple, improve your distribution and improve your performance. New technology in CFD allows much better modeling and will give you the data to get your distribution to as low as 3%.



A good mixing system can reduce the catalyst in each reactor.

- This is proven technology in the Industry market. Reduction of NOx by 99% has been achieved.
- Difference is not the chemistry but the industry applications.
- Most are not as dirty, which is why it is essential to keep your catalyst clean.
- Keeping your system clean adds a new dimension to good SCR operation and saves money.

Two-Cassette Design in Plate Catalyst

- Originally introduced in Europe to enhance NOx reduction for bituminous coal (non-sticky).
- The free area between the elements generates a change in the gas flow direction the reduces ash pluggage and increases non-laminar flow.
- Non-laminar flow increases the interaction of the flue gas with the catalyst thereby increasing NOx reduction.
- Non-laminar flow improves ammonia-maldistribution.
- BUT Sticky coals increases the possibility of buildup.
- That is why you must KEEP THE CATALYST CLEAN

Yesterday's setup

- Pressure drop
- 1st layer =.1”
- 2nd layer = 1”
- Total 2.0”
- Annual Operational cost (based on $150,000 per 1” Pressure drop equals $300,000

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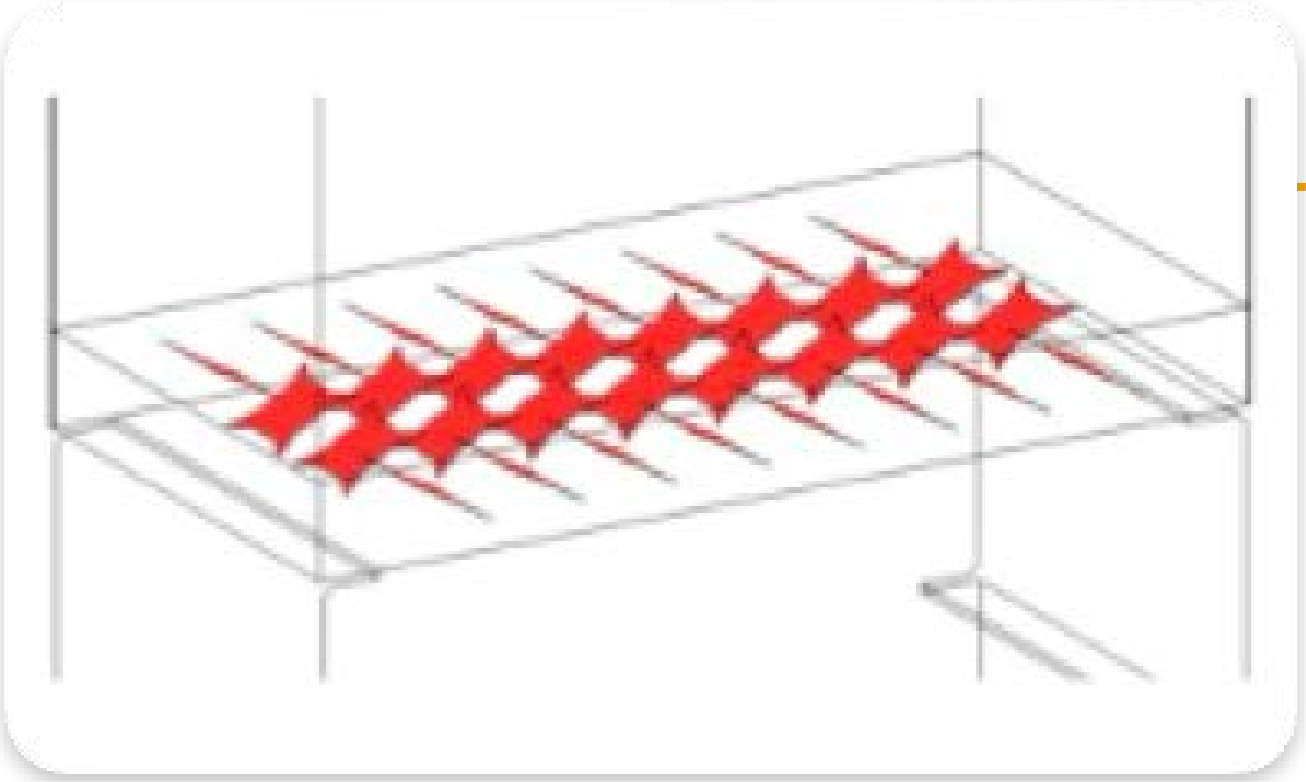
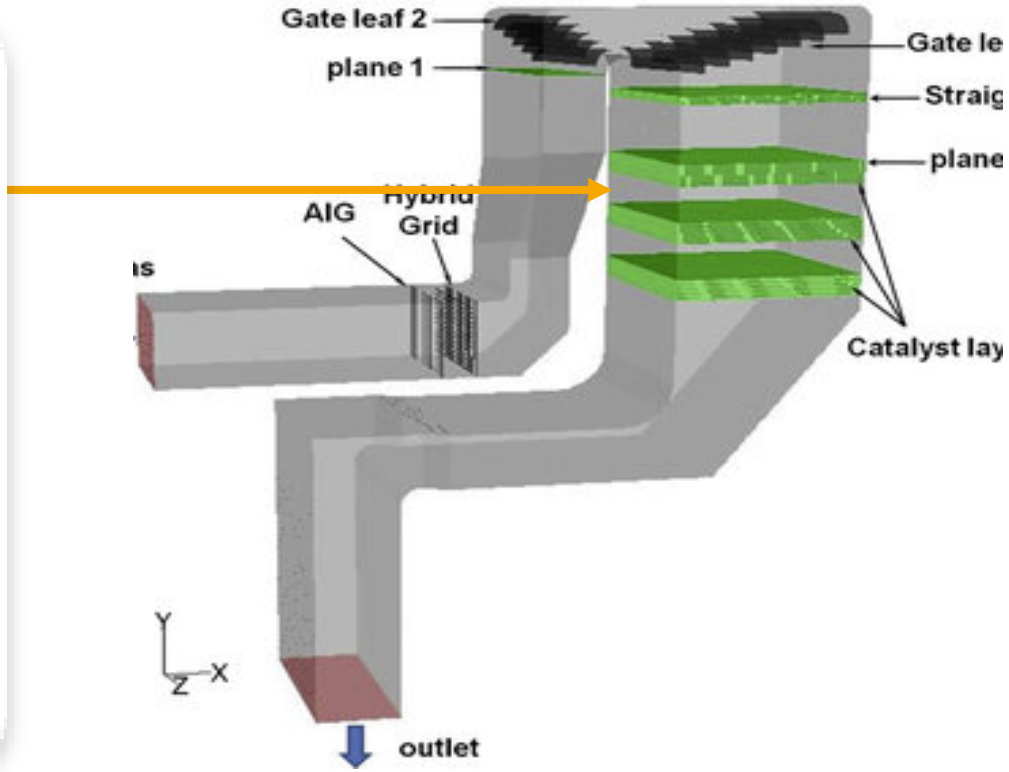
Emerging Techology – Inter Layer Mixers





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Today's setup (Interlayer Mixing System)

- Pressure drop
- 1st layer =.5 “
- Mixing System .1”
- 2nd layer = 1”
- Total 1.6”
- Annual Operational cost (based on $150,000 per 1” Pressure drop equals $240,000

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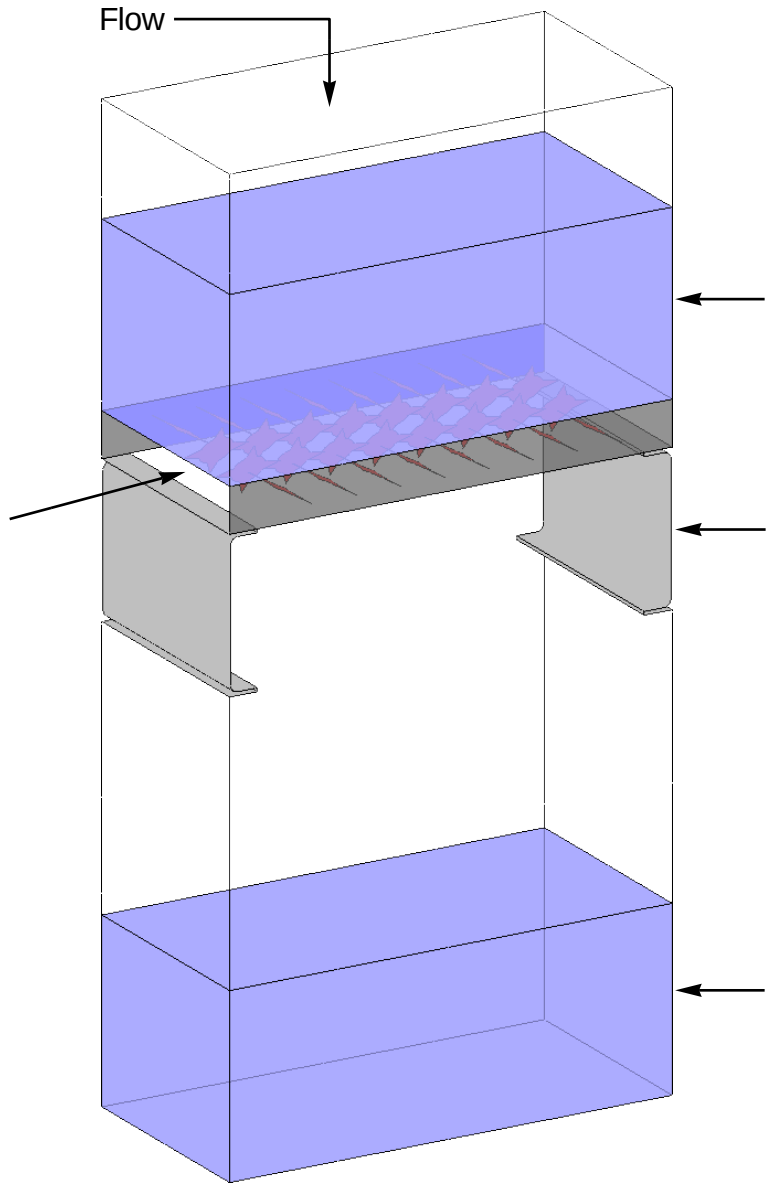
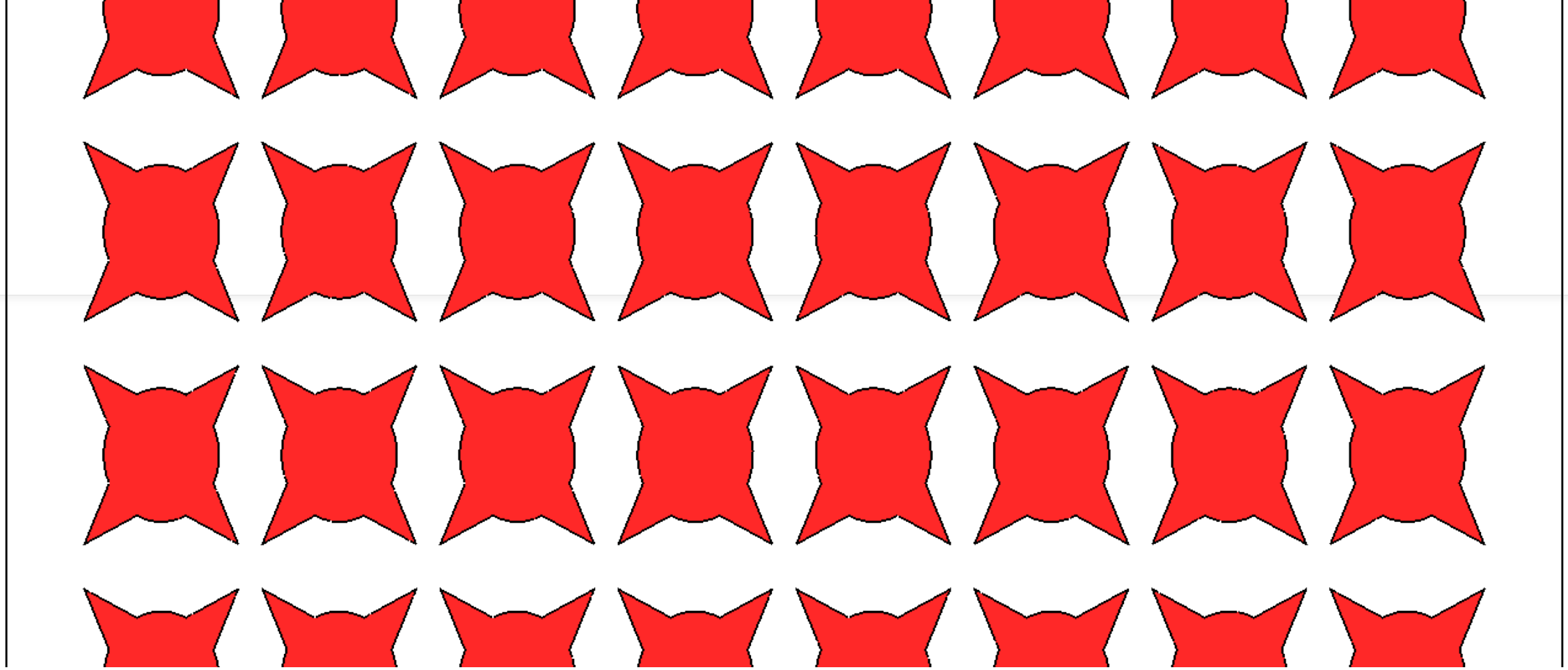
Did you know?

- In the first 12 inches of the first layer removes up to 50 to 60% of the NOx emissions, depending on the SCR and the catalyst pitch.
- This is for the following reasons:
  - This is the easiest NOx to remove. (highest value)
  - The NO and ammonia interacts with the catalyst.
  - The second cassette removes only 15%
  - The Dual cassette Plate catalyst was designed for the European market to increase this interaction between the plates. New wider pitch catalyst reduces surface area and prevent this interaction between the NO, ammonia, and catalyst surface

Interlayer Mixing System

Pressure Drop Increase with Mixer = 0.05 IWC





Why is first cassette the most efficient?

- Largest % of NOx—easier to remove
- Turbulent flow—catalyst is great flow straighter, Mass flow prevents modulus of NO and ammonia to interface with catalyst and chemical reaction is not allowed to occur.
- Mixer system will remix gas flow and use all the catalyst

Emerging Techology – Inter Layer Mixers

Case Study for a 250 MWe plant

- Assume you start with 300 ppm of NOx
- 1st layer, 1st cassette removes 61% = 183 ppm of NOx removed, remaining 117 ppm
- Mixing System (Pressure Loss 0.1 IWC)
- 2nd layer 1st cassette removes 23% = 68 ppm of NOx removed total 49 ppm
- 2nd layer 2nd cassette removes 8% = 24 ppm of NOx removed total 25 ppm
- Total reduction is 275 ppm of NOx or 92% removed

Case Study for a 250 MWe plant

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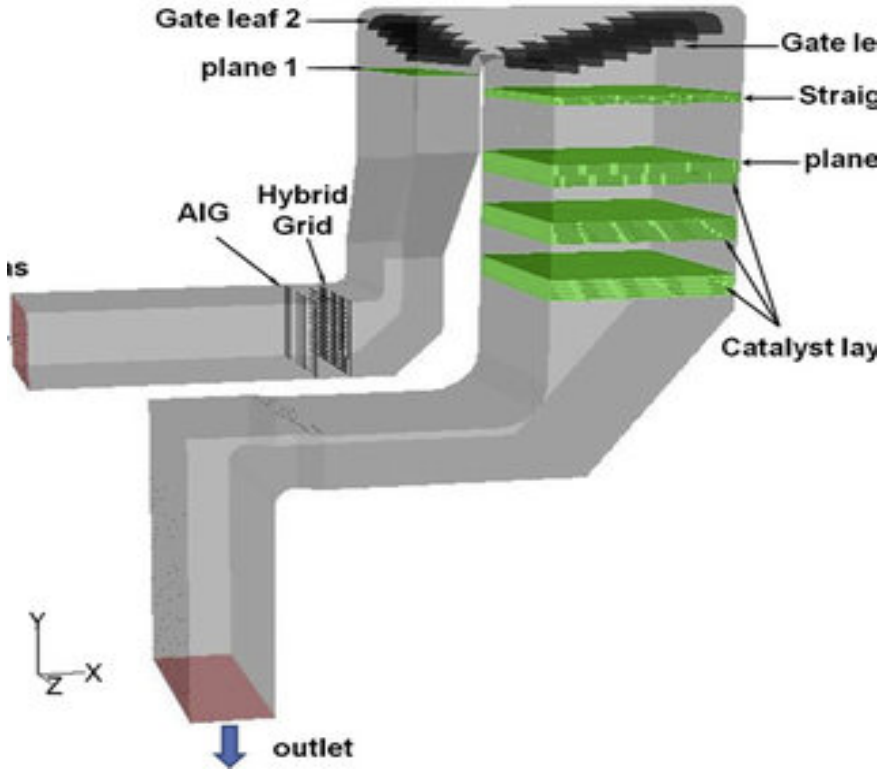
- Assume you start with 300 ppm of NOx
- 1st layer, 1st cassette removes 61% = 183 ppm of NOx removed, remaining 117 ppm
- 1st layer 2nd cassette removes 19% = 57 ppm of NOx removed total 60 ppm
- 2nd layer 1st cassette removes 5% = 15 ppm of NOx removed total 45 ppm
- 2nd layer 2nd cassette removes 5% =15 ppm of NOx removed total 30 ppm
- Total reduction is 208 ppm of NOx or 90% Removed



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Assume

- Replacement cost of two layers of catalyst is $2 million
- Mixing system is $500,000
- Total cost for system is $1.5 million
- Upfront saving $500,000
- Lower pressure drop by 1” or about $150,000 annual operational cost per year
- Reduce annual ammonia cost by $500,000
- Lower ammonia slip
- Lower vacuuming cost-$150,000 per year.
- Annual saving per year = $800,000

Huge potential Saving by doubling catalyst life!

- Save $4 million on capital money.
- Up to $3.2 million in operational cost

- **Total almost $8 million**

Interlayer Mixing System—has it been done before?

Yes

- Industry market has over 40 installation. The focus is improvement of DeNOx. System has eliminated up to 99% NOx.
- Plate catalyst OEMs employ mixing system with dual cassette. The open area between catalyst is designed to re-circulate flue gas to improve DeNOx

Conclusion

- A 5 year life guarantee is possible. Some plants already achieve it.
- Keys to success include proper installation, maintaining good flow and ammonia distribution, proactive catalyst management, and most importantly KEEPING THE CATALYST CLEAN