



TAIL-GAS TREATING CATALYSTS

Refineries and gas plants worldwide have reported lower operating costs, extended cycle lengths and reduced pressure drops 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 provide 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 catalyst offers the optimal balance between cost and activity

Pressure drop: Criterion’s C-534 and C-734 catalysts offer low 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-734 catalyst offers top-tier activity for lower temperature conversion of sulphur dioxide (SO₂), carbonyl sulphide (COS) and carbon disulphide (CS₂) to hydrogen sulphide (H₂S).

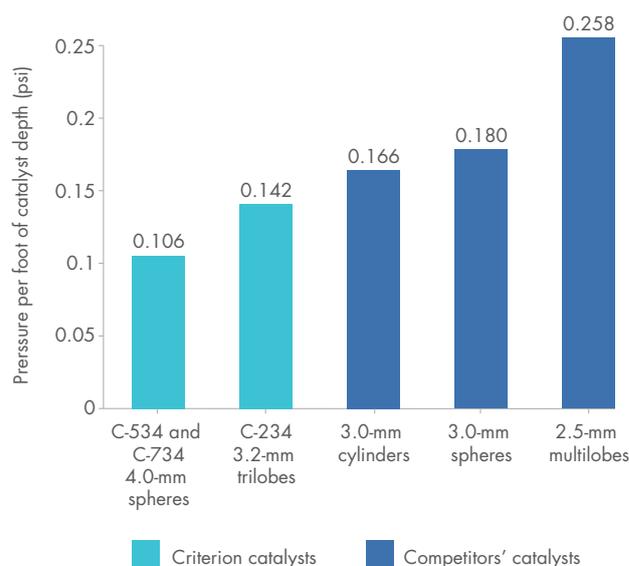


Figure 1: Tail-gas catalysts’ annual pressure drop. Pressure drop is a key parameter for Claus tail-gas treating catalysts: the lower the pressure drop, the less the chance there is of operational upsets. The larger particle size of Criterion’s C-234, C-534 and C-734 catalysts means they outperform the 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 C-234, C-534 and C-734 Claus tail-gas treating catalysts account for 80% 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 found wide acceptance globally: over 2,270 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. Substantial fuel savings can therefore be realised.

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). So, when a low fill cost is paramount, C-234 is the most appropriate Criterion Claus tail-gas treating catalyst to use.

THE VALUE OF LOW-TEMPERATURE OPERATION

Employing a high-activity catalyst enables operators to cut reactor inlet temperatures from 280 to 240°C or lower, thereby reducing the amount of natural gas required by the process. Criterion's low-temperature catalysts, C-234 and C-734, have sufficient activity to convert the same level of non-H₂S sulphur to H₂S as a conventional catalyst such as C-534 but at a lower temperature. Running at a lower operating temperature can also help to prolong 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.

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-734

Extensive research and development led to the creation of C-734, Criterion's newest and highest-activity Claus tail-gas catalyst. Not only does this spherical catalyst offer among the lowest pressure drop performance in the industry, it also provides top-tier catalytic activity.

The high activity is the result of an all-new substrate that Criterion has developed. The improved site architecture of the new substrate provides better metal dispersion and support interaction. Criterion's C-734 superior activity allows very low reactor inlet temperature operation, from 215°C.

In addition, C-734 features excellent COS and CS₂ conversion activity, and, in many cases, obviates the need for expensive COS/CS₂ hydrolysis catalyst in the Claus reactors.

C-734 also performs well in units that operate at conventional reactor inlet temperatures.

CATALYTIC INCINERATION – C-099

Refineries are increasingly cutting their energy bills and reducing emissions of greenhouse gases and harmful pollutants such as sulphur trioxide (SO₃) by replacing their thermal incinerators with a catalytic variant that is charged with Criterion's C-099 catalyst.

These incinerators are the final step in the sulphur complex and are designed to convert the remaining traces of sulphur compounds, including H₂S, COS and CS₂, to less harmful SO₂ before they enter the atmosphere.

Thermal incinerators are normally operated at about 700°C and can produce SO₃. Catalytic incineration provides an energy-saving alternative, as it operates at about 300°C. 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 SO₃. C-099 has operated well for over 10 years in several locations.

CRITERION'S C-234, C-534 AND C-734 CLAUS TAIL-GAS TREATING CATALYSTS ACCOUNT FOR 80% 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

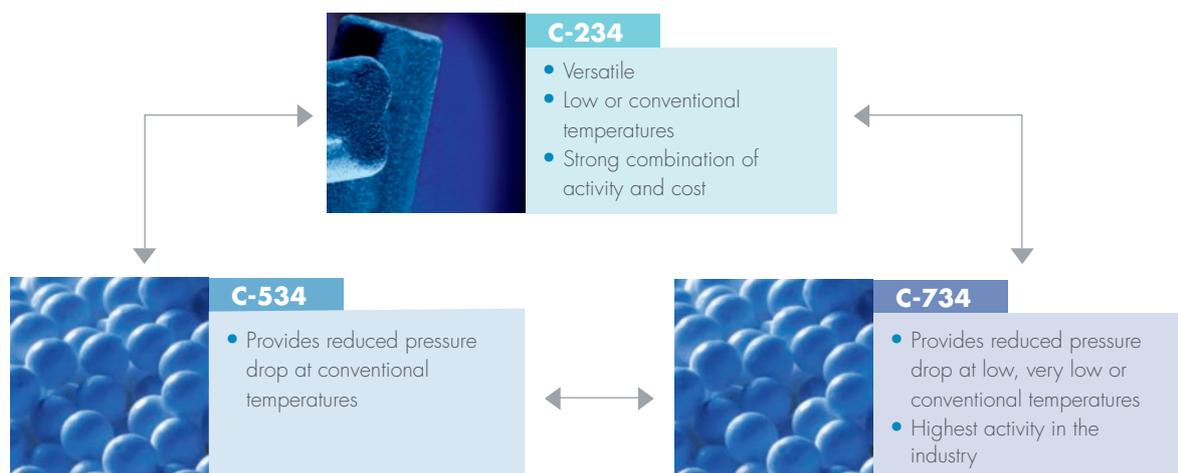
- very high stability. The reactor inlet temperature and the temperature differential distribution after six months were almost the same as the SOR results.
- extremely fast and complete SO₂ hydrogenation performance
- excellent activity. The COS at reactor outlet is 0–20 ppm, and the carbon monoxide content at the reactor outlet is close to zero.

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

PROOF POINT: NEW ZEALAND REFINING COMPANY

New Zealand Refining Company's Whangarei refinery cut its reactor inlet temperature from 280 to 235°C, which resulted in a 20–22% reduction in fuel gas use after switching to C-734 catalyst in its SCOT unit. It selected C-734 because of its high catalytic activity and low pressure drop characteristics. The unit has shown stable operation since it started up smoothly in May 2010.

SELECTING THE OPTIMUM CLAUS TAIL-GAS CATALYST



CRITERION'S TAIL-GAS TREATING CATALYSTS: PHYSICAL PROPERTIES

	C-234	C-534	C-734
COMPOSITION	CoMo	CoMo	CoMo
SHAPE	3.2-mm trilobe	4.0-mm sphere ¹	4.0-mm sphere
CRUSH STRENGTH	185 N/cm	100 N/bed	60 N/bed
COMPACTED BULK DENSITY (kg/m ³)	480	770	750
SURFACE AREA (m ² /g)	310	300	270
ATTRITION INDEX ²	98	98	94
MINIMUM REACTOR INLET TEMPERATURE (°C)	225	280	≤215

¹An 8.0-mm sphere is also available for grading purposes. ²Weight percent retained on 20-mesh screen after tumbling 1 h at 40 rpm.

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.

*SCOT is a Shell trademark

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