VK series

Sulphuric acid catalysts

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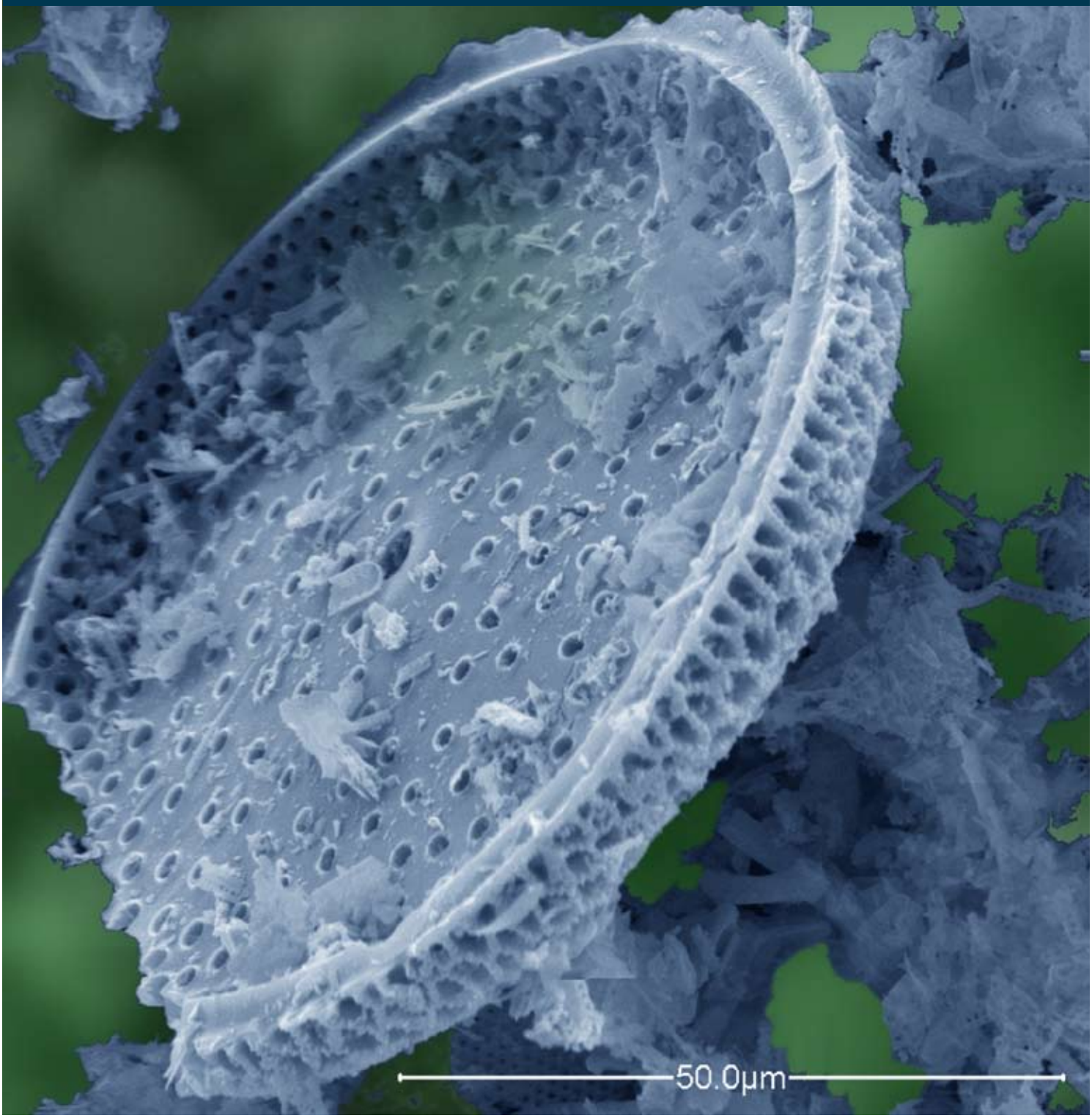
HALDOR TOPSØE

CATALYSING YOUR BUSINESS



Scanning Electron Micrograph of a typical diatom skeleton.
Selected diatomacerous earths are used as essential raw material for the sulphuric acid catalyst carrier and are crucial for the final catalyst properties.

VK series – catalysts for today and for the future

The catalytic SO_2 converter is the heart of the sulphuric acid plant and the quality and characteristics of the selected catalysts are crucial to a reliable and energy-efficient operation.

The catalyst properties are influenced by the chemical composition, the physical properties including the nature of the support material and the manufacturing process. Topsøe VK catalysts are uniquely balanced to combine high and stable activity, robustness, low pressure drop and a long service life.

Continual improvement of the VK catalysts is achieved through close cooperation between Topsøe's Catalyst Group, R&D and the production facilities. Over the years this cooperation has resulted in major product breakthroughs, providing the industry with new catalysts for more energy-efficient operation, lower SO_2 emissions and higher production rates.

Topsøe's VK series comprises four different formulations in a variety of sizes and shapes, effectively covering all operating conditions in any sulphuric acid plant.

By combining outstanding activity with low pressure drop and exceptionally high mechanical strength, the VK catalysts ensure cost-effective plant operation by providing:

- high SO_2 conversion efficiency
- improved energy efficiency
- enhanced operating flexibility
- low screening losses
- long service life

Product range

VK38

The VK38 formulation provides excellent activity over a wide range of operating conditions. VK38 is the only catalyst on the market that can be used effectively in all beds of any SO_2 converter.

For continuous operation VK38 offers a broad temperature range of 400-630°C (750-1170°F) and can withstand repeated temperature spikes up to 650°C (1200°F).

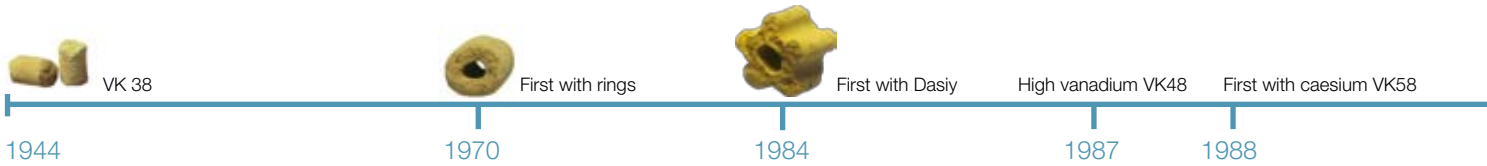
VK38 is designed to initiate the reaction at a temperature as low as 360°C (680°F), ensuring a smooth plant start-up, minimising pre-heat time due to its superior catalyst activity.

VK48

VK48 is a high-vanadium version of the standard all-round VK38 catalyst.

The catalyst composition is specifically formulated for lower pass service, particularly where the process gas contains large amounts of SO_3. The conversion ratio of SO_2 affects the balance between the active vanadium species in the catalyst. An optimised ratio of the alkali-metal promoters enables an increased vanadium content in VK48, resulting in a considerably enhanced activity.

In high SO_3 gas environments, such as the lower passes of single absorption plants, or the third pass of a 3:1 double absorption plant, VK48 offers a significant performance advantage.



Caesium catalysts

Incorporating caesium as an additional catalyst promoter enhances the action of the vanadium and activates the catalyst at a much lower temperature than conventional non-caesium catalysts.

Exceptionally high activity

Topsøe's caesium-promoted VK catalysts are up to three times more active than non-caesium catalysts, depending on the operating conditions. Topsøe's unique production techniques result in an optimised silica pore system that combines two important features: a very uniform distribution of the catalytically active melt within the pore system and better access for the process gas to the internal surfaces of the catalyst. This greatly improves the activity of the caesium-promoted VK catalysts.

Low ignition temperature

VK59 and VK69 have an exceptionally low ignition or "strike" temperatures of 320-330°C (610-625°F) that offer new possibilities for faster and cleaner start-ups. Autothermal restarts can be accomplished after a significantly longer idle time without the use of pre-heat.

VK59

VK59 is a caesium-promoted catalyst optimised for medium to high strength SO_2 gasses with continuous operation down to 370°C (700°F). A top layer of VK59 in the first pass makes it possible to accommodate high strength SO_2 feed gas without exceeding the maximum outlet temperature of 630°C (1165°F) and still maintain high bed conversion efficiency.

VK59 installed in the lower pass(es) of single absorption plants allows for significant conversion improvement.

Benefits

- accommodates strong SO_2 feed gas without excessive first pass exit temperatures
- greatly improved operating flexibility for rapidly changing feed gas composition
- low ignition temperature for faster and cleaner start-ups
- significantly extended idle time for autothermal restarts
- improved overall conversion in single absorption plants

VK69

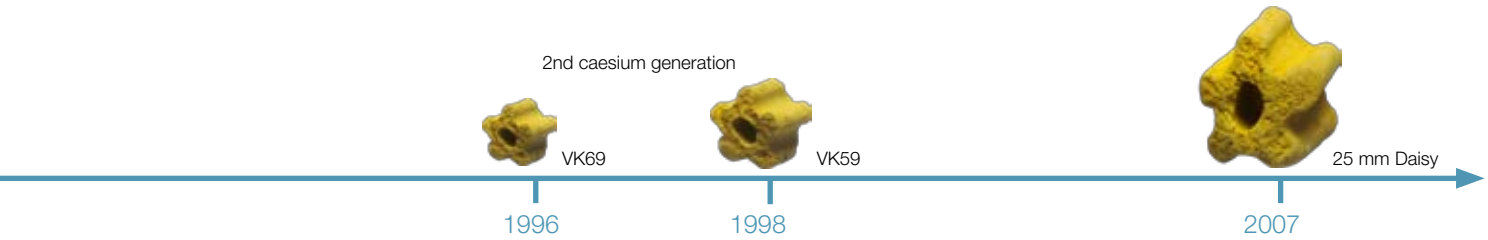
VK69 is designed specifically for the final pass(es) of double absorption plants. In the lean SO_2 gas environment after the inter-pass absorption tower, the unique VK69 formulation offers unmatched high activity throughout the entire operating temperature range. This affords existing plants the opportunity to greatly reduce SO_2 emissions and/or increase production rates. For new or revamped plants, SO_2 emissions of under 50 ppm are possible.

Using caesium as a promoter, VK69's extremely low ignition or "strike" temperature will significantly reduce pre-heat time and improve start-up performance.

VK69 is manufactured in a unique 9 mm Daisy-shape. The high surface area contributes to the high activity in this gas environment and the high void-fraction ensures a low pressure drop and good dust tolerance.

Benefits

- possibility for over 50% reduction in SO_2 emission from existing double absorption plants
- possibility for significantly increased production without increasing SO_2 emissions
- less than 50 ppm of SO_2 emissions possible from new or re-vamped plants
- low ignition temperature for faster and cleaner start-ups
- long lifetime and low screening losses industrially proven since 1996.



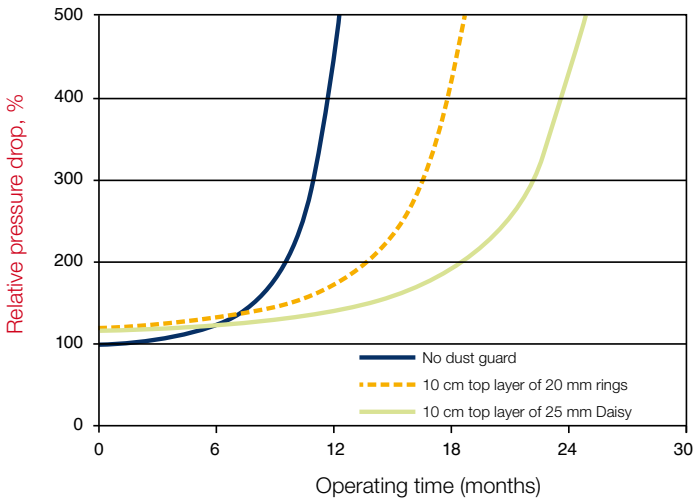
Sizes and shapes

25 mm Daisy - dust protection catalyst

For catalyst beds suffering from rapid pressure drop increase due to dust in the feed gas, a top layer of Topsøe's 25 mm Daisy-shape catalyst can provide a cost effective remedy. The extra void fraction and a lower specific surface area allow a significantly higher capacity for dust, distributing it throughout a larger volume of the catalyst bed. The result is a lower rate of pressure drop increase providing improved energy efficiency and longer intervals between catalyst screenings.

Benefits

- 30-50% longer on-stream time compared to existing ring-shaped dust-protection catalysts
- 100% longer on-stream time compared to 12 mm Daisy
- maintenance cost savings due to less frequent catalyst screening
- energy cost savings due to lower plant pressure drop
- production increase due to longer time at maximum rate before pressure drop forces production decay



Pressure drop development across various catalyst loadings in a dust laden feed gas. Installation of a 10-15 cm (4-6 inches) top layer of the 25 mm Daisy results in 30-35% longer production campaigns compared to the 20 mm rings or a doubling when compared to the 12 mm Daisy.

12 mm Daisy

The 12 mm Daisy has become the most widely used catalyst shape on the market since introduced by Topsøe in 1984. The high void fraction results in improved energy efficiency throughout the operating cycle due to low initial pressure drop and increased capacity for dust.

Topsøe's 12 mm Daisy-shape has proven to be robust as well, with reported screening losses typically well below 10%.

Topsøe's VK38, VK48, and VK59 formulations are all available in the 12 mm Daisy-shape.

Benefits

- low initial pressure drop
- high dust capacity yielding in a lower rate of pressure drop increase
- high activity
- low screening losses

9 mm Daisy

VK69 is produced in the unique 9 mm Daisy-shape. In the low SO_2 environment, after the intermediate absorption tower, the 9 mm size and Daisy-shape combination gives 30% extra activity compared to a 12 mm Daisy-shape, in part due to the higher surface area. Also, the Daisy-shape ensures remarkably low pressure drop.

10 mm rings and 6 mm cylinders

VK catalysts in the form of 10 mm rings and 6 mm cylinders remain available for plants that desire or require their continued use.

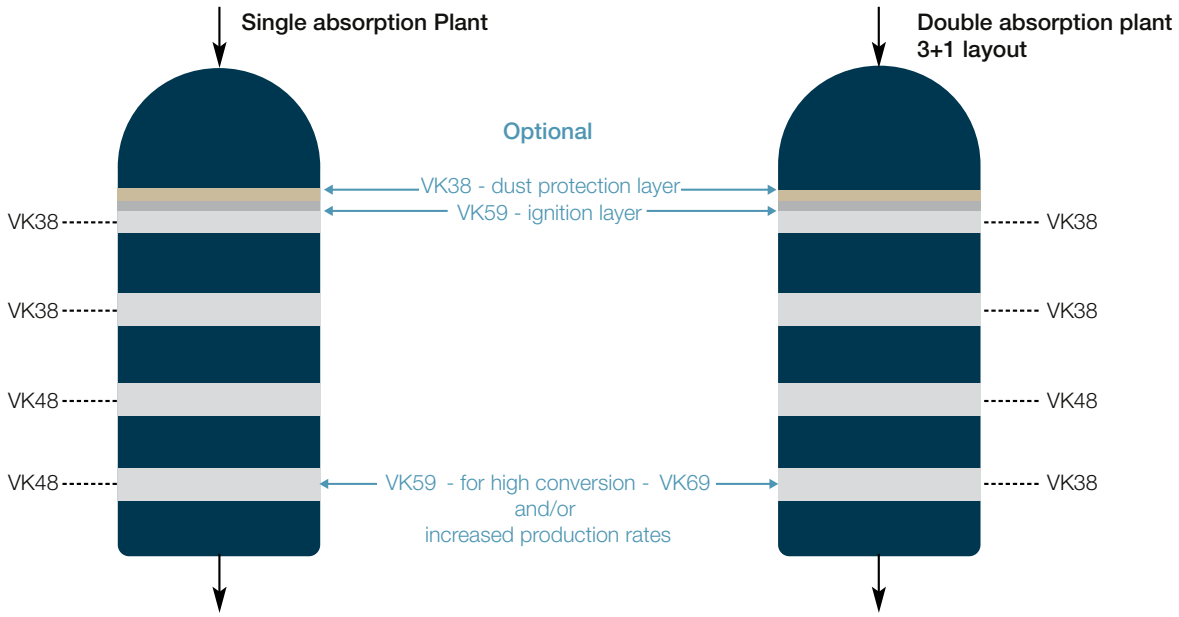
ISO

Catalyst manufacturing facilities are located in Denmark and in Houston, Texas, USA. Both plants are certified to the ISO 9001: 2000 and ISO 14001: 2004 standards. Topsøe's quality management system includes continuous improvement to achieve the highest quality.

Topsøe recognises its responsibility towards the local and global community in all its activities. We protect the external environment through responsible behaviour and are dedicated to a continual improvement of personal safety and internal work processes.

Packaging and storage

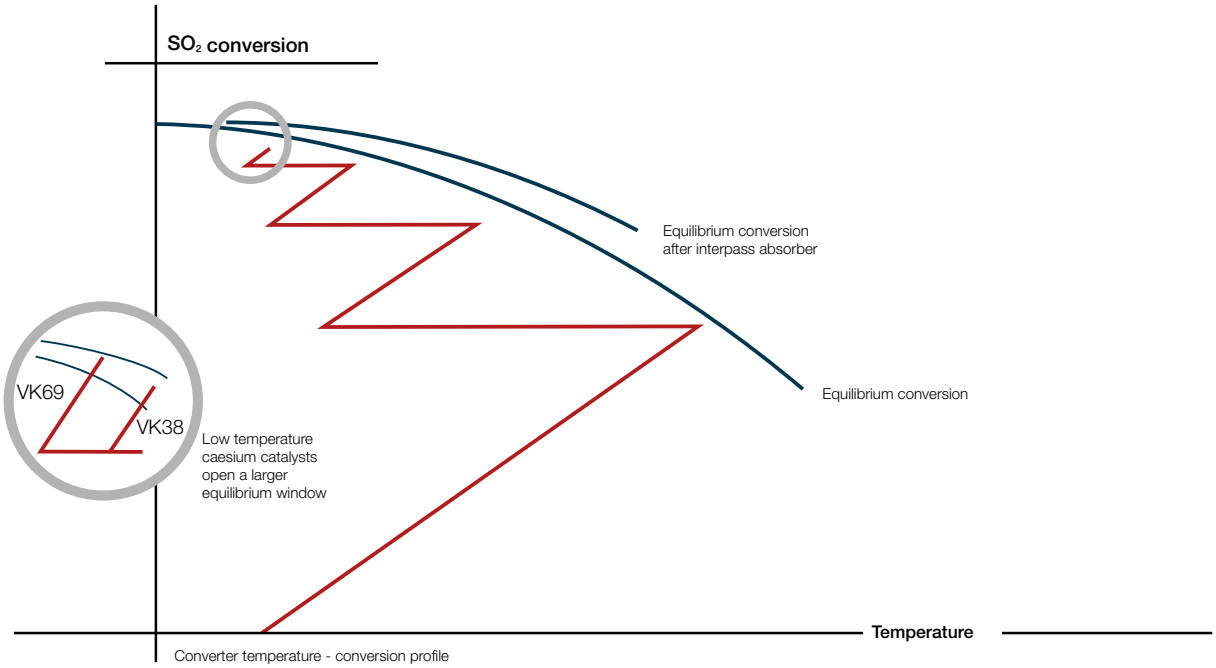
The standard packagings for VK catalysts are supersacks and 200 litre fibre drums. A polyethylene liner protects the catalyst from moisture. VK catalysts are very durable and can be stored for years without loss in activity or strength when kept dry and in the original packaging.



Tailored catalyst loadings

Topsøe's range of VK catalyst formulations and shapes allow tailored loadings for each plant's requirements. Topsøe's catalyst experts will assist in selecting the optimum catalyst type and shape for each pass in any converter design, keeping the client's objectives in mind.

	VK38	VK48
Type	Potassium-promoted	Potassium-promoted
Ignition temperature	360°C/680°F	360°C/680°F
Continuous operating temperature range	400-630°C 750-1165°F	410-550°C 770-1020°F
Thermostability	650°C/1200°F	650°C/1200°F
Size and shape	12 mm Daisy 25 mm Daisy 10 mm rings 6 mm cylinders	12 mm Daisy 10 mm rings 6 mm cylinders
Opportunities	Excellent activity in the full range of operating conditions. Suitable for use in all passes of all converters.	High-vanadium catalyst with enhanced activity for lower pass service, particularly where the process gas contains significant amounts of SO_3.



Technical service

Based on experience over more than half a century, Topsøe has established an extensive technical service programme available to our VK catalyst users. In addition to frequent contact, the service programme includes activity testing of catalyst samples, evaluations of catalyst performance, plant optimisation, trouble shooting and management of catalyst replacement.

Activity testing of catalyst samples represents a valuable source of information, which combined with computer evaluations of the plant performance enables Topsøe to optimise future catalyst management.

Topsøe's **P**ortable **G**as Analysis **Un**it, **TOPGUN** enables a thorough analysis of a sulphuric acid converter system. TOPGUN is a fully portable, infrared gas-analysis unit for SO_2 and O_2 analyses. The gas analyses are used as input to Topsøe's proprietary computer programs, which can accurately simulate the converter performance. TOPGUN has proven a very efficient tool for troubleshooting and optimising the plant performance.

	VK59	VK69
Type	Caesium-promoted	Caesium-promoted
Ignition temperature	320°C/610°F	320°C/610°F
Continuous operating temperature range	370-500°C 700-930°F	370-500°C 700-930°F
Thermostability	650°C/1200°F	650°C/1200°F
Size and shape	12 mm Daisy	9 mm Daisy
Opportunities	Optimised for medium to high-strength SO_2 gases. Use as an ignition layer in any bed. Improved conversion in single absorption plants.	Double absorption plants only - optimised for use in the pass(es) after the intermediate absorption tower. Extremely high activity throughout the entire temperature range.

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The information and recommendations have been prepared by Topsøe specialists having a thorough knowledge of the catalysts. However, any operation instructions should be considered to be of a general nature and we cannot assume any liability for upsets or damage of the customer's plants or personnel. Nothing herein is to be construed as recommending any practice or any product in violation of any patent, law or regulation.

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