DOE 2003 SCR/SNCR Workshop

Full-Scale Catalyst Regeneration Experience At The Coal-Fired Indiantown Generating Plant

Douglas W. Bullock, P.E.
National Energy Power Co. LLC
Indiantown Generating Plant

Hans Hartenstein
SCR-Tech LLC

NEGT National Energy & Gas Transmission

SCR-Tech LLC

The Indiantown Generating Plant

Location:	**Indiantown, Florida**
Owner:	**ICLP – Indiantown Cogeneration Limited Partnership**
Operator:	**National Energy Power Company LLC**
Capacity:	**360 MW electricity, 270 t process steam**
Start-up:	**1995**
Boiler:	**Bituminous coal, PC-wall-fired**
SCR:	**3 layer reactor, ~ 55% NOx removal efficiency**

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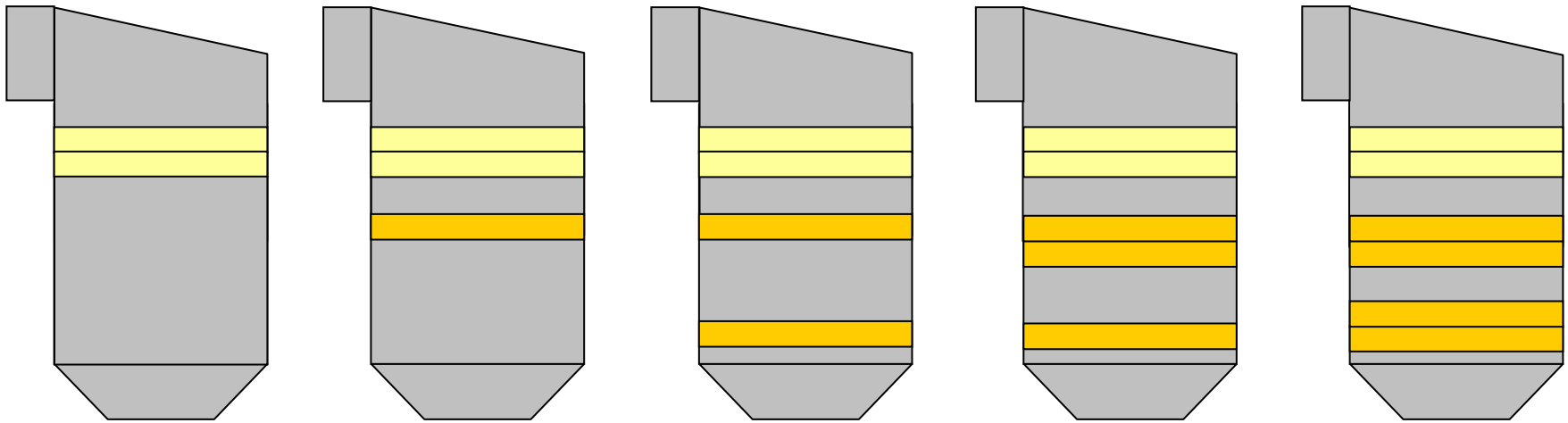
Catalyst Addition 1995 – 2000

After start-up on the initial catalyst fill of 2 half-layers in summer 1995, additional half-layers of catalyst were installed as soon as the ammonia concentration in the fly ash exceeded acceptable levels. This led to the following schedule of catalyst addition:



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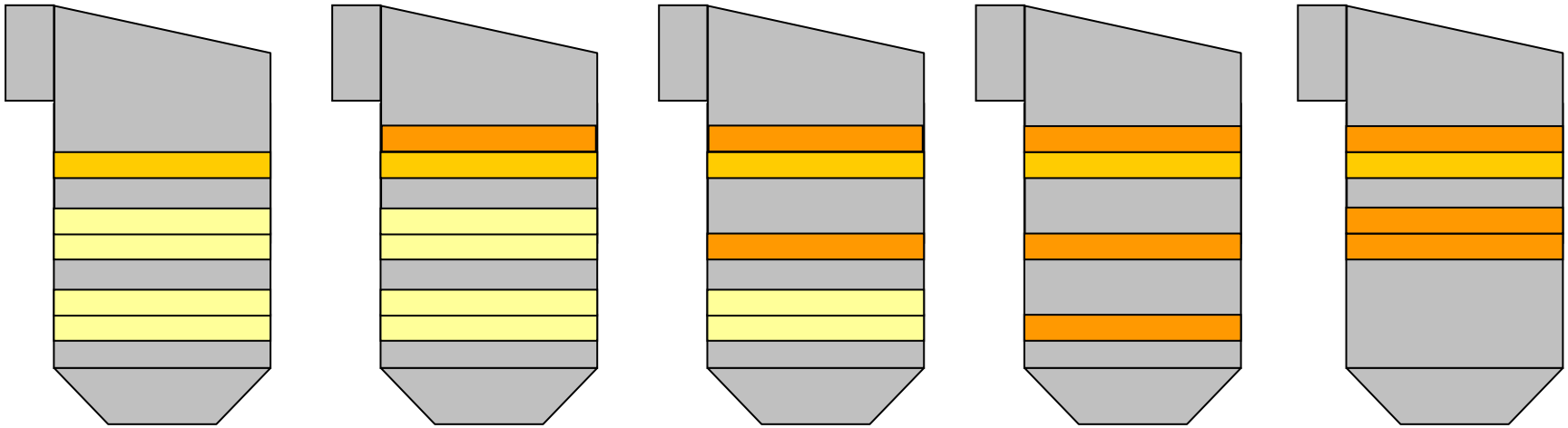
Catalyst Exchange Plan Since 2002

The transition from a former 3 full-layer SCR operating scheme to the new 4 half-layer SCR operating scheme has been started. This schedule calls for the following future catalyst exchange and regeneration cycles:



spring 02 **spring 03** **fall 03** **1st future exchange** **2nd future exchange**

initial fill catalyst

addition of new catalyst

addition/exchange and regeneration of catalyst

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Catalyst Regeneration – Timeline

Spring 2002:	**Removal of catalyst layer 1, 80 full modules after ~ 57,000 operating hours at a K/K_0 ~ 0.4. Replacement by a new half-layer, 80 half-modules.**
Fall 2002:	**Decision to regenerate and split the 80 full modules of layer 1 into 160 half-modules.**
January 2003:	**Catalyst regeneration and split of modules by SCR-Tech.**
March 2003:	**Delivery of 160 fully regenerated half-modules to Indiantown.**
April 2003:	**Installation of the first 80 half-modules of regenerated catalyst as the top half-layer.**
October 2003:	**Removal of catalyst layer 2, 80 full modules after ~ 60,000 operating hours. Installation of the second 80 half-modules of regenerated catalyst as the third half-layer.**

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Catalyst Regeneration – Disassembly

Modules were disassembled in order to split them and remove major accumulations of ash prior to regeneration.

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Catalyst Regeneration – Popcorn Ash

Large popcorn ash particles were found between the two layers of plate boxes within the modules.

These were mechanically removed prior to catalyst regeneration.

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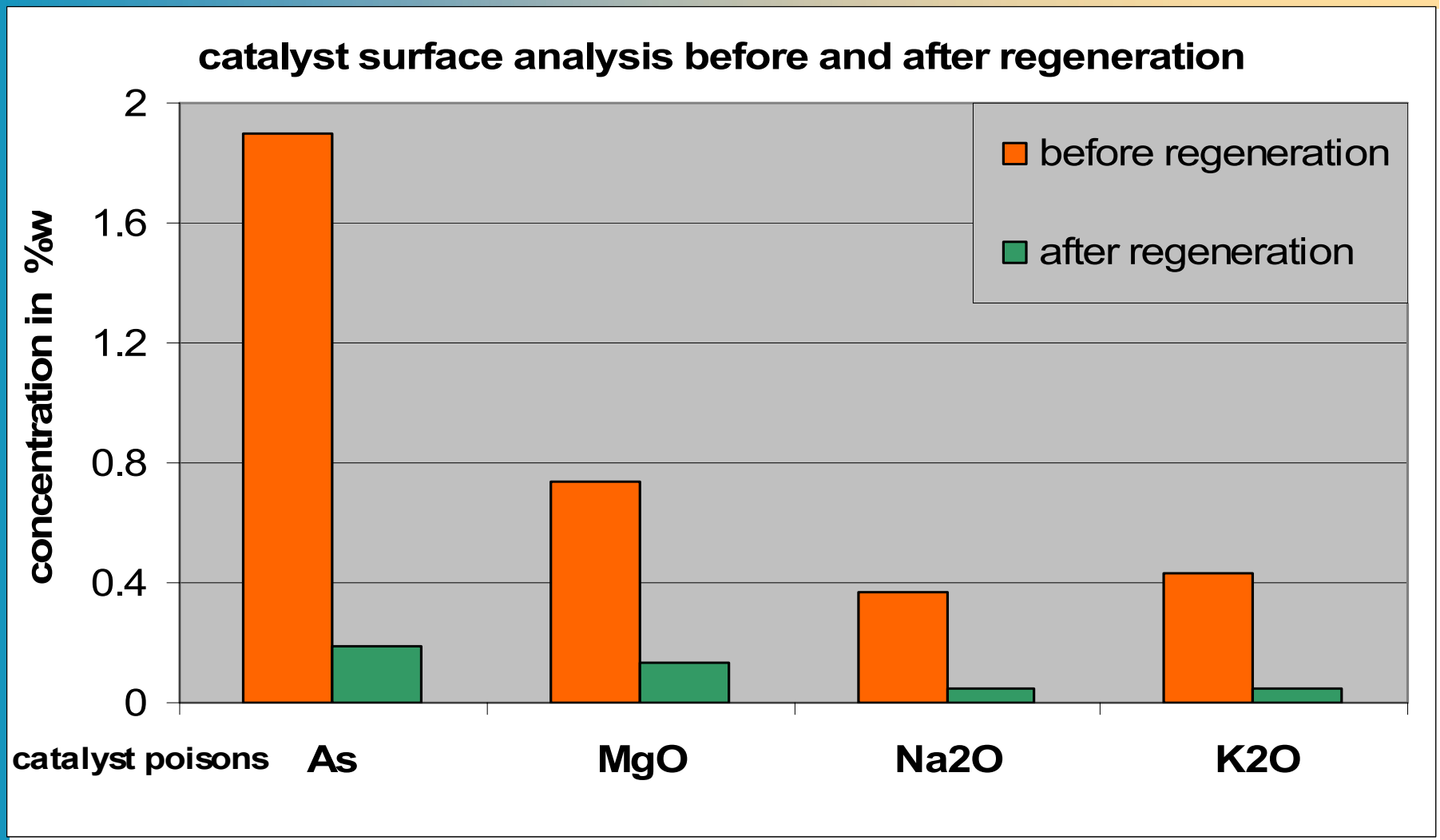
Catalyst Regeneration – Results



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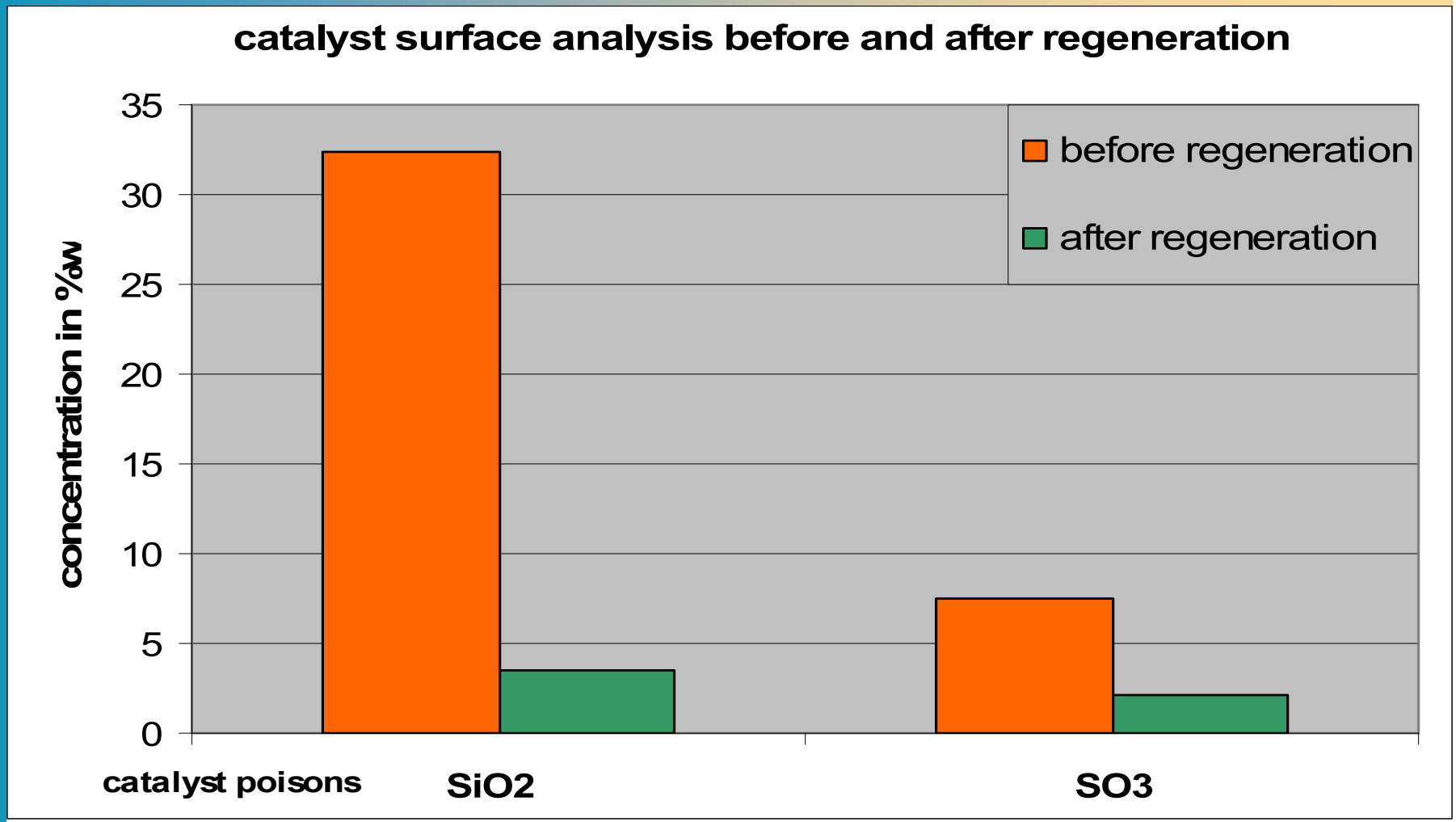
Catalyst Regeneration – Results



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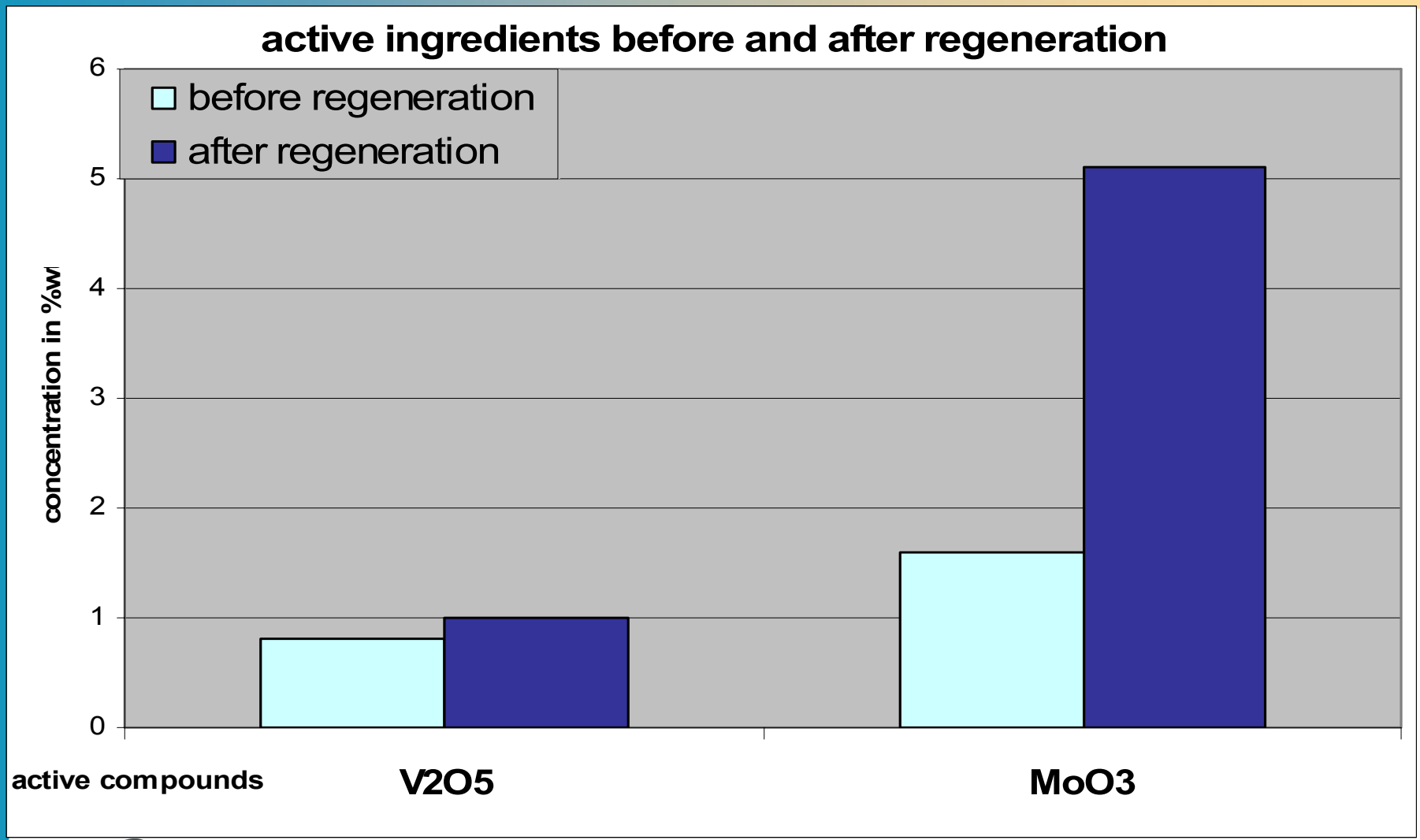
Catalyst Regeneration – Results



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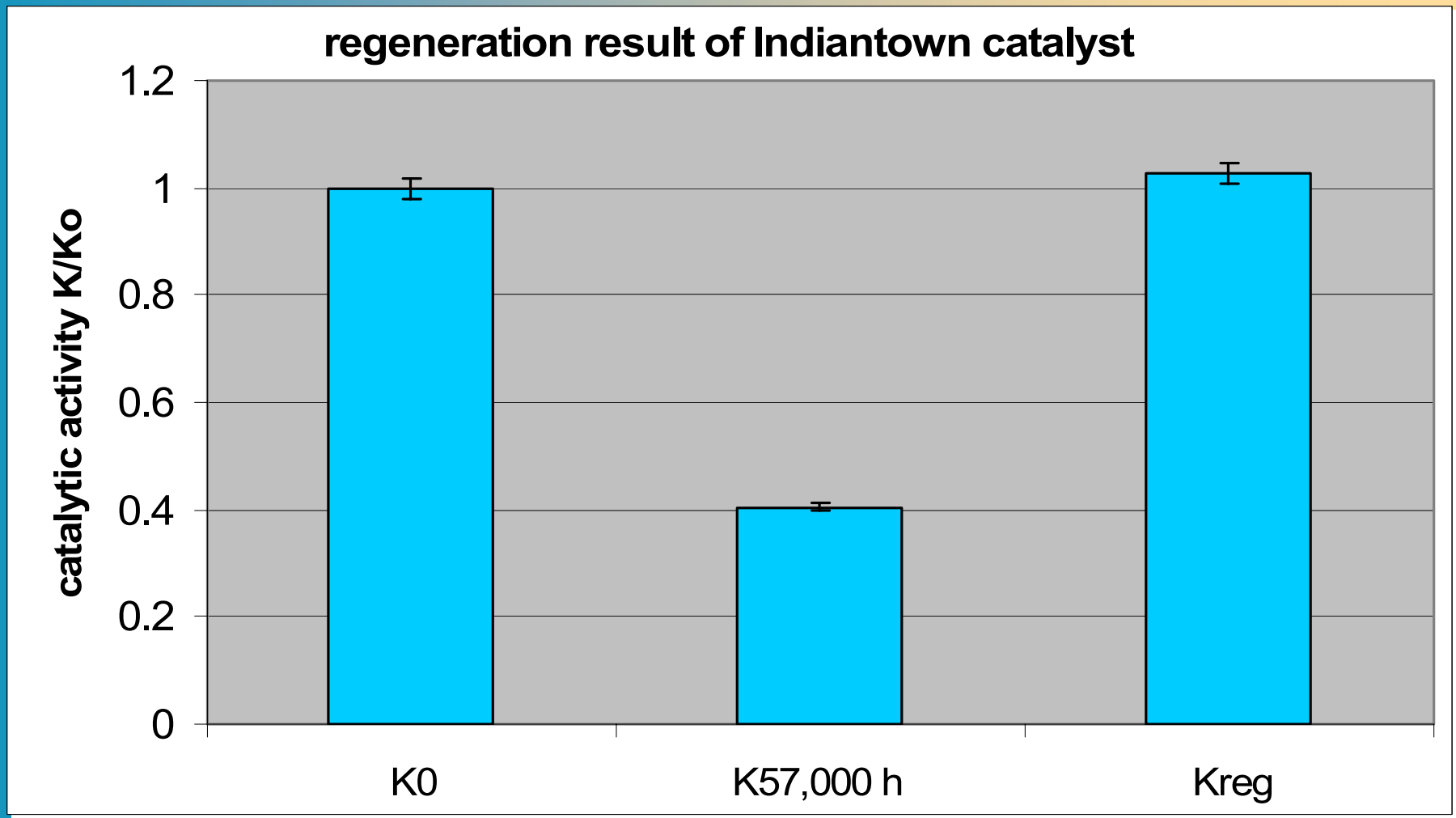
Catalyst Regeneration – Results



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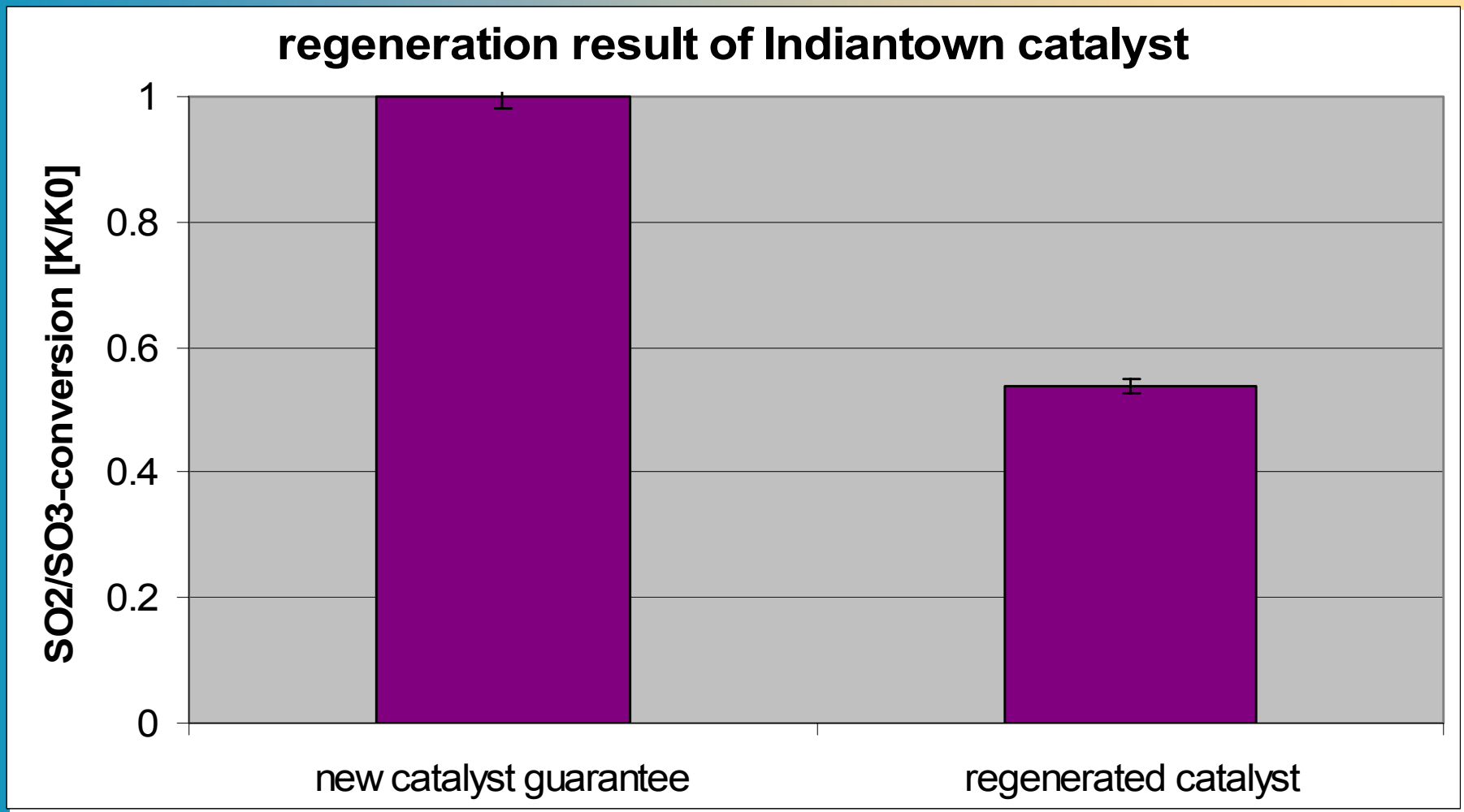
Catalyst Regeneration – Results



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Catalyst Regeneration – Results

The catalyst regeneration results can be summarized as:

1. **Catalyst was deactivated as expected ($K/K_0 \sim 0.4$)**
2. **Catalyst poisons were successfully removed**
3. **Catalyst activity after regeneration was $K_{reg}/K_0 = 1.03$**
4. **The SO_2/SO_3-conversion rate decreased significantly after regeneration to almost half of the manufacturer's original SO_2/SO_3-conversion rate guarantee for the new catalyst in 1995.**

Conclusion: Catalyst regeneration was very successful.

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Delivery of Regenerated Catalyst

Delivery of regenerated half-modules in March 2003.

Two half-modules were stacked for transportation.

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Installation of Regenerated Catalyst

Lifting of regenerated half-modules to the top layer of the SCR reactor for installation in April 2003.

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Installation of Regenerated Catalyst

Transport into the SCR reactor via a roller-conveyor.

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Installation of Regenerated Catalyst

April 2003: Placement of the regenerated half-modules on top of the half-layer of new catalyst, which was installed in spring 2002.

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Operation of Regenerated Catalyst

- No difference observed in overall SCR operation using regenerated versus new catalyst.
- SCR performance using regenerated catalyst identical compared to using new catalyst.
- Activity of regenerated catalyst about the same as new catalyst.
- SO_2/SO_3-conversion rate of regenerated catalyst lower than new catalyst.
- Pressure drop of regenerated catalyst same as new catalyst.
- Deactivation of regenerated catalyst same as new catalyst in the same layer of the same SCR reactor burning the same fuel.

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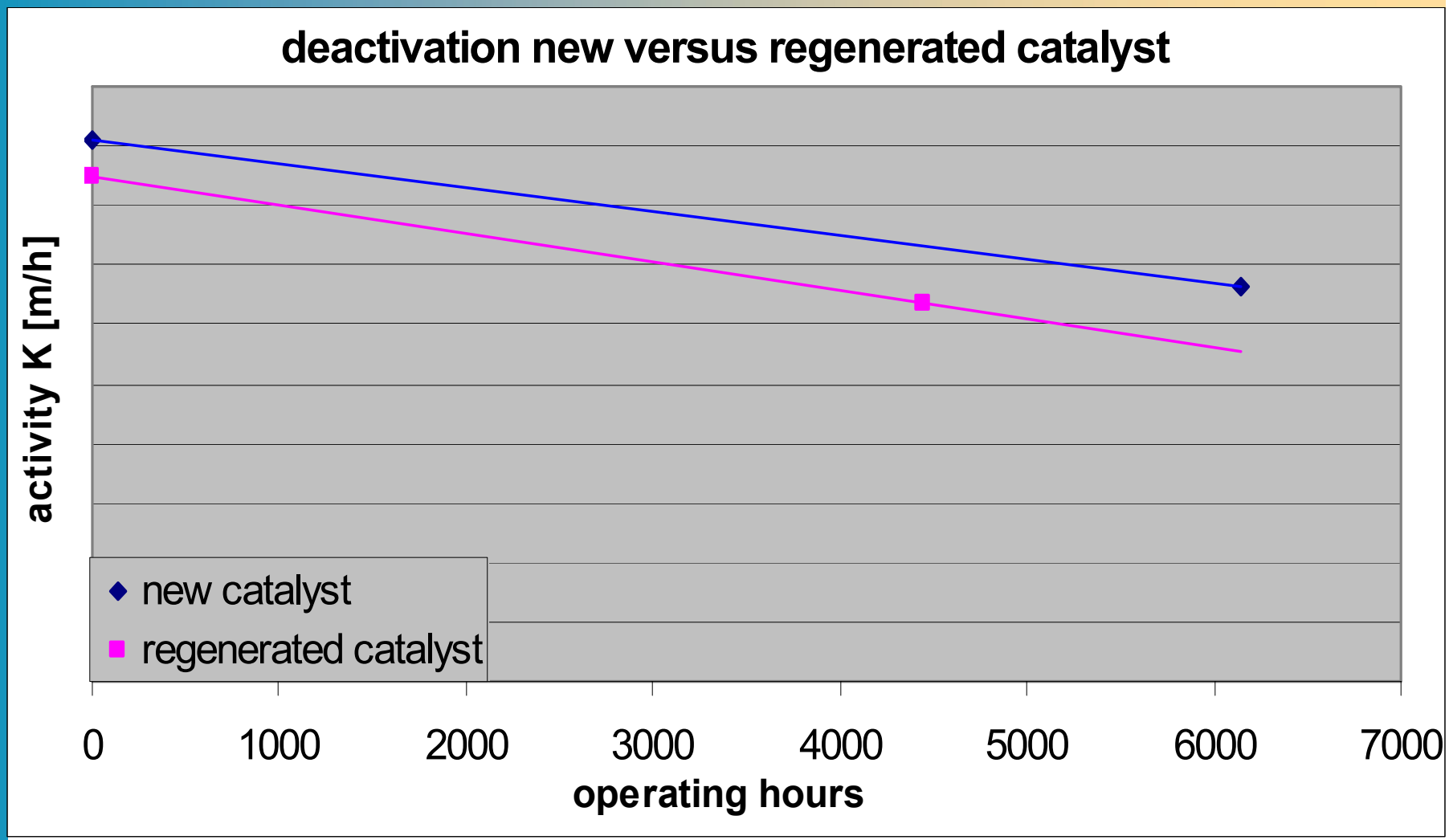
Deactivation of Regenerated Catalyst



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Future Catalyst Management Strategy

The original catalyst management strategy was based on a 3 full-layer operation with a perpetual replacement of 1 full-layer as needed by new catalyst and disposal of spent catalyst.

The new catalyst management strategy is based on 4 half-layers installed with a perpetual exchange of 1 half-layer as needed by a regenerated half-layer kept in stand-by at SCR-Tech.

Advantages:

- **Annual savings of over $ 330,000 in O&M cost**
- **Reduced SO_3 load in the system**
- **No catalyst disposal issues**

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Conclusions

- Catalyst regeneration was very successful.
- Operating experience with regenerated catalyst is positive. No difference was observed between operating the SCR with new versus regenerated catalyst.
- Catalyst deactivation of the regenerated catalyst is identical to the new catalyst in the same layer of the SCR reactor.
- Lower SO_2/SO_3-conversion benefits the plant's equipment.
- O&M cost savings of about $ 330,000 per year on average by using regeneration over new catalyst replacement (> $ 5 million over a 20 year period).
- Cost & potential future long term hazardous waste liabilities associated with catalyst disposal were avoided.

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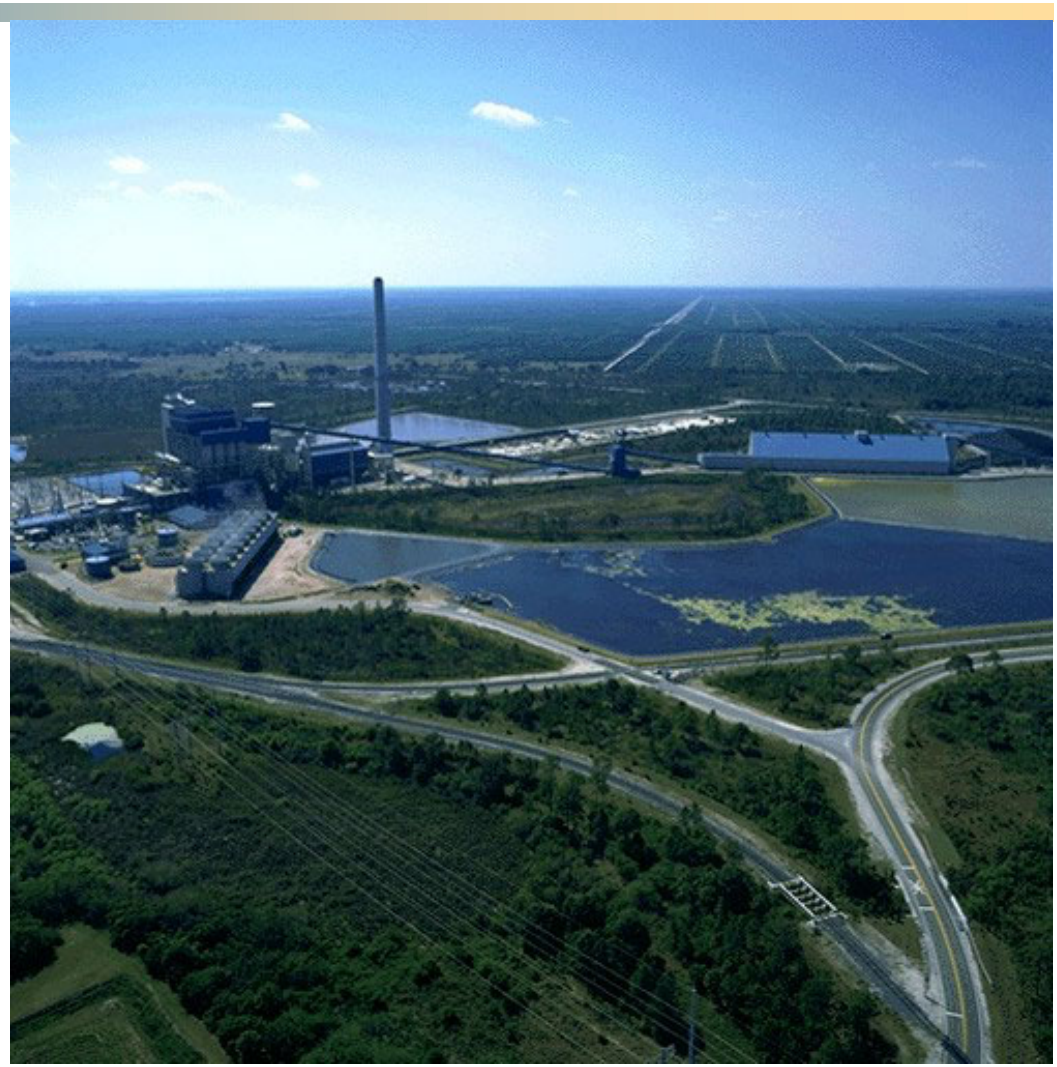
?? Questions ??

Douglas W. Bullock, P.E.
National Energy & Gas Transmission
National Energy Power Company LLC
Indiantown Generating Plant
P.O. Box 1799
13303 SW Silver Fox Lane
Indiantown, Florida 34956
E-mail: douglas.bullock@negt.com
Phone: 772- 597- 6500 Ext. 15
Fax: 772-597- 6520

Hans U. Hartenstein,
SCR-Tech LLC
P.O. Box 280
11701 Mt. Holly Road
Charlotte, North Carolina 28214
E-mail: h.hartenstein@scr-tech.us
Phone: 704-827-8933
Fax: 704-827-8933



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