Aging of $DeNO_x$ and DeN_2O catalysts for Nitric Acid plant

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Nitrous oxide (N_2O) is one of the most impacting greenhouse gasses that significantly contributes to climate change. In 2017, Europe alone emitted around 18 million tonnes of N_2O, mainly from agricultural activities and the production of nitric acid. [1] Scientist are constantly searching for effective new deN_2O catalysts that can be used in real-world applications. One crucial aspect of this research is the industrial aging of catalysts. This process simulates the conditions under which catalysts will be exposed to in industrial environments, including high temperatures and exposure to pollutants. By conducting representative industrial aging tests, researchers can gain a better understanding of how catalysts will perform over time in real-world settings and make necessary adjustments to improve performance and lifetime. Additionally, this process allows researchers to identify potential degradation mechanisms and optimize catalyst design, thus reducing N_2O emissions in the final stages of catalyst use. Industrial Fe-FER and Fe-ZSM5 catalysts were prepared by the French company ALSYS on an industrial scale. [2] The catalysts were exposed to a simulated accelerated aging procedure, which was created to model a specific catalytic aging process. This was done to study the $deNO_x$/deN_2O catalytic behavior at the end of the catalyst's life. The deNOx/deN2O catalytic performance was tested under relevant industrial conditions... A very high space velocity was used to stress the differences in catalytic activity between the catalysts that were tested. The aging treatments were conducted for 150 hours at two temperatures, 600 and 700°C. This study compares the catalytic activity of Fe-FER and Fe-ZSM5 catalysts for NO_x and N_2O abatement in a simulated nitric acid process. The study examines the structural, through XRD, and catalytic evolution of the catalysts upon aging under representative industrial conditions. The results show that Fe-FER has higher catalytic activity and structure stability than Fe-ZSM5, particularly after the aging procedure. Fe-ZSM-5 experiences loss in deN_2O activity, while Fe-FER retains its catalytic activity under these conditions. The stability of the Fe-FER catalyst is believed to be responsible for its higher catalytic activity and better preservation of deN_2O activity. The study highlights the importance of using representative industrial aging treatments and real industrial test conditions when studying new catalysts, as these conditions can greatly affect the catalytic activity and structure of the materials.

References

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[2] Hamon C. et al EP1918016B1 2006