

Low Temperature Operation of Tail Gas Units with Criterion Catalysts

Criterion Catalysts and Technologies LP continues to assess the needs for improved products and processes.

Well – operated tail gas units are required for today's refineries and gas plants to meet strict environmental regulations for sulfur emissions. While providing 99.8 – plus percent recovery of sulfur, these units are costly to build and to operate. In many circumstances, hydrogenation catalysts that can operate at lower reactor inlet temperatures would allow for substantial savings in capital and operating expenditures. The actual operating expenditures are site and fuel cost dependent. Usually, tail gas units operate at reactor inlet temperatures in the 540° F (280° C) range.

Criterion offers the proven Criterion 234 catalyst that can operate at reactor inlet temperatures in the 460° F (240° C)

range, and even lower. A catalyst in the development stage, Criterion 734, can be operated at reactor inlet temperatures in the 390° F (200° C) range.

The Tail Gas Treating Process

Claus Tail Gas Units (TGU's) that utilize catalytic reduction and hydrolysis over Criterion 534 or Criterion 234 catalysts to provide for the optimum overall recovery of sulfur in refineries and gas plants. These units are characterized as "Best Available Control Technology" (BACT) because they recover 99.8 – 99.9 percent or more of the sulfur that enters the Claus plant as hydrogen sulfide feed.

These tail gas units, when equipped with the proper catalysts, will successfully convert all of the sulfur compounds in the Claus tail gas to hydrogen sulfide. H₂S is efficiently picked up by the downstream amine systems so the H₂S can be recycled

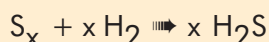


to the Claus process. To achieve 99.8 + recovery of the sulfur, the catalyst must be effective in facilitating a number of reactions.

Sulfur Dioxide must be reduced:



Sulfur vapor must be reduced:



Carbonyl sulfide and carbon disulfide must be hydrolyzed:



In areas where carbon monoxide is a regulated emission, and for efficiency, the water gas shift reaction must also be catalyzed:



These conversions must be accomplished without the formation of unwanted sulfur – containing compounds such as methyl mercaptan. Methyl mercaptan is neutral and will pass through the amine system and would then be oxidized in the incinerator to SO₂.

Catalysts for Lower Temperature Operation – Criterion 234

It has been standard practice to run the tail gas unit hydrogenation reactor inlet temperature at about 540° F (280° C). However, it has been shown in two refin-

ery tail gas units in the Gulf Coast that the inlet temperature for reactors loaded with Criterion 234 3.2 mm cobalt – molybdenum catalyst operate well at about 464° F (240° C). These two units have run at this temperature range for over four years, and the emissions from these units remained in the 10 – 20% range of the strict New Source Performance Standards (NSPS) sulfur emissions limit. This excellent performance is achieved without the use of expensive carbonyl sulfide conversion catalysts in the Claus reactors and without mercaptan formation.

Pilot plant studies have shown that the inlet temperature on such reactors may even be reduced further to the 430° F (220° C) range.

Catalysts for Lower Temperature Operation – The New Criterion 734

Recent investigations have led to the development of an entirely new tail gas catalyst, Criterion 734. This catalyst is so active that it has been shown to operate at reactor inlet temperatures in the range of 390° F (200° C) or even lower. Again, COS hydrolysis activity is excellent, and no expensive COS hydrolysis catalyst is required in the Claus process reactors. No mercaptans appear to form.

Opportunities for Tail Gas Process Savings

The reductive tail gas processes usually include the following primary components:

- In-line Heater
- Catalytic Reactor
- Waste Heat Boiler/Product Cooler
- Quench Tower
- Amine System

In the TGU, the tail gas is typically heated in a gas-fired reducing gas generator (RGG) burner prior to entering the reactor.

With the success of this lower temperature catalyst, new units could be designed with indirect heaters that use steam generated in the Claus reaction furnace boiler. Reactor outlet temperatures are low enough

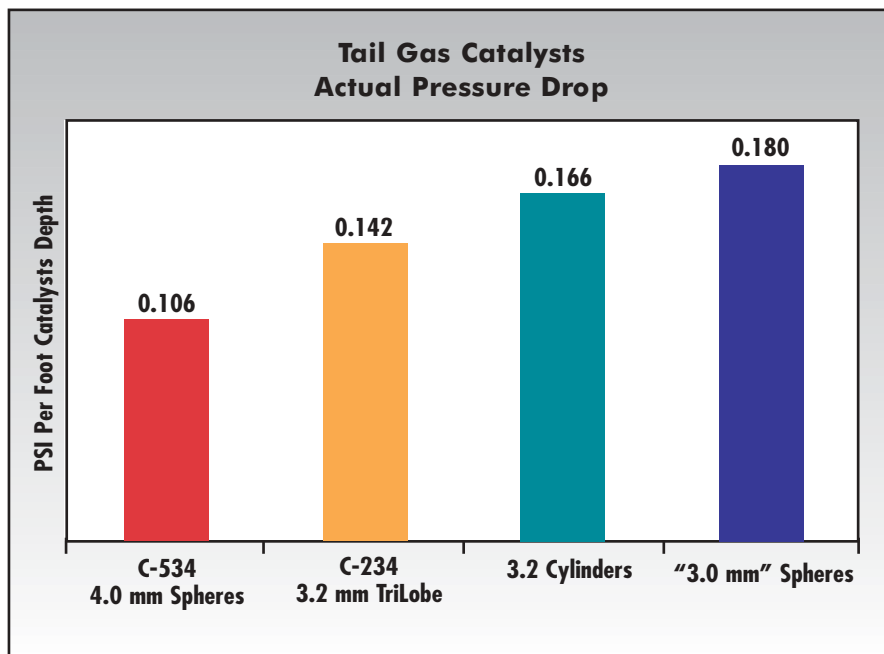
to be handled easily by the quench tower, thereby allowing omission of the waste heat boiler.

In existing tail gas units equipped with either in-line burners or indirect heaters, substantial fuel savings can be realized by merely operating at lower temperatures. The amount of savings is related directly to the cost of fuel.

In new designs and in existing units, the fuel savings must be balanced by the value of the steam that is generated by operating at higher temperatures with a waste heat boiler. If that steam has value, then it must be replaced.

Pressure Drop Considerations

Criterion 234 3.2 mm Trilobe™ tail gas catalyst is second only to Criterion 534 catalyst is giving the lowest pressure drop. Criterion 734 catalyst is a 4.0 millimeter sphere, and enjoys the same low pressure drop as does Criterion 534. (See Figure.)



Catalyst pressure drop is extremely important in tail gas units. The sulfur plant and tail gas unit operate at atmospheric pressure, with only about five pounds of pressure drop across the entire system including three Claus catalyst beds, the tail gas catalyst bed, all piping, towers, and heat exchangers. Any increase in pressure drop across these processes carries severe

penalties in lost capacity for sulfur handling. In the worse case, crude oil or natural gas must be backed out of the front of the refinery or gas plant, with substantial decrease in the amount of products available for sale.

Call your Criterion representative to learn more about improving your tail gas unit operation.

Important:

All information contained in this document is considered accurate at the time of the testing, based on the equipment, and specific conditions and other limitations during the testing process. It is being furnished upon the express condition that the user will make its own assessment to determine the accuracy and applicability for the user's particular purpose.

© 2005 Criterion Catalysts & Technologies



CRITERION
CATALYSTS & TECHNOLOGIES

Worldwide Offices:

HOUSTON:

16825 Northchase Dr.
Suite 1000
Houston, Texas 77060-6029
Telephone: (281) 874-2600
Facsimile: (281) 874-2641

CANADA:

Suite 810, Centre 104
5241 Calgary Trail Southbound
Edmonton, Alberta T6H 5G8
Canada
Telephone: (1) 780-438-4188
Facsimile: (1) 780-438-3473

UNITED KINGDOM:

1650 Parkway
The Solent Business Park,
Whiteley, Fareham,
Hampshire, PO15 7AH
England
Telephone: (44) 1 489-881881
Facsimile: (44) 1 489-881882

SINGAPORE:

298 Tiong Bahru Road
#07-03 Central Plaza
Singapore 168730
Telephone: (65) 6276-3627
Facsimile: (65) 6276-7455

Visit us on the web: www.criterioncatalysts.com

e-mail address: publicaffairs@criterioncatalysts.com



CRITERION
CATALYSTS & TECHNOLOGIES