BENCH-SCALE SCR CATALYST TESTING FOR LONG-TERM MANAGEMENT AND TROUBLESHOOTING

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The power industry is now transitioning from a period of SCR technology implementation to a period of long-term operation and maintenance. Integral to this effort is the proper testing and management of SCR catalyst. The large capital outlays associated with replacing or adding catalyst make careful analysis of catalyst activity a necessity, and optimized management can result in significant cost savings to the technology user. Bench-scale catalyst tests using laboratory reactors are a valuable tool for establishing remaining catalyst activity, rates of deactivation, and mechanisms of deactivation. In addition, bench-scale tests can provide a cost effective method of troubleshooting, helping to quickly identify the sources of poor SCR system performance. Bench-scale testing also helps to establish the performance of catalyst regeneration processes, allowing independent verification of regeneration performance.

Periodic catalyst sampling allows the SCR user to perform activity testing which is an integral input to the long-term catalyst management strategy. These laboratory activity tests allow the system owner to better predict the need for catalyst upgrades, and to "recalibrate" the original catalyst management plan. By better predicting the need for catalyst upgrades, a more responsive catalyst management plan can be developed, taking advantage of future planned outage times, as well as providing better planning in terms of capital outlays. An improved management plan will maximize deNOx performance while minimizing adverse balance-of-plant impacts. A well-designed and calibrated management plan will also help to minimize fluctuations in ammonia on ash content, a critical concern for some facilities. Routine activity testing will also aid in the identification of any catalyst-related problems prior to the problem becoming critical for acceptable deNOx performance. Problematic issues related to such parameters as fuel, SCR operating conditions, start-up and shut-down procedures, and catalyst cleaning can be identified early using laboratory testing, allowing correction of the problems prior to significant degradation in system performance.

Troubleshooting is also an important aspect of bench-scale testing. When a performance problem arises, bench-scale testing allows a quick and economical method of identifying the source of a problem. This allows a confident assessment as to whether the catalyst itself, or some other system parameter is the source of the problem. If catalyst performance is at issue, reactor tests, along with various chemical and physical analyses can identify the reasons for poor catalyst performance. These tests can be performed with little or no disruption to normal day-to-day operations at the plant, and are quite inexpensive compared to troubleshooting associated with the full-scale equipment, especially if any flue gas testing is involved. Consequently, test reactor activity and analytical tests are often used as a first-step in a troubleshooting program.

Many facilities are currently considering catalyst regeneration as an economical method of addressing normal catalyst deactivation. Bench-scale testing offers an accurate method of identifying the performance of regeneration technologies, providing an important verification of the claims of regenerated catalyst performance. In addition, the improvements in the catalyst management plan due to routine catalyst reactivity testing allow for better planning of future catalyst needs, allowing a user to capitalize on regeneration options.
Bench-scale catalyst testing is conducted in a small reactor where flue gas constituents, temperature, flow rate, ammonia injection, and deNOx performance can all be monitored closely and continuously. This offers a highly controlled environment impossible to achieve at full scale. Thus bench-scale testing offers the only accurate method of determining catalyst activity. Although estimations of activity at full scale are tempting, it is costly and difficult to accurately assess activity at full scale, and requires the measurement of parameters such as NOx and ammonia distribution, along with ammonia slip, to fully establish activity. This limits the degree to which catalyst activity can be assessed at full scale. In addition, industrial equipment, such as flow measurement devices and gas-phase monitors are typically incapable of the accuracy required to establish true catalyst performance at full scale. Bench-scale testing also allows the catalyst performance to be assessed at various conditions with minimal effort. Effects of parameters such as temperature and flow rate can be easily established under the highly controlled conditions of the laboratory reactor. In addition, parameters such as SO_2 conversion can be quantified with confidence, offering an extremely economical method of determining the impact of the SCR system on other downstream equipment as well as stack emissions.

Bench-scale activity data are often coupled with chemical and physical analyses to help determine the source of deactivation, especially when higher than expected deactivation rates are encountered. Quantification of trace elements such as arsenic, sodium, and potassium help to identify the deactivation mechanisms and assist in evaluating impacts on the catalyst to parameters such as fuel. Physical analyses such as surface area and pore size distribution help to establish if any adverse physical phenomenon are occurring in association with the catalyst substrate. Fouling and masking problems can also be identified using analytical techniques, helping the system owner develop more responsive methods of catalyst cleaning, or improve start-up and shut-down procedures, allowing catalyst life to be maximized.

In conclusion, bench-scale catalyst testing offers a highly effective and economically attractive method of assessing SCR catalyst performance. This provides invaluable information related to long-term catalyst management as well as troubleshooting efforts. For more information related to test reactor facilities, their capabilities, and interpretation of test reactor data, please contact the following.

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