



شرکت ملی گاز ایران

امورتدوین استناداردها

IGS

مشخصات فنی خرید

کاتالیست های واحد بازیافت گوگرد (کاتالیست کلاوس)

Claus Catalysts



تاریخ: ۱۳۹۲/۶/۲۷
شماره: ک/۰/دب/۰/۳۱۰-۱۶۷۶۲



دفتر مدیرعامل



ابلاغ مصوبه هیأت مدیره



مدیر محترم پژوهش و فناوری و رئیس شورای استاندارد

باسلام،

به استحضار می‌رساند در جلسه ۱۵۵۰ مورخ ۱۳۹۲/۴/۲۳ هیأت مدیره، نامه شماره گ/۹۳۹۹/۰۰۰/۹ مورخ ۹۲/۴/۱۶ مدیر پژوهش و فناوری و رئیس شورای استاندارد در مورد تصویب نهایی استاندارد تحت عنوان کاتالیست‌های واحد بازیافت گوگرد (کاتالیست کلاوس) به شماره تقاضای IGS-M-CH-054(0) مطرح و مورد تصویب قرار گرفت .

ناصر آبگون

دبیر هیأت مدیره

رونوشت: مدیرعامل محترم شرکت ملی گاز ایران و نائب رئیس هیأت مدیره

: اعضای محترم هیأت مدیره

: رئیس کل محترم امور حسابرسی داخلی

: رئیس محترم امور حقوقی

: رئیس محترم امور مجامع



FOREWORD

This standard is intended to be mainly used by NIGC and contractors and has been prepared based on interpretation of recognized standards, technical documents and experience in natural gas industry at national and international level.

Iranian Gas Standards (IGS) are prepared, reviewed and amended by technical standard committees within NIGC Standardization division and submitted to the NIGC's "STANDARDS COUNCIL" for approval.

IGS Standards are subject to revision, amendment or withdrawal, if required. Thus the latest edition of IGS shall be checked/inquired by NIGC employees and contractors.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation from normative references and / or well-known manufacturer's specifications must be reported to Standardization division.

The technical standard committee welcomes comments and feedbacks about this standard, and may revise this document accordingly based on the received feedbacks.

GENERAL DEFINITIONS:

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is a committee organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.

4- "SHALL ": is used where a provision is mandatory.

5- "SHOULD": is used where a provision is advised only.

6- "MAY": is used where a provision is completely discretionary.

Website: <http://igs.nigc.ir>

E-mail: igs@nigc.ir

TABLE OF CONTENT

1. SCOPE	1
2. REFERENCES	1
3. DEFINITIONS	2
4. REQUIREMENTS	3
5. DOCUMENTATION	3
6. INSPECTION	4
7. MARKING	5
8. PACKAGING	6
9. STORAGE LIFE	6
ANNEX A – Data Sheet for Claus Catalysts	7

1. SCOPE

This standard specification covers the minimum requirements of catalysts for sulfur recovery units by Claus process (Claus catalysts) in natural gas treating plants. Industrial Claus catalysts usually including three types: Catalyst for conversion of H₂S and SO₂ to sulfur (Conversion Claus catalyst), Catalyst for Hydrolysis of COS and CS₂ to H₂S (Hydrolysis Claus catalyst) and Oxygen scavenging catalyst. Each type used in any Claus reactor loaded full bed or in combination with each others. This standard specification specifies physical and chemical properties, test methods, inspection and packaging of Claus catalysts.

2. REFERENCES

Throughout this standard specification the following standards are referred to. The editions of these standards that are in effect at the time of issuing this standard specification (2013) shall be used, to the extent specified herein. The applicability of changes in standards that occur after the date of this standard specification shall be mutually agreed upon by the purchaser and the supplier and/or manufacturer.

ASTM D 3663 (2008) "Standard Test Method for Surface Area of Catalysts and Catalyst Carriers"

ASTM D 4058 (2006) "Standard Test Method for Attrition and Abrasion Catalysts and Catalyst Carriers"

ASTM D 4513 (2006) "Standard Test Methods for Particle Size Distribution of Catalytic Materials by Sieving"

ASTM D 4164 (2003) "Standard Test Method for Mechanically Tapped Packing Density of Formed Catalysts and Catalyst Carriers"

ASTM D 4179 (2006) "Standard Test Methods for Single Pellet Crush Strength of Formed Catalyst Shapes"

ASTM E 104 (2002) "Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions"

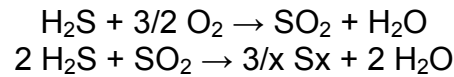
ASTM E 725 (2006) "Standard Test Method for Sampling Granular Carriers and Granular Pesticides"

BS ISO 15901-2 (2006) "Pore size distribution and porosity of solid material by mercury porosimetry and gas adsorption" "Part 2: Analysis of mesopores and macropores by gas adsorption"

BS ISO 9277 (1995) "Determination of specific surface area of solids by gas adsorption using the BET method"

UOP 879-87 "Aluminum in Catalysts by Atomic Absorption"**3. DEFINITIONS****3.1 Claus process**

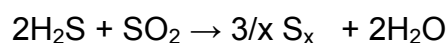
The Claus process is the most significant gas desulfurizing process, recovering elemental sulfur from gaseous hydrogen sulfide. First patented in 1883 by the scientist Carl Friedrich Claus, the Claus process has become the industry standard. The Claus process shall be done in two steps, First, the air to the acid gas ratio is controlled such that in total 1/3 of all H₂S is converted to SO₂, then 2/3 of remaining H₂S reacted with SO₂ in thermal and catalytic sections and sulfur produced. Reactions could be illustrated in the following reactions.

**3.2 Claus catalysts**

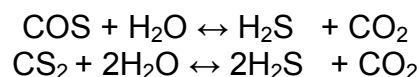
Claus catalysts are highly porous based on alumina or titanium that may promoted by adding other chemicals, such as iron, which is synthetically produced in the form of hard regular beads or cylinders; Claus catalysts usually have been used in three types in Claus process.

3.2.1 Conversion Claus Catalyst

Alumina based catalysts with high surface area and purity, low bulk density and optimized macro porosity that ensure maximum activity to enhance the conversion of H₂S and SO₂ to sulfur. Acts as catalyst in the following equation.

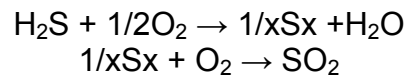
**3.2.2 Hydrolysis Claus Catalyst**

COS and CS₂ are produced as by products in thermal section of Claus process and Titanium promoted alumina used in sulfur recovery in Claus process to enhanced organic sulfur hydrolysis rate to improve the total sulfur conversion. Depending on amount of TiO₂, two types of hydrolysis catalyst are being used, Low TiO₂ and High TiO₂ (Higher Hydrolysis needs more TiO₂ content). Act as catalyst in the following equations.



3.2.3 Oxygen scavenging type

This ferrous sulfate Claus catalyst is commonly used in sulfur recovery units, as an oxygen scavenger. The guard catalyst serves to provide protection to prevent alumina based catalyst from sulfate poisoning. Iron promoted alumina beads used in dual bed with H₂S and SO₂ Conversion or COS and CS₂ Hydrolysis type, acts as Claus catalyst and oxygen scavenger to avoid sulfate poisoning. Used for any Claus reactor loaded full bed or in combination with other different types and functions catalysts. In terms of preventing sulfate formation by oxygen consumption; two reactions are possible:



Oxygen scavenging type loaded in sulfur recovery units on top (upper section) of second or third converter (usually 1/3 of the total catalytic volume) to protect efficiency the alumina based catalysts against sulfate poisoning due to oxygen breakthrough coming from main or auxiliary burners.

4. REQUIREMENTS

4.1 Properties

The physical and chemical properties of Claus catalysts shall be in accordance with Table 1 when tested in accordance with specified test methods.

4.2 Sampling

Sampling shall be carried out in accordance with ASTM E 725.

5. DOCUMENTATION

The manufacturer/supplier shall provide sufficient information and shall supply the technical information as a minimum requirement as follows:

- Approval test reports, original technical catalogues, manufacturing product data sheet and application procedure recommendation and guidelines.
- Claus catalyst loading and unloading procedure.
- Material Safety Data Sheet (MSDS).
- ISO 9001: 2008 or equivalent certification for quality control of offered Claus catalysts for sulfur recovery units issued by an internationally recognized body.

Table 1 – Physical and Chemical Properties

Item	Characteristic		Unit	Claus Catalyst Requirement				Test Method
				H ₂ S/ SO ₂ Conversion	COS,CS ₂ Hydrolysis		Oxygen Scavenger	
					Low TiO ₂	High TiO ₂		
1	Composition	Al ₂ O ₃ , min	wt %	93	90	---	80	UOP 879 or XRF
		TiO ₂ , min	wt %	---	4	85	---	XRF
		Fe ₂ O ₃	wt %	≤0.5	≤0.5	≤0.5	≥3	XRF
		Na ₂ O, max	wt %	0.3	0.3	0.3	0.3	XRF
2	Size		mm	3-6	3-6	3-4	4-8	ASTM D 4513
3	Surface Area(BET), min		m ² /gr	300	280	100	250	ISO 9277 or ASTM D 3663
4	Total Pore Volume, min		cm ³ / gr	0.4	0.4	0.2	0.3	ISO 15901-2 or ASTM D 6761
5	Pore Volume ≥1000 nm , min		cm ³ / gr	0.15	0.15	0.1	0.1	ISO 15901-2 or ASTM D 6761
6	Attrition Loss, max		wt %	1	1	1	1	ASTM D 4058
7	Crushing Strength, min		N	120	90	70 **	130	ASTM D 4179
8	Loss on ignition at 1000 °C, max		wt %	8	6	7	8	UOP 954
9	Bulk Density		gr/ cm ³	0.65±.05	0.7±0.05	0.9±0.1	0.7±0.05	ASTM D 4164
10	Appearance, shape		---	White Sphere	White Sphere	White Extrudate, Cylinder	Red- Brown, Sphere	---

* X-ray fluorescence

** Unit of measurement for extrudate cylinder type is (N/cm)

6. INSPECTION

The purchaser reserves the right to perform any inspections set forth in this standard specification where such inspections are deemed necessary to assure that supplies and services conform to the prescribed requirements.

The purchaser's inspector reserve the right to have access to the material subject to inspection for the purpose of witnessing selection of the samples , preparation of the test samples and performance of the test(s) .

For such tests, the inspector reserves the right to indicate the sample(s) from which the quantities will be taken in accordance with the provisions of this standard specification.

The manufacturer shall provide all means necessary for carrying out all inspections and tests as required by this standard specification.

The manufacturer shall set up and maintain such quality assurance and inspection systems to ensure that the material comply in all respects with the requirements of this standard specification.

The supplier shall furnish to the purchaser a certificate of quality stating that each batch has been sampled , tested , and qualified in accordance with this standard specification and has been found to meet the requirements specified .

Tests and qualification records shall be available for review by the purchaser.

Inspection or tests carried out by the purchaser's inspector, in no way relieves the supplier of his responsibilities and liabilities under the requirements of this standard specification.

7. MARKING

7.1 Marking of Containers

Each container shall be legibly marked with at least following information:

Composition

MESC No.

Handling Guidelines

Safety precautions

Storage Symbols

Date of Manufacture

Date of expiry

Batch No.

Net weight

Gross weight

HMIS (including Health, Fire, Reactivity, Personal Protection, Specified Hazard, etc)

7.2 Precautionary Marking

All individual containers shall be marked with precautionary symbols and/or phrases.

8. PACKAGING

8.1 The Claus catalysts shall be suitably packed in approved containers (New steel drums with inner PE liner or Big Bags) in accordance with the requirement of the contractor or order.

8.2 The containers shall be protected against all damages or defects which may occur during handling.

9. STORAGE LIFE

The Claus catalysts that meet all requirements of this standard specification shall have at least 24 months storage life from date of delivery.

Note: Store in dry and ventilated places, preventing from pollution, moisture and raining during storage and transportation.

**ANNEX A
"Data Sheet for Claus Catalysts"**

The following Tables shall be filled, signed and stamped by manufacturer/supplier.

Product Designation	
Manufacturer's/Supplier's Name	
Manufacturer's/Supplier's Address	

Table A – Physical and Chemical Properties

Item	Characteristic		Unit	Claus Catalyst Requirement			Test Method
				H ₂ S/ SO ₂ Conversion	COS,CS ₂ Hydrolysis		
					Low TiO ₂	High TiO ₂	
1	Composition	Al ₂ O ₃	wt %				UOP 879 or XRF
		TiO ₂	wt %				XRF
		Fe ₂ O ₃	wt %				XRF
		Na ₂ O	wt %				XRF
2	Surface Area(BET)		m ² /gr				ISO 9277 Or ASTM D 3663
3	Bulk Density		gr/ cm ³				ASTM D 4164
4	Total Pore Volume		cm ³ / gr				ISO 15901-2 Or ASTM D 6761
5	Pore Volume ≥1000 nm		cm ³ / gr				ISO 15901-2 Or ASTM D 6761
6	Size		mm				ASTM D 4513
7	Attrition Loss		wt %				ASTM D 4058
8	Crushing Strength		N				ASTM D 4179
9	Loss on ignition at 1000 °C		wt %				UOP 954
10	Appearance, shape		---				---

Notes:

1. This data sheet shall be filled, signed and stamped by manufacturer/supplier.
2. Any deviation from this standard specification shall clearly be specified by manufacturer/supplier.

DEVIATION(S)

AUTHORIZED SIGNATURE:

COMPANY'S STAMP: