

DEVICE AND METHOD FOR COLLABORATIVE RECOVERY OF SULFUR AND HYDROGEN RESOURCES FROM HYDROGEN SULFIDE ACID GAS

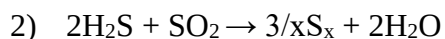
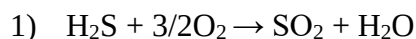
5 TECHNICAL FIELD

The disclosure belongs to the technical field of decomposition and recovery of a hydrogen sulfide acid gas, and relates to a device and method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas.

10

BACKGROUND

In the chemical industry (petrochemical industry, coal chemical industry and natural gas chemical industry), a large amount of acid gas (H₂S) will be generated during a production process. H₂S is a highly-toxic and foul-smelling colorless gas, which not only harms human health, but also causes corrosion to metal materials. At present, H₂S treatment in the chemical industry mainly adopts the traditional Claus process, which converts hydrogen sulfide into elemental sulfur and water:



20

Chinese patent CN201610052763.X discloses an SWSR-7 sulfur recovery process, which utilizes a sulfur recovery and tail gas treatment process formed by optimizing and combining the Claus process, a hydrogenation or oxidation process, and a hydrogen peroxide desulfurization technology. Although the Claus process can realize the harmless treatment of hydrogen sulfide, the hydrogen resource with a higher added value is converted into water, which results in a waste of precious resources. Hydrogen energy is the most promising fuel to replace fossil energy in the future. At present, industrial hydrogen is produced by reforming of light hydrocarbons, coal, natural gas, methanol and the like or electrolysis of water, which is costly and expensive, making hydrogen difficult to be widely used as a fuel.

30

Therefore, if hydrogen sulfide can be decomposed, not only can hydrogen sulfide be made harmless, but also hydrogen and elemental sulfur with high added values can be obtained. The current methods for directly decomposing H₂S to produce hydrogen and sulfur mainly include: thermal decomposition, thermal catalytic decomposition, electrochemical decomposition, photocatalytic decomposition and plasma decomposition. The thermal catalytic decomposition is one of the most promising H₂S decomposition technologies in industrial applications. Chinese patent CN201510730163.X discloses a process of producing hydrogen and elemental sulfur by subjecting iron powder and H₂ to pyrolysis reaction, which requires a magnetic field to separate the iron powder and gas. The process is complicated, and sulfur produced from the process has a high iron ion content, which does not meet the requirement that qualified industrial sulfur has a Fe content $\leq 0.02\%$ (w). Moreover, the FeS generated will combust spontaneously in the air, posing a safety risk.

Therefore, if a safe and reliable process technology with high hydrogen yield can be developed, it will have important research significance and practical value for realizing the collaborative recovery of sulfur and hydrogen resources in chemical industry.

SUMMARY

The disclosure is intended to overcome the above-mentioned shortcomings in existing processes for decomposition and recovery of a hydrogen sulfide acid gas, and provide a device and method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas, which can maximize the conversion rate of sulfide into hydrogen and sulfur, provide a reasonable process for recovering hydrogen and elemental sulfur, and increase the total conversion rate of hydrogen sulfide.

The disclosure is implemented by the following technical solutions.

The disclosure provides a device for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas, including a catalytic unit, a sulfur-hydrogen separation unit, an amine regeneration unit, pipelines connecting the above units, and

delivery pumps, valves and gauges for automatic control that are disposed on the connecting pipelines.

The catalytic unit includes a feedstock heater, a thermal catalytic reactor and a sulfur condenser that communicate with each other in sequence; the sulfur-hydrogen separation unit includes a process gas heater, a hydrogenation reactor, a steam generator, a quench tower and an absorption tower that communicate with each other in sequence; a gas inlet of the hydrogenation reactor communicates with a gas outlet of the sulfur condenser; and the top of the absorption tower is provided with a hydrogen-rich tail gas outlet, and the bottom is provided with a rich liquid outlet communicating with an amine regeneration device in the amine regeneration unit via a rich liquid pump.

Preferably, a hydrogen sulfide outlet of the amine regeneration device communicates with a gas inlet of the feedstock heater, and a lean liquid outlet communicates with the upper part of the absorption tower.

Preferably, a process gas-feed gas heat exchanger is disposed between the thermal catalytic reactor and the sulfur condenser, and pipelines entering and exiting the thermal catalytic reactor are subjected to heat exchange in the process gas-feed gas heat exchanger.

A liquid sulfur-trapping device is disposed below the sulfur condenser; and the process gas-feed gas heat exchanger and the steam generator are both provided with a deoxygenated water inlet and a steam outlet.

The thermal catalytic reactor is a catalytic pyrolysis device provided with a heat-insulating and wear-resistant lining therein, which is a fixed bed reactor filled with a pyrolysis catalyst inside. A hydrogen sulfide acid gas enters the thermal catalytic reactor from one side thereof, and a reacted process gas exits from the other side thereof to enter the next device.

The disclosure also provides a method for collaborative recovery of sulfur and hydrogen

resources from a hydrogen sulfide acid gas using the device, which achieves the collaborative recovery of sulfur and hydrogen resources as follows: subjecting a hydrogen sulfide acid gas to catalytic reaction in the thermal catalytic reactor; recovering sulfur generated by cooling sulfur vapor; and absorbing hydrogen by amine, and then purifying and concentrating the hydrogen, where, a small amount of hydrocarbons in the acid gas react with water vapor at a high temperature to form CO and H₂; and a small amount of NH₃ is thermally decomposed into N₂ and H₂ at a high temperature under the action of a catalyst.

The method specifically includes the following steps:

(1) thermal catalytic decomposition of a hydrogen sulfide acid gas:

heating a hydrogen sulfide acid gas to form a high-temperature acid gas, and then transferring the high-temperature acid gas to the thermal catalytic reactor, where, hydrogen sulfide is decomposed into elemental sulfur and hydrogen under the action of a catalyst, hydrocarbons react with water vapor to form CO and H₂, and NH₃ is thermally decomposed into N₂ and H₂;

(2) trapping of liquid sulfur:

cooling a process gas including hydrogen sulfide, sulfur vapor and hydrogen, then transferring the process gas to the sulfur condenser for further cooling, and trapping and recovering liquid sulfur generated from the cooling of sulfur vapor;

(3) hydrogenation:

heating a cooled process gas, then transferring the process gas to the hydrogenation reactor, and subjecting the sulfide other than hydrogen sulfide and elemental sulfur in the process gas to hydrogenation reduction and hydrolysis;

(4) separation of sulfur and hydrogen:

cooling a hydrogenated tail gas, then transferring the gas to the quench tower for further cooling to 40°C, and then transferring the gas to the absorption tower for absorption, where, a lean liquid is used to absorb hydrogen sulfide in the hydrogenated tail gas, and a hydrogen-rich tail gas is concentrated and purified to give hydrogen;

(5) regeneration of amine:

transferring a rich liquid that has absorbed hydrogen sulfide to the amine regeneration device for regeneration, returning separated hydrogen sulfide to the thermal catalytic reactor for recycling, and returning a lean liquid to the absorption tower for recycling to absorb hydrogen sulfide.

In step (1), the high-temperature acid gas entering the thermal catalytic reactor has a temperature of 700°C to 1,000°C. In step (2), the process gas is cooled to 250°C to 300°C; and in step (3), the process gas is heated to 280°C to 300°C.

In the disclosure, the control of operating temperatures can be realized by the device of the disclosure, and a process gas-acid gas heat exchanger or an electric heating automatic control system disposed on the connecting pipelines associated with the device.

In addition to inert gases, a general acid gas also includes NH_3 , H_2O and hydrocarbons. Under the action of a pyrolysis catalyst, NH_3 can be thermally decomposed into N_2 and H_2 . Pyrolysis of H_2S is conducted at 700°C to 1,000°C, and at this temperature, hydrocarbons react with water vapor to form CO and H_2 .

Compared with the prior art, the disclosure has the following beneficial effects:

(1) The recovery of hydrogen requires the absorption of unreacted hydrogen sulfide. As sulfides such as CS_2 and COS will inevitably be generated during reaction, and part of the generated elemental sulfur cannot be trapped, sulfides other than hydrogen sulfide and elemental sulfur in a process gas must be converted into H_2S by hydrogenation reduction and hydrolysis, so that hydrogen can be separated. The disclosure combines thermal catalytic decomposition of hydrogen sulfide, hydrogenation and amine regeneration for the first time to decompose a hydrogen sulfide acid gas into elemental sulfur and hydrogen, which can fully recover sulfur resources while recovering hydrogen resources with a higher added value. The disclosure exhibits high sulfur recovery efficiency, and the sulfur product obtained in the disclosure meets or exceeds the first-class sulfur standard specified in

GB/T2449. The device in the disclosure can achieve a recovery rate of sulfur and hydrogen reaching more than 99%. The greater the amount of amine circulated in the absorption unit, the less the hydrogen sulfide carried away in a hydrogen-rich gas, resulting in a higher total recovery rate. The conversion rate of hydrogen sulfide is 30% to 50% during the thermal catalytic reaction, and the regenerated hydrogen sulfide is returned to the catalytic reactor for recycling.

(2) The disclosure adopts a mature, reliable and low energy-consuming thermal regeneration technology for amine regeneration while improving the conversion rate of hydrogen sulfide. The disclosure simplifies a process flow, reasonably utilizes reaction heat, and generates 0.3 MPa (g) saturated steam to heat a jacket and an amine regeneration reboiler, which reduces the energy consumption of a device.

(3) The disclosure has advantages such as a simple process flow, easy startup, shutdown and normal operations, high economic performance, small floor space, and low investment cost. Moreover, the disclosure effectively reduces the labor intensity and lowers the cost.

BRIEF DESCRIPTION OF DRAWING

The accompanying drawing is used to further illustrate the disclosure and constitute a part of the specification. The accompanying drawings, together with the examples of the disclosure, are provided to explain the disclosure, but do not constitute a limitation to the disclosure.

In the accompanying drawing:

FIG. 1 is a process flow diagram illustrating the device and method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas provided in the disclosure.

In the figure: 1 represents a feedstock heater, 2 represents a thermal catalytic reactor, 3 represents a process gas-feed gas heat exchanger, 4 represents a sulfur condenser, 5

represents a hydrogenation reactor, 6 represents a steam generator, 7 represents a quench tower, 8 represents an absorption tower, 9 represents a rich liquid pump, 10 represents a quench water pump, 11 represents a quench water cooler, 12 represents an amine regeneration device, 13 represents a process gas heater, A represents an inlet direction of the feedstock of an acid gas, B represents a deoxygenated water inlet, C represents a steam outlet, D represents a liquid sulfur outlet, and E represents a hydrogen-rich tail gas outlet.

DETAILED DESCRIPTION

To make the objectives and technical solutions of the disclosure clearer, the disclosure is further described in detail below with reference to the accompanying drawing. Unless otherwise specified, the experimental methods described in the following examples are all conventional methods. If specific techniques or conditions are not indicated for a method in examples, the method shall be conducted in accordance with the techniques or conditions described in literatures in the art or in accordance with product specifications. The reagents and materials are all commercially available unless otherwise specified.

The thermal catalytic reactor is a conventional fixed bed reactor, and the catalyst used is the hexaaluminate composite oxide material disclosed in Chinese Patent CN201810780422.4.

An absorbent such as amine (MDEA) or low-temperature methanol is used in the absorption tower. The amine regeneration process is a well-known single-tower stripping thermal regeneration process, and the amine regeneration device 12 is a regeneration tower.

As shown in FIG. 1, the device for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas used in the following examples includes a catalytic unit, a sulfur-hydrogen separation unit, an amine regeneration unit, pipelines connecting the above units, and delivery pumps, valves and gauges for automatic control that are disposed on the connecting pipelines.

The catalytic unit includes a feedstock heater 1, a thermal catalytic reactor 2 and a sulfur condenser 4 that communicate with each other in sequence; a process gas-feed gas heat exchanger 3 is disposed between the thermal catalytic reactor and the sulfur condenser, and pipelines entering and exiting the thermal catalytic reactor are subjected to heat exchange in the process gas-feed gas heat exchanger. A liquid sulfur-trapping device is disposed below the sulfur condenser to trap cooled liquid sulfur.

The thermal catalytic reactor is a fixed bed reactor with a lining structure, and a catalyst is packed in the catalytic reactor. An acid gas enters the thermal catalytic reactor from one side thereof, and the outlet is on the other side, which is connected to the process gas-feed gas heat exchanger.

The sulfur-hydrogen separation unit includes a process gas heater 13, a hydrogenation reactor 5, a steam generator 6, a quench tower 7 and an absorption tower 8 that communicate with each other in sequence, and a gas inlet of the hydrogenation reactor communicates with a gas outlet of the sulfur condenser. The process gas-feed gas heat exchanger and the steam generator are both provided with a deoxygenated water inlet B and a steam outlet C. The bottom of the quench tower communicates with a quench water cooler 11 via a quench water pump 10, and cooled water is returned to the quench tower from the upper part of the quench tower.

The top of the absorption tower is provided with a hydrogen-rich tail gas outlet E, and the bottom is provided with a rich liquid outlet communicating with an amine regeneration device 12 in the amine regeneration unit via a rich liquid pump 9. A hydrogen sulfide outlet of the amine regeneration device communicates with a gas inlet of the feedstock heater, and a lean liquid outlet communicates with the upper part of the absorption tower.

To avoid repetition, the feedstocks and preparation conditions and parameters involved in this specific implementation are now uniformly described as follows, which will not be repeated in the specific examples:

(1) Thermal catalytic decomposition of a hydrogen sulfide acid gas:

At the beginning of a process, a feedstock gas is heated to a required temperature of 700°C to 1,000°C by the feedstock gas heater; and then the acid gas with hydrogen sulfide enters the thermal catalytic reactor. The reactor is a fixed bed reactor with lining, and the acid gas enters into the catalyst bed from one side of the reactor. Hydrogen sulfide is decomposed into elemental sulfur and hydrogen under the action of a catalyst, hydrocarbons react with water vapor to form CO and H₂, and NH₃ is thermally decomposed into N₂ and H₂. One side of the thermal catalytic reactor is directly connected to the process gas-feed gas heat exchanger. The heat of a process gas obtained after the thermal catalytic reaction is reasonably used to heat a feed gas, and insufficient part of the heat for heating a feed gas is provided by a feed gas heater, which effectively uses high-temperature heat. The process gas is cooled to 250°C to 300°C.

(2) Trapping of liquid sulfur:

A process gas including hydrogen sulfide, sulfur vapor and hydrogen is cooled and then transferred to the sulfur condenser for further cooling; and liquid sulfur generated from the cooling of sulfur vapor is trapped and recovered, and at the same time, the sulfur condenser uses low-temperature heat to generate low-pressure steam (0.3 MPa (g)), which reduces the energy consumption of the device. The sulfur vapor is cooled into liquid sulfur that will be trapped and used as industrial sulfur.

(3) Hydrogenation:

The cooled process gas has a temperature of about 160°C. The process gas includes a small amount of sulfur vapor and impurities generated during the reaction including COS, CS₂ and a small amount of SO₂, which must be converted into hydrogen sulfide by hydrogenation or hydrolysis, so that hydrogen sulfide can be effectively removed to give a relatively-pure hydrogen-rich gas. The cooled process gas is heated to 280°C to 300°C and enters the hydrogenation reactor where the sulfides other than hydrogen sulfide and elemental sulfur in the process gas are subjected to hydrogenation reduction and hydrolysis, which facilitates the absorption of hydrogen sulfide and the separation of high-purity

hydrogen.

(4) Separation of sulfur and hydrogen:

A hydrogenated tail gas is cooled to 170°C in the steam generator, then enters the
5 quench tower for further cooling to 40°C, and then enters the absorption tower for
absorption. A lean liquid is used to absorb hydrogen sulfide in the hydrogenated tail gas, and
a hydrogen-rich tail gas is concentrated and purified to give hydrogen.

(5) Regeneration of amine:

10 A rich liquid that has absorbed hydrogen sulfide is transferred to the regeneration tower
for regeneration, and separated hydrogen sulfide is returned to the thermal catalytic reactor
for recycling. The regeneration tower has an outlet pressure of 0.06 MPa to 0.08 MPa (g)
and a temperature of 122°C at the top. A lean amine liquid is returned to the absorption
tower for recycling to absorb hydrogen sulfide. The regeneration of rich liquid adopts a
15 mature and reliable thermal regeneration technology with low energy consumption, and the
steam adopts the self-produced 0.3 MPa (G) steam.

Example 1

In this example, in the catalytic reactor, the conversion rate of H₂S was about 30% to
20 50%; hydrocarbons reacted with water vapor at a high temperature to generate CO and H₂;
and a small amount of NH₃ was thermally decomposed into N₂ and H₂ at a high temperature
under the action of a catalyst. H₂S absorbed by amine was desorbed and then returned to the
catalytic reactor. The total recovery rate of H₂S can reach more than 99%, and the recovered
sulfur meets the requirements for high-class industrial sulfur specified in GB/T2449-2014.

25 A larger amount of amine circulated in the amine absorption tower makes more H₂S be
trapped and less H₂S be carried away in a hydrogen-rich gas, and the trapped H₂S will be
regenerated from amine and then returned to the thermal catalytic reactor for reaction, which
results in a higher total recovery rate of H₂S.

30 An acid gas entering the catalytic reactor generally has a pressure of 0.06 MPa (g), the

pressure drop of each device is considered as 5 kPa, an acid gas regenerated from amine has a pressure of 0.05 MPa to 0.08 MPa (g), and a hydrogen-rich gas has an outlet pressure of 0.03 MPa to 0.04 MPa (g).

5 Example 2

In this example, the source, composition and quantity of feedstocks for a 10,000 ton/year sulfur recovery device of a chemical plant are shown in Table 1 below.

Table 1. Composition and flow rate of acid gas entering the thermal catalytic reactor

Source of acid gas	Clean acid gas derived from amine regeneration	Ammonia-containing acid gas derived from sour water stripping	Mixed acid gas
Temperature °C	40	85	71
Pressure MPa (g)	0.05	0.05	0.05
Flow rate (Nm ³ /h)	963	538	1501
Composition (v%)			
H ₂ S	57.16	39.46	49.98
CO ₂	41.84	/	26.85
H ₂ O	/	26.92	9.59
C ₂	1.0	/	0.65
NH ₃	/	33.62	12.93
Total	100	100	100

10 The above mixed acid gas, after subjected to hydrogen sulfide thermal catalytic decomposition, hydrogenation and amine regeneration in the device for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas in the disclosure, has a significantly-changed gas composition. The detailed data are shown in Table 2.

15 Table 2. Composition and flow rate of a process gas at the outlet of the thermal catalytic reactor, a purified hydrogen-rich gas and a regenerated acid gas

Material	Process gas at the outlet of the catalytic reactor	Purified hydrogen-rich gas	Regenerated acid gas
Temperature °C	700 to 1000	40	40
Pressure MPa (g)	0.05	0.03	0.06
Flow rate (Nm ³ /h)	2005.2	1142.7	495
Composition (v%)			
H ₂ S	22.45	1.02	88.57
CO ₂	20.10	31.74	8.13
CO	0.50	0.87	/
H ₂ O	7.18	5.28	3.30
H ₂	25.13	44.11	/

N ₂	9.68	16.98	/
S _x	14.96	/	/
Total	100	100	100

In Table 2, the conversion rate of the thermal catalytic reactor is considered as 40%, and the hydrogen sulfide content in the purified hydrogen-rich gas is 1% (v).

5 It can be seen from the gas composition changes in Table 1 and Table 2 that the device and method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas provided in the disclosure can efficiently treat hydrogen sulfide in the hydrogen sulfide acid gas to give liquid sulfur resources and recover hydrogen resources with a higher added value, and can also synchronously treat hydrocarbons and ammonia gas
10 in the acid gas, which improves the treatment efficiency of the device for acid gas.

Of course, the above descriptions are only preferred examples of the disclosure and are not intended to limit the disclosure. Although the disclosure is described in detail with reference to the foregoing examples, a person skilled in the art can still make modifications
15 to the technical solutions described in the foregoing examples, or make equivalent replacement to some technical features. Any modifications, equivalent substitutions, improvements and the like made within the spirit and principles of the disclosure are intended to be included in the scope of the disclosure.

20

What is claimed is

1. A method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas, wherein the method uses a device for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas, comprising a catalytic unit, a sulfur-hydrogen separation unit, an amine regeneration unit, pipelines connecting the above units, and delivery pumps, valves and gauges for automatic control that are disposed on the connecting pipelines; wherein,

the catalytic unit comprises a feedstock heater (1), a thermal catalytic reactor (2) and a sulfur condenser (4) that communicate with each other in sequence; the sulfur-hydrogen separation unit comprises a process gas heater (13), a hydrogenation reactor (5), a steam generator (6), a quench tower (7) and an absorption tower (8) that communicate with each other in sequence; a gas inlet of the hydrogenation reactor (5) communicates with a gas outlet of the sulfur condenser (4); and the top of the absorption tower (8) is provided with a hydrogen-rich tail gas outlet (E), and the bottom is provided with a rich liquid outlet communicating with an amine regeneration device (12) in the amine regeneration unit via a rich liquid pump (9); a process gas-feed gas heat exchanger (3) is disposed between the thermal catalytic reactor (2) and the sulfur condenser (4), and pipelines entering and exiting the thermal catalytic reactor (2) are subjected to heat exchange in the process gas-feed gas heat exchanger (3); a liquid sulfur-trapping device is disposed below the sulfur condenser (4); and the process gas-feed gas heat exchanger (3) and the steam generator (6) are both provided with a deoxygenated water inlet (B) and a steam outlet (C); a hydrogen sulfide outlet of the amine regeneration device (12) communicates with a gas inlet of the feedstock heater (1), and a lean liquid outlet communicates with the upper part of the absorption tower (8);

wherein the collaborative recovery of sulfur and hydrogen resources is achieved as follows: subjecting a hydrogen sulfide acid gas to catalytic reaction in the thermal catalytic reactor; recovering sulfur generated by cooling sulfur vapor; and absorbing

hydrogen by amine, and then purifying and concentrating the hydrogen; a small amount of hydrocarbons in the acid gas react with water vapor at a high temperature to form CO and H₂; and a small amount of NH₃ is thermally decomposed into N₂ and H₂ at a high temperature under the action of a catalyst;

5 wherein the method specifically comprises the following steps:

(1) thermal catalytic decomposition of a hydrogen sulfide acid gas:

heating a hydrogen sulfide acid gas to form a high-temperature acid gas, and then transferring the high-temperature acid gas to the thermal catalytic reactor, wherein, hydrogen sulfide is decomposed into elemental sulfur and hydrogen under the action of
10 a catalyst, hydrocarbons react with water vapor to form CO and H₂, and NH₃ is thermally decomposed into N₂ and H₂; wherein in step (1), the high-temperature acid gas entering the thermal catalytic reactor has a temperature of 700°C to 1,000°C;

(2) trapping of liquid sulfur:

cooling a process gas comprising hydrogen sulfide, sulfur vapor and hydrogen,
15 then transferring the process gas to the sulfur condenser for further cooling, and trapping and recovering liquid sulfur generated from the cooling of sulfur vapor; wherein in step (2), the process gas is cooled to 250°C to 300°C;

(3) hydrogenation:

heating a cooled process gas, then transferring the process gas to the
20 hydrogenation reactor, and subjecting the sulfide other than hydrogen sulfide and elemental sulfur in the process gas to hydrogenation reduction and hydrolysis; wherein in step (3), the process gas is heated to 280°C to 300°C;

(4) separation of sulfur and hydrogen:

cooling a hydrogenated tail gas, then transferring the gas to the quench tower for
25 further cooling to 40°C, and then transferring the gas to the absorption tower for absorption, wherein, a lean liquid is used to absorb hydrogen sulfide in the hydrogenated tail gas, and a hydrogen-rich tail gas is concentrated and purified to give hydrogen;

(5) regeneration of amine:

transferring a rich liquid that has absorbed hydrogen sulfide to the amine regeneration device for regeneration, returning separated hydrogen sulfide to the thermal catalytic reactor for recycling, and returning a lean liquid to the absorption tower for recycling to absorb hydrogen sulfide.

5

2. The method for collaborative recovery of sulfur and hydrogen resources from a hydrogen sulfide acid gas according to claim 1, wherein, the thermal catalytic reactor (2) is a catalytic pyrolysis device provided with a heat-insulating and wear-resistant lining

10 therein, which is a fixed bed reactor.