Investigation of Commercial SCR Catalysts Deactivation Under Industrial Conditions

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OBJECTIVES

- Quantify the change in activity of commercial catalysts over time.
- Investigate the deactivation mechanism.

EXPERIMENT

Commercial V_2O_5/TiO_2 catalysts used to reduce NO_X emissions in coal-boiler systems were tested. Fresh samples (left), samples exposed in the flue gas of a boiler for 2063 hours (middle), and for 3800 hours (right) were tested for each catalyst.

Sample Preparation:

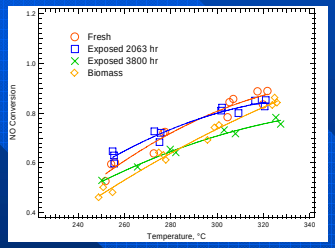
- Sample piece (A) is cut from larger monolith (B).
- Sample is loaded into monolith test reactor (C).
- Simulated flue gas is introduced to the sample via automated flow control system (D).

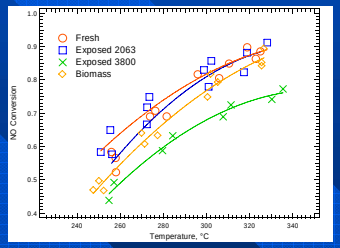
EXPERIMENTAL CONDITIONS

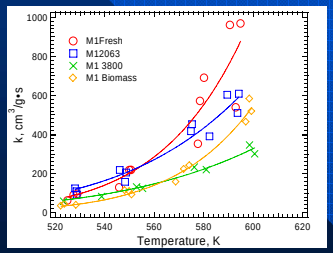
Flow Rate: 1000 sccm
Feed:
- 900 ppm NO
- 900 ppm NH_3
- 2% O_2
- Balance He

Temperature: 250-325 °C

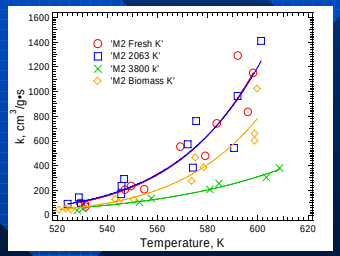
RESULTS





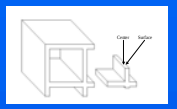


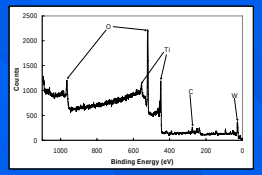
Catalyst M1 Results



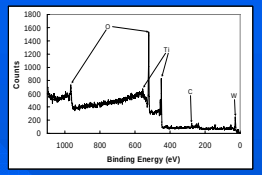
Catalyst M2 Results

Accumulation of Alkali Metals
(Preliminary XPS Analysis)

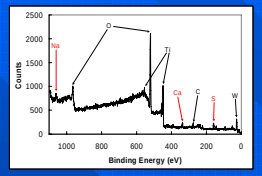




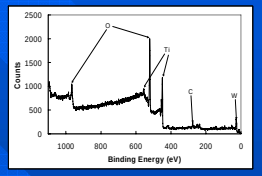
Surface of Fresh Catalyst



Center of Fresh Catalyst



Surface of Exposed Catalyst



Center of Exposed Catalyst

CONCLUSIONS

- The catalyst exposed for 2063 hours exhibited higher or similar activity as the fresh catalyst.
- The catalyst exposed for 3800 hours exhibited a decrease in activity.
- Exposure to Biomass for 450 hours exhibited a significant decrease in activity
- Alkali metals were detected on catalyst surface, but not at center of catalyst wall.
- Decrease in activity over time appears to result from build-up of ash on the catalyst surface and from channel plugging rather then chemical poisoning.