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# GAS SWEETENING

SOLID BED H<sub>2</sub>S SCAVENGERS  
SOUR GAS SWEETENING UNIT  
H<sub>2</sub>S SCAVENGER

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HK HUICHUAN INTERNATIONAL PETROLEUM  
EQUIPMENT CO., LIMITED

2019-2020

# SOLID BED H<sub>2</sub>S SCAVENGERS

- ◆ SINGLE TOWER PROCESS
- ◆ TWO TOWER PROCESS
- ◆ SPONGE BED REGENERATION



## SOLID BED H<sub>2</sub>S SCAVENGERS

Solid Bed H<sub>2</sub>S Scavenger Unit is designed to remove hydrogen sulfide effectively and safely from natural gas stream in oilfield facilities. Solid Bed H<sub>2</sub>S Scavengers are ideal solution for gas processors to lower H<sub>2</sub>S amount and export through pipelines protecting personnel and downstream equipment from hazardous and highly corrosive hydrogen sulfide.

Unlike liquid H<sub>2</sub>S scavengers, solid scavengers are applied in batch mode. Sour gas (H<sub>2</sub>S-containing gas) usually flows from well site 2-phase or 3-phase separator and enters Solid Bed Scavenger Units, which consists of inlet separator (vertical gas-liquid separator), one or two process columns, which contains adsorbent beds, dry gas filters, instruments, sampling ports and sampling kit, operator platform and other system components specified in either in HC's technical proposal or client's requirements. As shown in given charts by HC Petroleum Equipment, all free liquids shall be removed from feed sour gas, as iron sponges require dry gas for quality H<sub>2</sub>S-removal performance. Liquid droplets present in the gas blocks porous structure of iron sponge slowing down its performance. For this reason, gas-liquid inlet separator is required.

After gas-liquid separation, sour gas enters process columns from the top nozzle, and flows downwards. In process column, when sour gas flows downwards, hydrogen sulfide reacts with iron sponge, forming iron sulfide and water. As H<sub>2</sub>S trapped in the sponge bed, sweet gas (H<sub>2</sub>S-free gas) flows out from the sponge bed. At downstream, dry gas filters may be used to filter small particles and dust of iron sponge. HC offers solid bed scavengers both with dry gas filter and without, based on the client's requirements. Water, which is produced after H<sub>2</sub>S reacting with iron sponge is accumulated at the bottom of the process columns, and drained. Gas sweetening system by iron sponge process also consists of flowline valves, relief valves, process gauges, sampling ports and sampling system (optional) and other auxiliary parts required by the project.



# SOUR GAS SWEETENING UNIT

## SOUR GAS SWEETENING UNIT

Sour Gas Sweetening Unit is designed to remove hydrogen sulfide (H<sub>2</sub>S) by adsorption process and handle mid and large amount of natural gas. Gas Sweetening Units of HC Petroleum Equipment is designed to remove effectively and safely hazardous H<sub>2</sub>S by employing adsorption process.

Gas Desulfurization Unit consists of inlet gas-liquid separator, process columns fixed adsorbent bed, end gas filters, sampling ports, instruments, valves, safety devices, operator platforms, and other components specified in HC's proposal.



There are several options for hydrogen sulfide removal adsorbents offered by HC Petroleum Equipment. We use quality H<sub>2</sub>S adsorbents, such as iron based solid H<sub>2</sub>S scavenger, activated carbon and other adsorbents specified in HC's catalogue. In HC's design solutions range also covers molecular sieve gas sweetening units and amine sweetening units, which are alternative solutions for gas sweetening in large amounts. The main benefits of HC's Solid Bed Scavenger are cost-effectiveness, fast delivery period and process guarantee. Our solid bed scavengers require minimum operating cost in compared to molecular sieve and amine treatment processes. However, selection of certain process depends on the operating conditions, such as concentration of H<sub>2</sub>S in natural gas, flow rate of natural gas, client's own preference to process and other factors. HC Petroleum Equipment is one of the leading and qualified companies which can supply gas sweetening units for natural gas industry. Our experienced and qualified technical team consists of process engineers, chemical engineers, mechanical engineers, E & I engineer, which allow us to provide high-end solutions for gas processors.

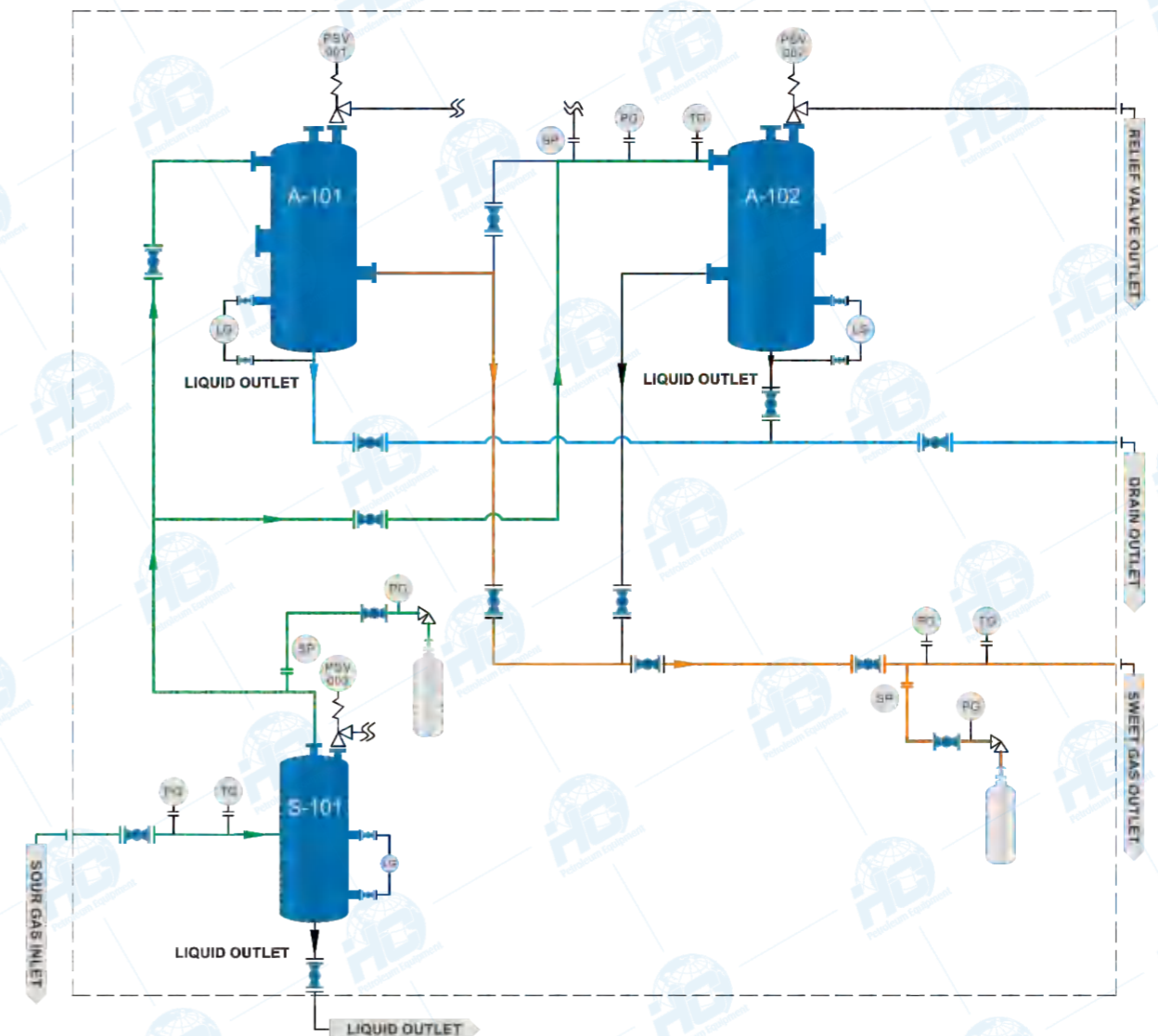
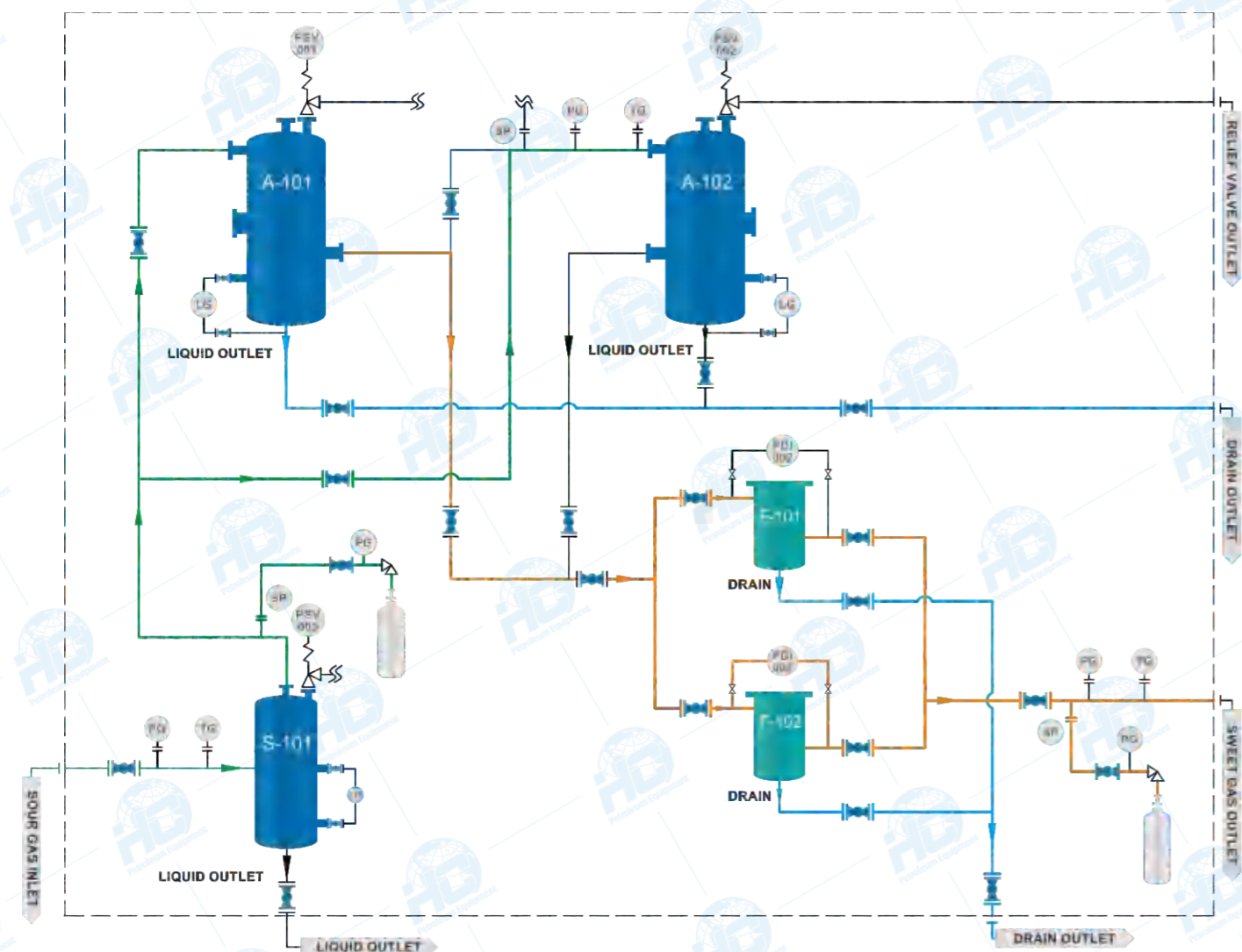
Gas sweetening by iron sponge process usually consists of several steps. First step is removing liquid drops present in feed natural gas. Liquid droplets decrease efficiency of adsorbent bed by blocking small pores of iron-rich impregnated chips. The center of all gas-sweetening operation is process columns, usually two columns filled with H<sub>2</sub>S adsorbents, tower A and tower B. another advantage of HC is ability to provide multipurpose solutions. Tower A and Tower B usually work as one operating, another is stand-by. It means when adsorbent bed of Tower A is spent, operators switch flow to Tower B. Also, Tower A and Tower B can be operated simultaneously in case of high concentration of H<sub>2</sub>S. Dry gas filters are employed to remove dust and small particles which may present in sweet gas after flowing downwards through adsorbent bed and losing H<sub>2</sub>S. However, configuration fully depends on the project's requirements. HC can offer both own solution or customize based on the client's requirements.



Level of control and automation depends on the client's operational characteristics and budget. Equipment can be designed with manually operated valves, instruments with indication functions, while fully automated system is also available. In fully automated system, several transmitters, control valves, valves with actuators, electrical and signal devices can be included, which can increase total cost price. Being flexible and experienced company, HC Petroleum Equipment can offer both manual and automatic type of control for the gas sweetening system.

## TWO TOWER PROCESS

Usually iron sponge gas desulfurization units are supplied with two towers, A and B. In practice, tower A is active and removes  $H_2S$ , while tower B is standby or under regeneration process. Another operational option offered by HC Petroleum Equipment is applying two towers work simultaneously. Two towers are used simultaneously in case of high ppm content of  $H_2S$  or high flowrates.



# SINGLE TOWER PROCESS

Iron sponge gas desulfurization units sometimes supplied with single column, based on the requirements of the client. HC Petroleum Equipment offers both options with single tower and dual tower.

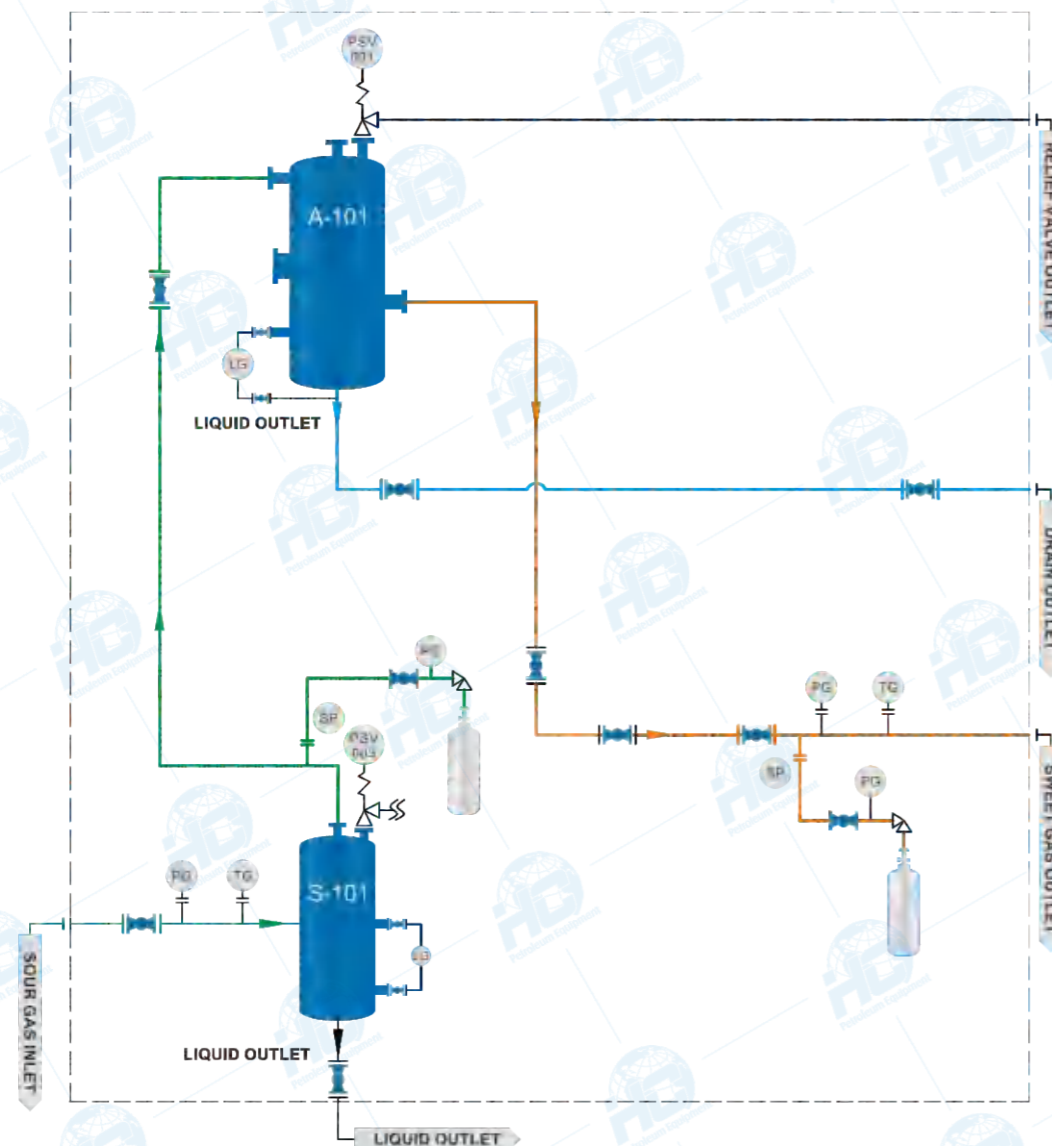
## SPONGE BED REGENERATION

Iron sponge can be regenerated achieving around 50%. Regeneration is conducted by directing air upwards from the column bottom to the top nozzle. Additional nozzle for regeneration can be added to the configuration of the column or relief valves' nozzle can be used with proper design. HC will provide PFD and P&IDs showing the flowlines and configuration of the system.

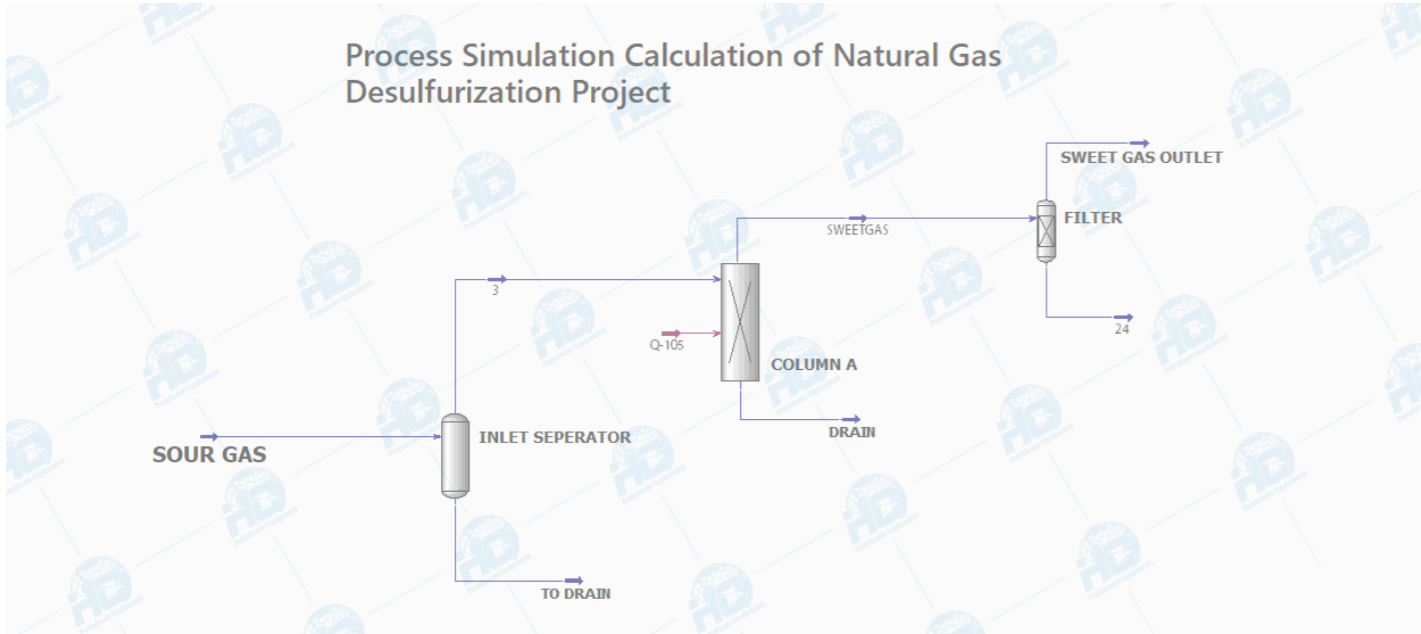
In practice, most companies usually replace spent sponge bed with new iron sponge, safely disposing spent beds. Replacement of spent iron sponge is simple but still very meticulous process, which requires to be handled by professionals with experience and qualifications. HC Petroleum Equipment will provide necessary documentation and manuals to handle spent sponge bend properly.

Size and configuration of the gas sweetening units by iron sponge process depends on several factors, such as flowrate, operating pressure, amount of H<sub>2</sub>S, etc. Please send your requirements and oilfield conditions to HC Petroleum Equipment to get the best suitable and cost-effective solution for oilfield gas sweetening. Another option is sending a request to HC, we will provide our data sheets for you to fill.

HC Petroleum Equipment designs and fabricates Iron Sponge Gas Sweetening System in own workshop located in Dongtai city, China. Our specialized production and assembly facility ensure fabrication, test, and inspection of the vessel as per ASME, PED and GB standards. Flowline parts will be ANSI rated and tested as per codes and standards. Construction of process flowline equipment shall be applicable in H<sub>2</sub>S-containing environments. HC Petroleum Equipment will comply with NACE MR0175 / ISO 15156 standards.



ASPEN HYSIS Process Simulation



Basic Parameters

System size	Gas Flow rate	H2S content (inlet)	H2S content (outlet)	Pressure range(Mpa)	Temp. range	
	Nm³/d	ppm	ppm	MPa	°C	°F
Small	0~5000	≤ 1000	≤ 1	Atm. - 10	10 - 80	50-176
Medium	5000~12000	≤ 1000	≤ 1	Atm. - 10	10 - 80	50-176
Large	12000~30000	≤ 1000	≤ 1	Atm. - 10	10 - 80	50-176

Important Notes:

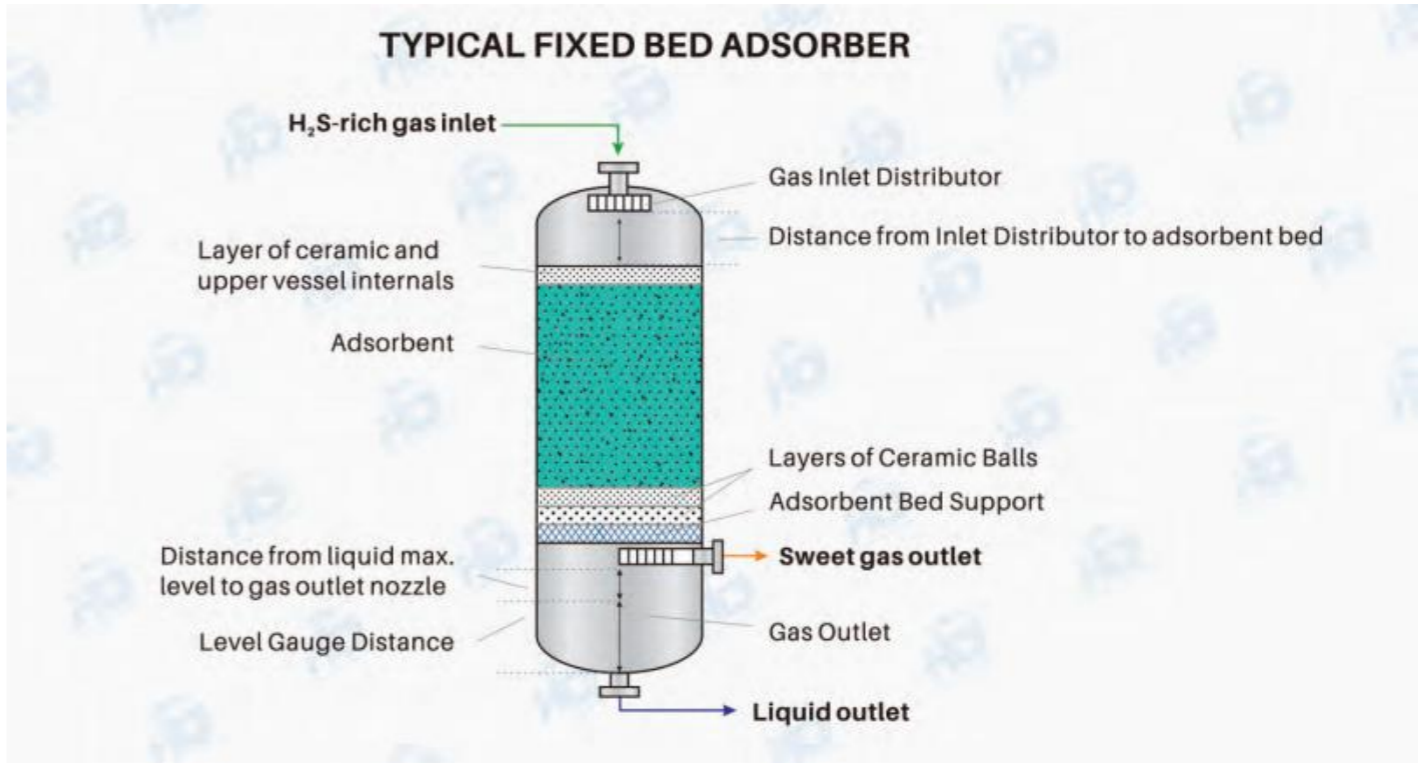
- Given parameters are for reference only. In case of flow rate greater than 300 000 Nm3/day, HC Petroleum Equipment shall conduct study of the client’s requirements and provide suitable solution for greater flow rates. Contact HC for technical assistance.
- In case of H2S content in natural gas stream between 1000 ppm and 10 000 ppm, HC Petroleum Equipment studies process data provided by the client and will provide suitable solutions to handle larger amount of hydrogen sulfide.
- When contacting us for customized design, it is necessary to provide the natural gas flow rate, pressure, temperature and composition list of natural gas, including the content of hydrogen sulfide, mercaptan, sulfide, carbon dioxide and other substances, water dew point, hydrocarbon dew point and other process data.
- Current parameters are for reference only. Each Solid Bed Scavenger is designed and fabricated based on requirements of the project. Contact HC for technical assistance.

Features

- Reliable and stable for H2S removal
- Process guarantee
- Easy to transport and installation (Plug and Play)
- Easy to operate
- Optional gas sampling kit and gas-analyzing systems
- Immediate supply of consistent quality iron sponge
- Designed by qualified natural gas and chemical engineers
- Self-contained skid
- Digital control system
- ASME or PED pressure vessels
- Compliance with NACE MR0175 / ISO 15156
- Cost-effective
- Fast delivery period



Process Flow Chart



# GAS SWEETENING H<sub>2</sub>S SCAVENGER



Iron sponge (Solid H<sub>2</sub>S Scavenger) is a special granular sold which is widely used in gas sweetening where iron sponge process is applied. Iron sponge process employs iron oxide which reacts with hydrogen sulfide (H<sub>2</sub>S) forming iron sulfide and water. Iron oxide is impregnated on special chips, which contain other chemical additives to increase efficiency of solid bed scavengers. Iron sponge is a very efficient adsorbents widely used in gas treatment processes.

Iron sponge is widely used as gas desulfurization agent for many applications, such as oilfield natural gas treatment, coke oven gas treatment, environment protection systems, textile industry, chemical industry, metallurgy, etc. However, the most challenging application is oilfield natural gas treatment. Being technologically strong and experienced oilfield equipment supplied, HC Petroleum Equipment mainly focuses on oilfield natural gas sweetening by iron sponge process. Challenges rises where high pressure; high flowrate and high H<sub>2</sub>S amount is present in natural gas stream. For this reason, HC's natural gas desulfurizers are exceptionally produced, selected, and tested to ensure process performance, lowering H<sub>2</sub>S amount to pipeline's acceptance standard. Our iron sponges withstand high pressure and effective in H<sub>2</sub>S removal.

Solid H<sub>2</sub>S Scavengers are the essential component of gas sweetening system by iron sponge process. Adsorbents shall be carefully chosen based on the field operating conditions, natural gas compound and properties, sizing requirements, project budget limits, delivery period and operation philosophy.

HC Petroleum Equipment is high-end solid bed scavenger supplier, which supplies iron sponge as well as complete professionally designed gas sweetening system. Iron sponge is contained in the specialized vertical vessels (process column), which have properly arranged internals to keep sponge bed at required level. Ceramic ball may be placed on the bottom and at the top of the sponge bed to hold sponge bend and prevent their escape from towers during gas sweetening.

**FEEL FREE TO CONTACT HC PETROLEUM EQUIPMENT FOR MORE TECHNICAL INFORMATION AND PRICE OF SOLID H<sub>2</sub>S SCAVENGERS. WE ENSURE QUALITY PERFORMANCE, FAST DELIVERY, AND IMMEDIATE AFTER-SALES SERVICE.**



Features

- ◆ Supplied in solid, granular form
  - ◆ Very efficient in stripping H2S from gas
  - ◆ Cost-effective
- ◆ East for transport and storage
  - ◆ 25 kg or 800 kg bags
  - ◆ Compound customization

Models and Parameters

	HCS-101	HCS-102	HCS-103	HCS-104	HCS-105	HCS-106	HCS-201
	Ordinary Iron Oxide	Ordinary Iron Oxide	Ferric Hydroxide	Ferric Hydroxide	Ferric Hydroxide	Zinc Oxide	Activated Carbon
Diameters of solids	4-8 mm	4- 11.5 mm	4- 8 mm	8- 11.5 mm	4- 11.5 mm	3-5 mm	3-5 mm
Density	0.65 - 0.85kg/l	0.7 - 0.95kg/l	0.65 - 0.85kg/l	0.7 - 0.95kg/l	0.8 - 0.95kg/l	0.95 - 1.2kg/l	0.55 - 0.65kg/l
Strength	≥50N	≥80N	≥50N	≥80N	≥48N	≥70N	≥90N
H2S-removal efficiency	≤1ppm	≤1ppm	≤1ppm	≤1ppm	≤1ppm	≤1ppm	Organic Sulfide Removal
Sulfur capacity	≥20%	≥20%	≥35%	≥35%	≥33%	≥30%	≥550mg/g
Operating Pressure	Atm. - 8 MPa	Atm. - 10 MPa	Atm. - 8 MPa	Atm. - 10 MPa	Atm. - 8 MPa	Atm. - 8 MPa	Atm. - 6 MPa
Operating Temperature	Atm. - 80℃	Atm. - 80℃	Atm. - 80℃	Atm. - 80℃	Atm. - 80℃	200 - 400℃	Atm. - 100℃

Notes:

HC Petroleum Equipment can customize adsorbents based on the process data of the project. Please contact HC for technical assistance and quotation.

