Improving plant performance using state-of-the-art MECS® catalysts

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Major sulfuric acid producers worldwide have installed MECS® catalyst since the 1920s. Over the past 90 years, the dedicated research and development team at MECS, Inc. (MECS) has evolved catalyst from pellets to energy-saving rings to low-emission cesium-promoted catalyst. As energy savings and environmental concerns create new operational and design challenges for sulfuric acid plants, innovations in catalyst technology provide the solution. This article will detail the MECS® catalyst portfolio of vanadium-based and cesium-promoted catalysts for sulfuric acid, including the latest innovations, GEAR® catalyst and improved formulation cesium catalyst. The benefits of lower SO₂ emissions, increased acid production, energy savings and longer production cycles through utilization of these contemporary catalyst products will be explored.

A rich history of catalyst developments

Driving innovation in the sulfuric acid market since the 1920s, MECS remains the industry leader in technology, engineering and equipment dedicated to sulfuric acid producer’s needs. Major sulfuric acid plants worldwide have installed MECS® catalyst and have benefited from the technical developments offered by MECS over the years. With a comprehensive understanding of sulfuric acid plants, MECS product innovations and customer service offerings continue to provide benefits far beyond that of catalyst.

Sulfuric acid catalyst history began with platinum-based catalysts, which were expensive, unreliable and easily poisoned. Through a partnership in research and development between various independent entities and corporations (including MECS), a new vanadium-based catalyst formula was developed. The first installation of MECS® catalyst occurred in 1925 when a vanadium-based, pellet-shaped catalyst was shipped to the Monsanto Chemical Works plant in Sauget, Ill. This catalyst remained the industry standard until the 1960s, when MECS developed and introduced a new formula of catalyst designed specifically for the low SO₂ and kinetically-hindered conditions located in beds three and four of the standard sulfuric acid plant converter. The new catalyst provided higher activity per unit volume with the identical catalyst dimensions and resulting pressure drop of the existing catalyst. The advent of this new catalyst formula in the early 1960s marked a major improvement in the overall acid plant process.

Due to major societal concerns regarding the environment and energy consumption in the 1970s, the industry began to focus on technology and products that could respond to these challenges. MECS offered a catalyst solution in the form of a larger diameter pellet and then a new type of catalyst shape, called a “Rasching” ring. These catalysts lowered pressure drop across the converter and provided higher activity. In addition, MECS focused on reducing acid plant costs by developing more robust catalysts offering lower screening losses.

The 1990s saw an increased need for production efficiency and reduced SO₂ emissions. MECS responded to these needs with the introduction of a cesium-promoted catalyst, which took advantage of the low temperature properties of the cesium promoter. This catalyst generated excellent SO₂ conversion at bed inlet temperatures from 55 to 75 degrees F (30 to 40 degrees C) lower than conventional catalysts. The low temperature activation allowed for new acid plant designs with dramatically lower SO₂ emissions as well as improving the conversion performance of existing double and single absorption acid plants.

MECS® Catalyst Research and Development continued to innovate in the form of shape modifications and formula enhancements. Ribbed ring catalysts, with much lower pressure drop characteristics, as well as increased activity offered by a larger surface area, were developed for both the vanadium-based and cesium-promoted catalyst formulas. The ribbed ring products quickly became the industry standard due to their high performance and low pressure drop. With these introductions, MECS offered sulfuric acid plant producers a strong portfolio of catalyst products with benefits applicable for a multitude of operating requirements.

With a continued focus on energy savings and performance improvement, MECS expanded their catalyst portfolio yet again in 2011. MECS is the only catalyst manufacturer to offer GEAR® catalyst, using a unique hexa-lobed ring shape which, combined with an improved catalyst formula, has demonstrated better conversion performance, lower pressure drop and improved dust handling. By geometrically optimizing the catalyst shape, GEAR® catalyst offers more surface area for access to active sites than any other catalyst on the market. In addition, when loaded into a catalyst bed, the hexa-lobed ring shape creates a catalyst bed configuration that increases spacing between the catalyst rings, lowering pressure drop significantly over other manufacturer’s catalyst.

Innovative new product introductions

An interesting extension of the unique GEAR® catalyst properties is offered for customers who would benefit from combining the low temperature benefits of cesium-promoted catalysts with a GEAR® catalyst shape. An example would be an existing acid plant with one of the following challenges:

- High dust contamination in the gas stream (such as metallurgical plants or sulfur burning plants with varying quality of sulfur in the feed)
- Desire to increase throughput without increasing pressure drop or emissions

The demonstrated superior dust handling provided by the hexa-lobed ring shape of the GEAR® catalyst, especially in pass one, inspired the addition of GEAR® cesium catalyst, GR-Cs, to the MECS® catalyst portfolio. Sulfuric acid plant converters operating with lower bed-inlet temperatures have the opportunity to upgrade to GEAR® cesium catalyst for energy savings and excellent dust handling.

The most recent product enhancement developed by MECS® Catalyst Research and Development is a minor, but high activity boosting modification to the well-established Super Cesium SCX-2000 cesium catalyst formula. This proprietary formula improvement positively affected the SCX-2000 cesium catalyst activity, offering customers higher performance in the fourth and fifth...
Fluorsid II converter pressure drop data.

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Proven MECS® catalyst excellence

The low pressure drop, high-performance benefits of MECS® catalyst are currently being enjoyed by the Fluorsid II sulfuric acid plant in Italy. This plant selected GEAR® catalyst with Super Cesium SCX-2000 in the final pass for their recent new plant designed by MECS. After a smooth start-up in 2013, MECS technicians visited the plant to perform a PeGASys (MECS proprietary Portable Gas Analysis System) test, to evaluate the plant performance on a pass-by-pass basis. At Fluorsid, the PeGASys test demonstrated that the GEAR® catalyst pressure drop after 10 months of service was lower than typical daisy-shaped catalyst at clean pressure drop. Pass one showed no pressure drop build-up after 10 months of operation.

Low SO₂ emissions and higher production than name plate were also design criteria for the Fluorsid II Plant. Fluorsid returned to MECS for their new plant design after successfully operating Fluorsid I with MECS® sulfuric acid technology for several years. For Fluorsid II, the company wanted to maximize acid production, minimize SO₂ emission and reduce capital expenditures by reusing the Plant I converter design. This requirement meant that there was no flexibility to add converter passes or additional catalyst in the new plant. In order to achieve higher production and lower emissions with a set converter size and fixed catalyst volumes, MECS knew that Fluorsid II needed high performance catalyst. The premium GEAR® catalyst combined with high-activity Super Cesium SCX-2000 catalyst offered exactly the required characteristics to meet Fluorsid’s stringent design criteria.

Specifically, Fluorsid requested that MECS offer them the ability to produce 10 percent more sulfuric acid than the design capacity. After optimizing the catalyst design using the same converter specifications as the previous plant, Fluorsid was able to run at 110 percent of design capacity with low pressure drop. The Fluorsid SO₂ stack analyzers showed lower SO₂ emissions than permitted, thus illustrating the ability of MECS to meet customer’s unique design challenges.

MECS is known for its proven sulfuric acid catalyst portfolio and catalyst designs based on practical experience and extensive plant knowledge. But, MECS offers the client more than just catalyst. MECS offers world-class knowledge of sulfuric acid, innovative technologies and proprietary products for the entire acid plant. Local, personalized service and technical services are also offered for troubleshooting, maintenance, training and optimization, as well as maintenance planning support. MECS offers everything the client needs to achieve optimal sulfuric acid plant performance.

For more information, please visit www.mecsglobal.com.

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<th>Start-Up Values Normalized</th>
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