CRITERION
CATALYSTS & TECHNOLOGIES

TAIL-GAS TREATING CATALYSTS

Refineries and gas plants worldwide have reported lower operating costs, extended cycle lengths and reduced pressure drop as a result of installing Criterion's state-of-the-art catalysts in their Claus tail-gas treating units.

Well-operated Claus tail-gas units are increasingly important as operators strive to meet their sulphur emissions mandates. Although these processes can deliver greater than 99.9% sulphur recovery, careful selection of the catalyst is necessary to ensure optimum performance and process economics.

CATALYST SELECTION

When selecting a Claus tail-gas catalyst, there are three key aspects to consider.

Cost: Criterion's low bulk density C-234 and C-834 catalysts offer the optimal balance between cost and activity

Pressure drop: Criterion's C-534 catalyst offers slow start-of-run (SOR) pressure drop performance, unsurpassed in the industry (see Figure 1), which maximises the cycle time between catalyst replacements.

Activity: Criterion's C-834 catalyst offers top-tier activity for lower temperature conversion of sulphur dioxide (SO_2), carbonyl sulphide (COS) and carbon disulphide (CS_2) to hydrogen sulphide (H_2S).

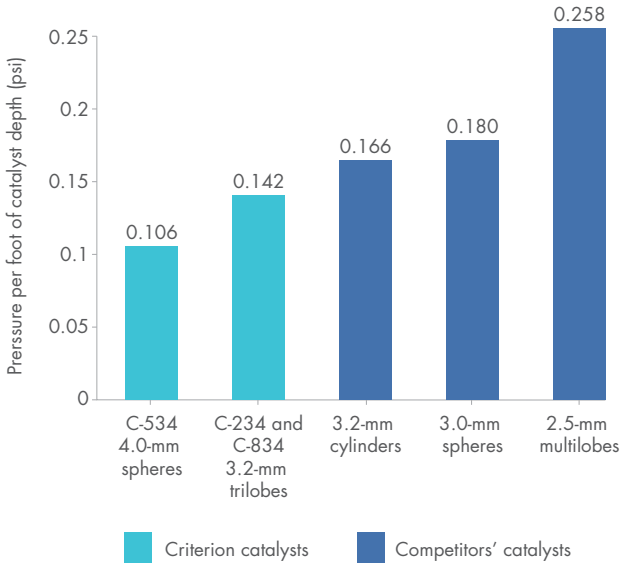

Figure 1: Tail-gas catalysts' annual pressure drop. Pressure drop is a key parameter for Claus tail-gas treating catalysts: the lower the pressure drop, the less the chance there is of operational upsets. The larger particle size of Criterion's catalysts means they outperform the competition in this crucial aspect.

CRITERION OFFERS A RANGE OF TAIL-GAS TREATING CATALYSTS AND WORKS WITH CUSTOMERS TO SELECT THE MOST APPROPRIATE CANDIDATE FOR EACH INDIVIDUAL UNIT. WE ALSO HELP CUSTOMERS TO OPTIMISE TREATMENT PROCESSES IN TERMS OF THE HARDWARE INVOLVED AND THE CONDITIONS IN THE UNIT.

TECHNOLOGY LEADERSHIP

Criterion's Claus tail-gas treating catalysts account for more than 65% of the world's installed capacity. They are installed in over 270 reactors worldwide, including nearly all of the industry's largest units.

ABOUT THE CATALYSTS

C-234

C-234, a low-bulk-density trilobe catalyst, has achieved global acceptance: more than 5,440 t of this catalyst has been installed worldwide. The catalyst is outstanding in low-temperature service: it operates at reactor inlet temperatures from 225°C, which makes substantial fuel savings possible.

Owing to its high surface area, low pressure drop and excellent catalytic activity, C-234 is also highly suitable for operations where there are problems with carbon or soot formation, or when cycle length is curtailed. C-234 also performs well in units that operate at conventional reactor inlet temperatures (280°C or higher). When the emphasis is on a low fill cost, C-234 is the most appropriate Criterion Claus tail-gas treating catalyst to use.

C-534

C-534 is a high-strength spherical catalyst that offers improved pressure drop characteristics. It has established an enviable track record in the industry and achieved cycle lengths of over 10 years in Shell Claus off-gas treating (SCOT®) units. Its physical strength and thermal stability safeguard it from the typical upsets encountered in tail-gas treating.

C-834

C-834 is Criterion's most active tail-gas treating catalyst and provides the optimal solution for the most challenging low temperature applications. C-834 is a low-bulk-density trilobe catalyst that builds on C-234's market-leading status. Having the best metals dispersion of any of our catalysts – the catalyst can operate at reactor inlet temperatures as low as 210°C, thus making it possible to achieve substantial fuel savings.

Owing to its high surface area, low pressure drop and excellent catalytic activity, C-834 is also highly suitable for operations where there are problems with carbon or soot formation, or when cycle length is curtailed. C-834 also performs well in units that operate at conventional reactor inlet temperatures (280°C or higher).

C-834 provides the maximum value Criterion can offer and meets the industry's highest performance needs.

THE VALUE OF LOW-TEMPERATURE OPERATION

Employing a high-activity catalyst enables operators to cut reactor inlet temperatures from 280 to 240°C or substantially lower, thereby reducing the amount of natural gas required to fuel the process. Criterion's designated low-temperature catalysts, C-234 and C-834, have sufficient activity to convert the same level of non-H_2S sulphur to H_2S as a conventional catalyst such as C-534 but at a lower temperature.

Running at a lower operating temperature can also help to extend cycle life. One European client calculated that it would save $4,800 a year for every cubic metre of C-234 that it installed. The entire cost of the catalyst was paid back in less than two years by operating at the lower temperature.

CATALYTIC INCINERATION – C-099

Incineration is normally the final stage in the sulphur removal process and converts any remaining traces of sulphur compounds, including H_2S, COS and CS_2, to less harmful SO_2 before release into the atmosphere. Thermal incinerators are normally operated at about 700°C, a temperature at which SO_2 may also be produced.

Refineries are increasingly replacing their thermal incinerators with catalytic units charged with Criterion's C-099 catalyst. Significantly, these units operate at about 300°C, which lowers energy bills, cuts greenhouse gas emissions and reduces the amount of SO_3 produced. In fact, the use of Criterion C-099 catalyst behind a tail-gas unit can offer savings of 60% in the fuel that would be required for a similar thermal incinerator. In addition, C-099 has extremely low selectivity for SO_3. C-099 has operated well for over 10 years in several locations.

CRITERION'S CLAUS TAIL-GAS TREATING CATALYSTS ACCOUNT FOR MORE THAN **65% OF THE WORLD'S INSTALLED CAPACITY.** THEY ARE INSTALLED IN OVER **270 REACTORS WORLDWIDE**, INCLUDING THE MAJORITY OF THE INDUSTRY'S LARGEST UNITS.

PROOF POINT: **CHINA PETROLEUM AND CHEMICAL CORPORATION (SINOPEC)**

Sinopec's Zhongyuan Puguang natural gas purification plant in Sichuan Province, China, features Claus conversion processes and tail-gas treating units that include C-234 catalyst.

Operating results confirm that the catalyst has

- very high stability. The reactor inlet temperature and the temperature differential distribution after six months were almost the same as the SOR results.
- extremely fast and complete SO_2 hydrogenation performance
- excellent activity. The COS at reactor outlet is 0–20 ppm, and the carbon monoxide content at the reactor outlet is close to zero.

In addition, operating the tail-gas treating units at low temperatures significantly reduces energy consumption.

SELECTING THE OPTIMUM CLAUS TAIL-GAS CATALYST

C-234

- Versatile
- Low or conventional temperatures
- Strong combination of activity and cost

C-534

- Provides reduced pressure drop at conventional temperatures

C-834

- Lowest temperature operation
- Highest activity in the industry

CRITERION'S TAIL-GAS TREATING CATALYSTS: PHYSICAL PROPERTIES	C-234	C-534	C-834
COMPOSITION	CoMo	CoMo	CoMo
SHAPE	3.2-mm trilobe	4.0-mm sphere	3.2-mm trilobe
COMPACTED BULK DENSITY (kg/m^3)	480	770	480
SURFACE AREA (m^2/g)	300	300	300

CONTACT US

For more information about how we can help you to enhance operational performance, meet increasingly stringent environmental regulations and increase revenues, visit us at **www.criterioncatalysts.com.**

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*SCOT is a Shell trademark

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CRITERION and its affiliates are dedicated to providing a broad customer base with effective and cost-efficient catalysts and technologies available in focus areas that include the entire range of hydroprocessing applications.