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Improving Useful Service Life of Catalysts

Catalysts play a crucial part in the successful operation of many processes, and are a major contributor to the overall economics. Precious metal-based catalysts are extensively used in chemical applications and refining, such as catalytic reforming units utilising platinum or platinum-rhenium catalysts. The trend is towards employing catalysts of even higher activity and stability, so an installed catalyst inventory could be worth several million dollars. In a chemical process, even small changes in catalyst formulations, preparation techniques or operational conditions can strongly enhance or harm catalyst performance, and hence the overall process economics.

Today the market place is ever more competitive and it is imperative that chemical plants operate at maximum efficiency. Additionally, the conditions of operation and regulation in processing industries are becoming increasingly severe. This necessitates close cooperation between the catalyst supplier and the operator, and a solid basis of trust has to be established between them to achieve the maximum benefits. The provision of technical service is also a vital aspect of a catalyst suppliers' remit.

Catalyst abuse, misuse or mal-operation are major problems for a catalyst supplier to contend with. Operating companies have a tendency to downsize, and this can result in chemical processors having less personnel to monitor and supervise units. The consequence has been an increasing number of 'catalyst incidents'. Catalyst suppliers must therefore provide appropriate technical service and after-sales support, and include, for instance, training for operators, troubleshooting if needed, and impartial advice for technical enquiries. All this is aimed at preventing unplanned shutdowns and premature catalyst change-outs.

The level of technical service should always be agreed between the operator and the catalyst supplier at the outset, to share expectations and avoid later disappointment. As a minimum, the process operator should expect the catalyst supplier, on a quarterly basis, to evaluate process data and perform requisite laboratory analyses of any spent catalyst samples from the process. This evaluation will provide the best evidence of events during service and it remains the most conclusive and reliable means of assessing the condition of used catalyst, and how the catalyst has performed and responded to the operating conditions.

Recommended Evaluations

For precious metal catalysts the evaluations should include:

- Physical analysis, including the crush strength, pore volume and porosity; the BET and/or the metal surface area should be obtained for comparison with typical fresh catalyst batches. This can provide evidence of sintering through thermal/hydrothermal ageing mechanisms.
- The level of any contaminant on the catalyst surface should be accurately measured (ICP, AA, XRF, etc.) and compared to recommended maximum permissible levels for those particular poisons. These levels are often based on invaluable information the catalyst supplier has acquired through years of experience. Catalysts are very sensitive, even to low levels of contaminants in feedstocks being processed. Many common contaminants (sulfur, halides, alkalis, heavy metals, etc.) can have a significant deactivating effect on the achieved activity/selectivity, even if their inlet concentrations are below the level of detection (1).
- Finally, a pilot plant or microreactor test of catalyst activity and selectivity should be made on a used sample and compared to a retained sample of fresh catalyst from the batch provided to the customer. This will help determine the remaining useful service life of the catalyst.

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Reference

1 J. K. Dunleavy, *Platinum Metals Rev.*, 2005, **49**, (3), 156

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