

Environment, Energy and Chemistry

E&Chem Solution

Environment Energy & Chemical Solution

Biogas pretreatment equipment and desulfurization agents

“Environmental New Technology (NET) Certification”
Ministry of Environment (April 7, 2022)
(Manufacturing and application technology of acid mine drainage sludge
recycling desulfurization agent for the removal of hydrogen sulfide in biogas)

“Innovative Product Designation” Ministry of Environment (December 24, 2021)
(Desulfurization agent to remove hydrogen sulfide from biogas and odor)

“Product Performance Certification Securement”
Ministry of SMEs and Startups (March 13, 2019)
(Adsorbent for removal of hydrogen sulfide and siloxane from biogas)



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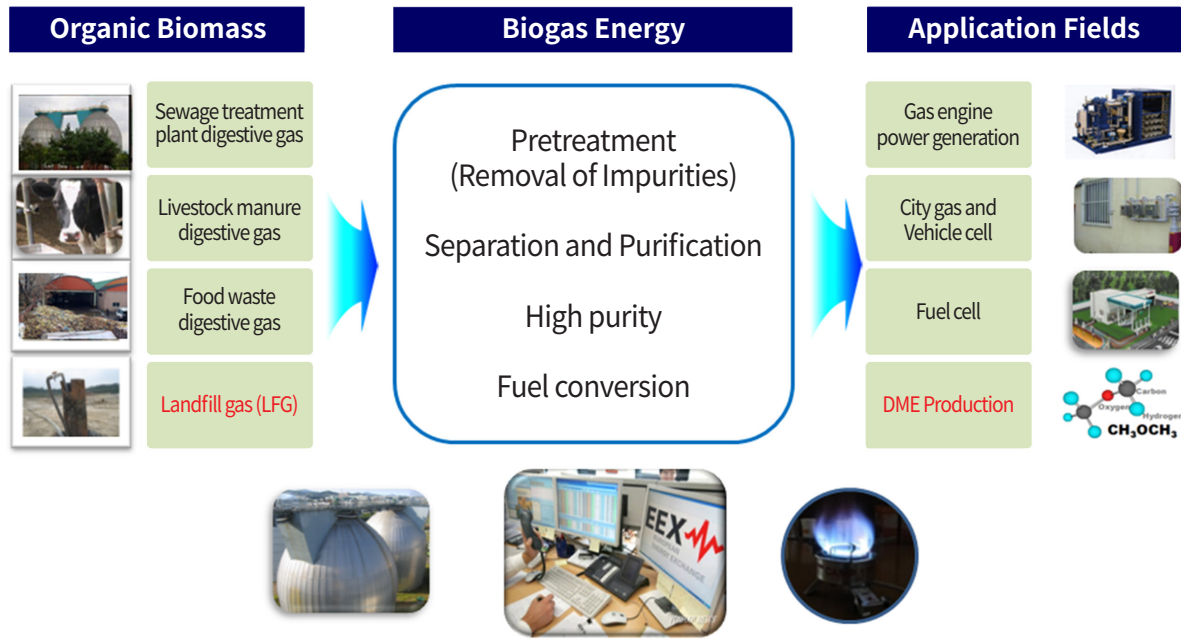
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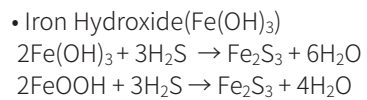
◆ Pretreatment process for Various biogas



◆ Removal of Hydrogen sulfide and Siloxanes from biogas

○ Concept

- Desulfurization agent in powder and pellet form for H₂S and siloxane removal from biogas



○ Technical excellence

- Removal of fine dust-causing substances from biogas (i.e H₂S and Siloxane)
- Removal 200 ~ 10,000 ppm H₂S down to ultra low concentration in less than 0.5ppm
- 100% removal of 5 to 100 mg/m³ of siloxanes
- No effect by moisture (High water resistance desulfurization agent)

○ Advantages in our technology

- High ability of simultaneous removals for H₂S and siloxanes
- A Installation and maintenance cost is 30% economical more than before.

○ Reference sites

- Hongcheon / Eco-friendly Energy Town (Manure, Wastewater)
- Chungju / Food Waste Bio-Energy Center (Food waste)
- Seoul / Tanchon Wastewater Recover Plant
- Incheon / Metropolitan Landfill Site
- Changwon / Changwon Food Waste Bio-Energy Center
- Iksan / Sewage Treatment Plant Biogas Equipment

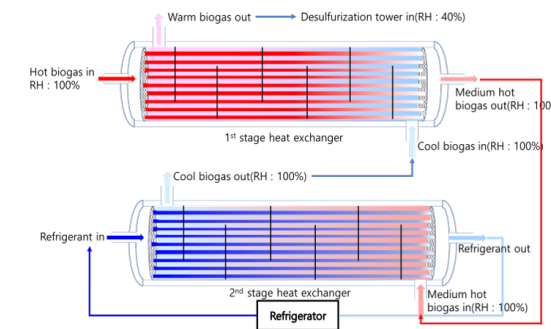
◆ Biogas Dehumidifier System

• The necessity of biogas dehumidification

- Biogas contain 4~8% Moisture (30 ~ 100g/m³)
- The moisture causes various problems such as loss in gas heat and engine power, corrosion of pipes and equipment components combined with acidic species, CO₂ and H₂S
- Acid condensates produces impurities degrading engine oil and increasing silica accumulation



• Biogas dehumidification technology



- High efficiency system for hazardous gas removal adopting 2-stages heat exchangers (Patent KR : 10-2300634)
- Energy saving by 60%, extended operating time with high durability

• Effects of biogas dehumidification

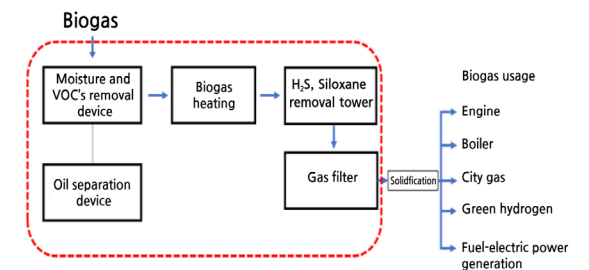
Upgrade in engine efficiency

Lowering the moisture content by 1% leads to the increase of methane(CH₄) content by 5%, thus increasing the electrical power by 5%

Reduction of Engine Oil Pollution

Increase in engine oil replacement cycle (1MWe engine 600L)
From 800 hours to 1,600 hours

• Biogas pretreatment system



- Biogas impurity removal method and removal system (Patent KR : 10-2196559)
- ppb-grade hydrogen sulfide removal rate and prevention of condensate production

Complies with supply standards of gas engines

Major engine manufacturers do not allow a moisture and pipe condensate from raw materials.

Corrosion protection of piping and components

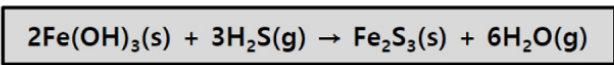
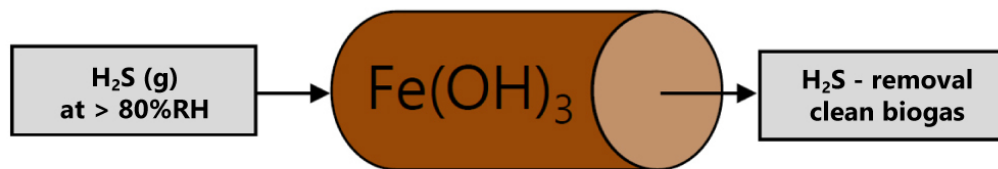
A dry gas supplied at low dew point prevents the generation of corrosive acid substances

◆ Hydrogen Sulfide (H₂S) Removal System

• The necessity of removal H₂S from biogas

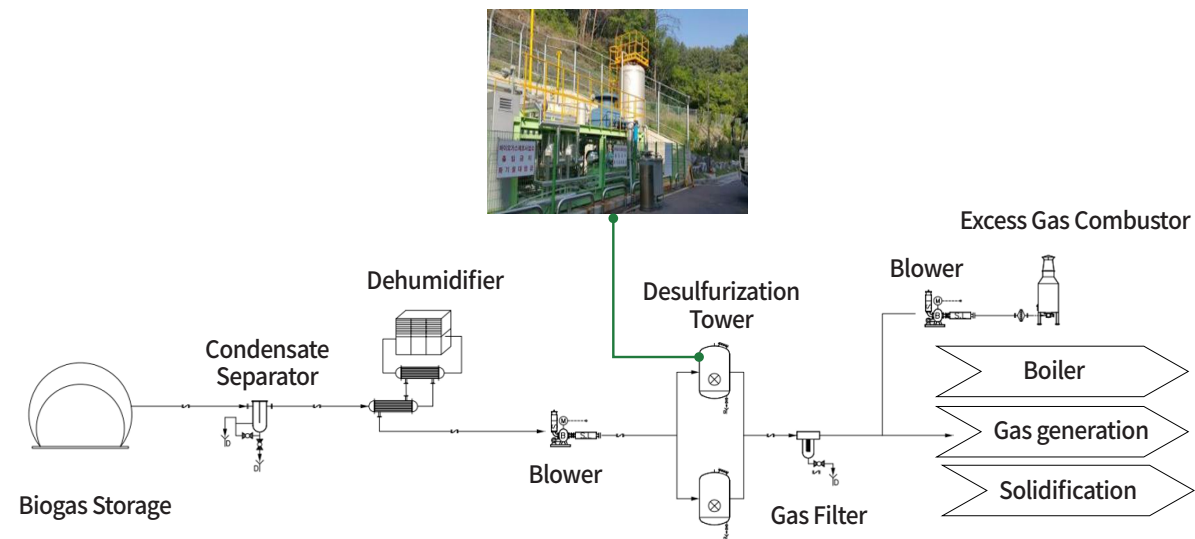
- Hydrogen sulfide is an air pollutant that causes toxicity and odor.
- It mainly occurs in the process of anaerobic decomposition and desulfurization of petrochemical plant.
- The sulfur compounds(H₂S, SO₂ etc.) contained in biogas exist in trace amounts, which generate the corrosion and odor-causing substances in the device
- When people inhale the hydrogen sulfide released into the atmosphere, it causes central nerve paralysis or suffocation

• Hydrogen sulfide (H₂S) removal process



Hydrogen sulfide removal process by using the iron hydroxide (Fe(OH)₃)

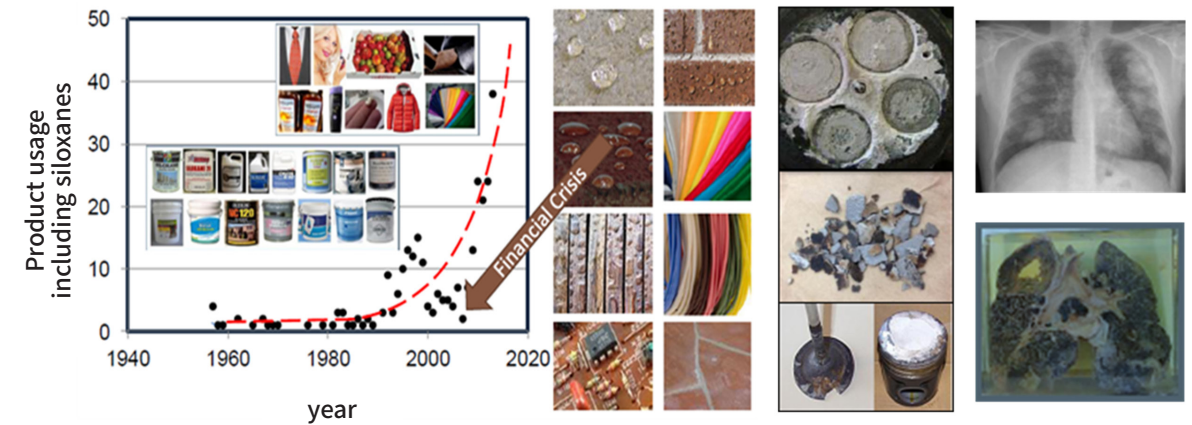
• Schematic diagram of hydrogen sulfide (H₂S) removal plant



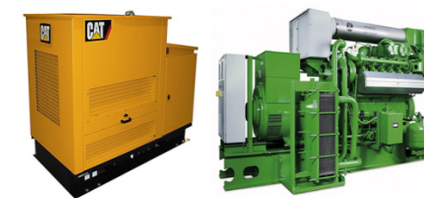
◆ Siloxanes Removal System

• The necessity of siloxanes removal in biogas

- A siloxanes generation increases according to landfill of waste chemical products increases
- Attachment of silicate to gas turbine, boilers, etc. leads to the increase in facility maintenance costs.
- The siloxanes are one of the fine dust-causing substance
- When inhaling the siloxane, it is harmful to human health



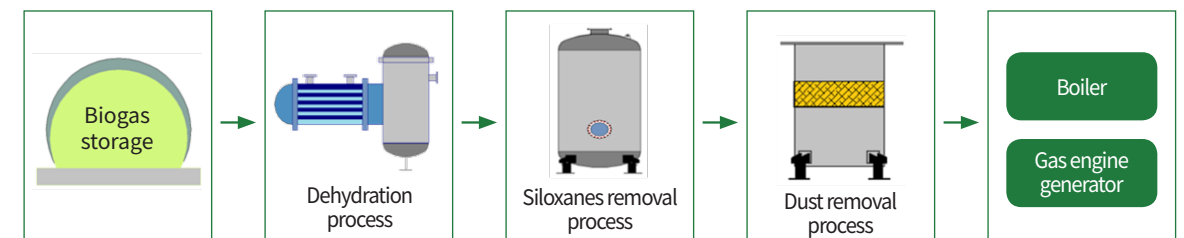
• Siloxanes removal effects (Generator parts life extension)



Biogas Generator

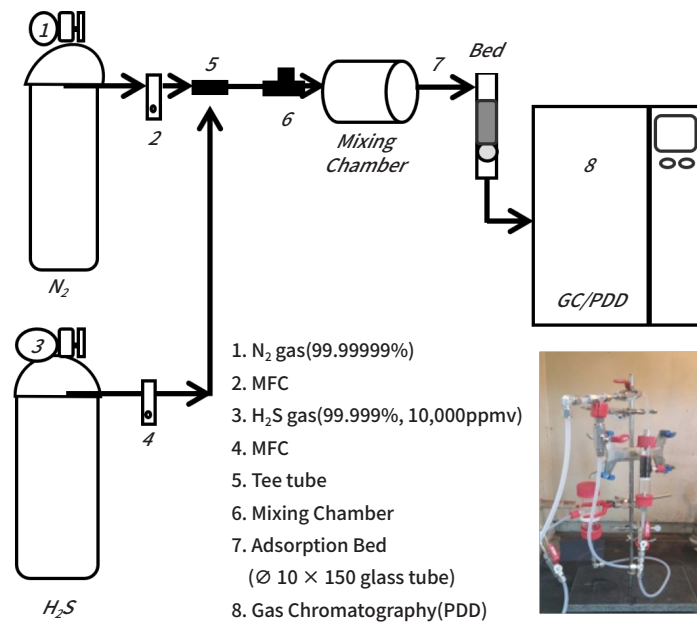
- Spark plug → 4 to 5 times longer lifetime of parts
- Engine reassemble → Extension of operation from 6,000 to 30,000 hrs
- Boiler pipe replacement → Increase in pipe lifetime by 300% to 400%
- SCR catalyst bed → Catalyst replacement cost savings by \$10,000 to \$1,000,000
- Power reduction → From 75% to 98%
- Oil exchange → Extension of exchange period from 500 to 2,500 hours

• Schematic diagram of siloxanes removal process

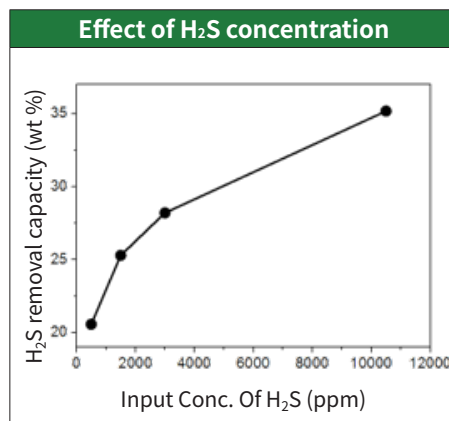
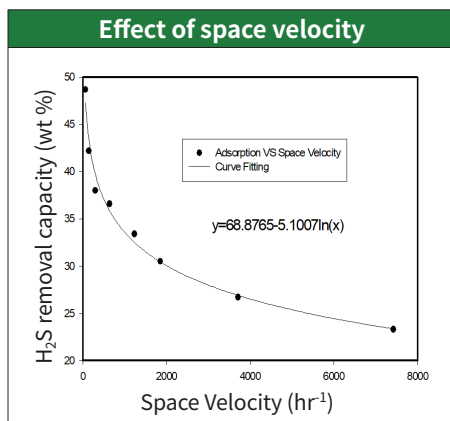
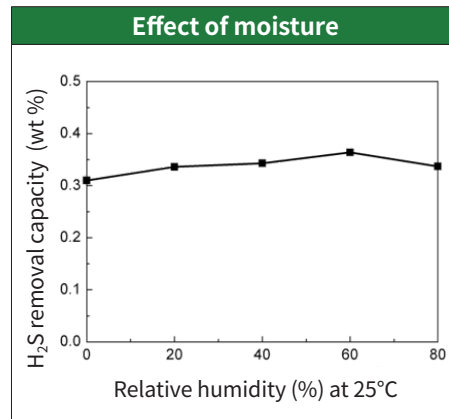


◆ Hydrogen sulfide (H₂S) removal capacity test

Item	Unit	DeHyS-200	DeHyS-250	Remarks
H ₂ S removal capacity	wt%	Above 25	Above 30	Breakthrough Curve



DeHyS-250
 Bed Volume(ml) = 3.88
 Concentration(ppm) = 10,300
 Retention Time(sec) = 2.9
 Space velocity(hr⁻¹) = 1,235
 Breakthrough point = 5%



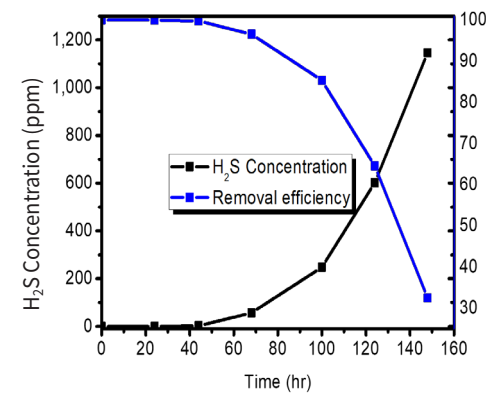
◆ Biogas Pretreatment Process Field Test : Result I

Busan Environmental Corp.

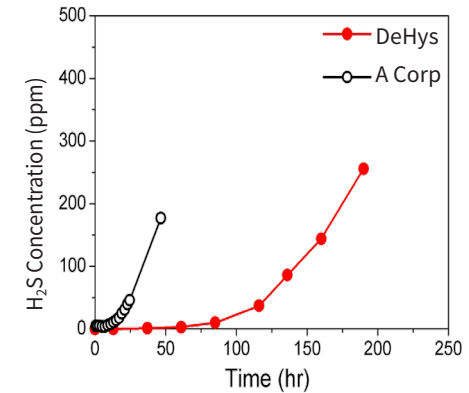
- Sewage treatment capacity : 550,000 m³ / day
- Sewage sludge and food waste : 1,300 ~ 1,400 tons/day
- Biogas generation : 23,000 m³ / day
- Hydrogen sulfide (H₂S): 1,000 ~ 3,000 ppm
- Siloxanes : about 55 mg/m³



(L) Dry-type desulfurization device
(R) Pilot-Plant



H₂S effluent concentration & removal rate (Space velocity = 600hr⁻¹)



A comparison of breakthrough curves between DeHyS and A's product (Space velocity = 600hr⁻¹)

<Before use>



Top

<After use>



Bottom

- Applications of biogas : City gas
- Process gas concentration : H₂S (1 ppm or less), Siloxanes (1 mg/m³ or less)
- Sample location : The input and output testbed
- Field test conditions : 0.48 m³ /hr, average H₂S concentration (1,649 ppm), operating hours (136 hr)
- H₂S removal capacity : 28.67 wt%(space velocity 600 hr⁻¹ condition), A's product = 3.8 wt%
- Siloxanes removal capacity : Incoming concentration 81 mg/m³, and removal rate 100% (after 120 hours)

◆ Biogas Pretreatment Process Field Test : Result II

Gwangju 1st WWP

- Sewage treatment capacity : 600,000 m³/day
- Sewage sludge and food waste : 300 ~ 400 ton/day
- Biogas generation : 30,000m³/day
- Hydrogen sulfide(H₂S) : about 2,500 ppm
- Siloxanes : about 60mg/m³



• Competitive Performance Comparison



Before use
(L) DeHyS
(R) Competitor A

After use
(L) DeHyS
(R) Competitor A

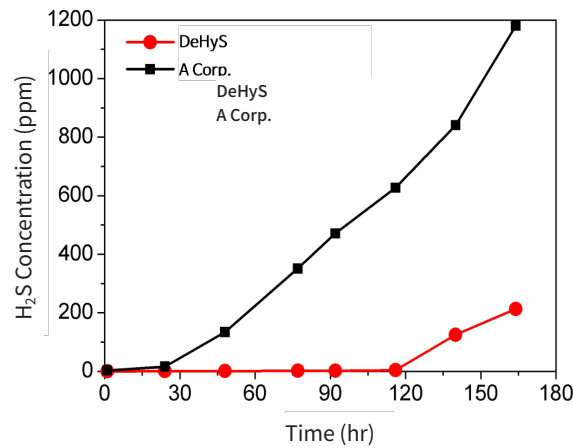


Fig. Comparison of DeHyS and A's product

- Applications of biogas : Boiler operation
- Process gas concentration: H₂S (1 ppm or less), Siloxanes (1 mg/ m³ or less)
- Sample location : The input and output testbed
- Field test conditions : 0.18 m³/hr, average H₂S concentration (2,355 ppm), operating hours(138 hr)
- H₂S removal capacity : 21.6 wt% (vs A's Product = 6.9 wt%)
- Siloxanes removal capacity : Incoming concentration 63 mg/m³, and removal rate 100%

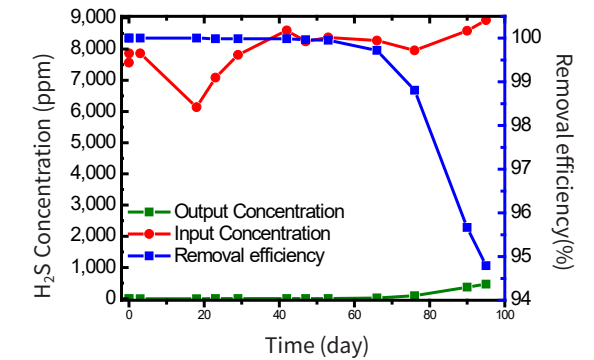
◆ Biogas Pretreatment Process Field Test : Result III

Incheon Environmental Corp. Seunggi branch

- Sewage treatment capacity : 275,000 m³/day
- Biogas generation : 8,000m³/day
- Hydrogen sulfide (H₂S): 5,000 ppm
- Siloxanes : about 50 mg/m³



Input Testing Bottom



Removal rate according to H₂S input/output

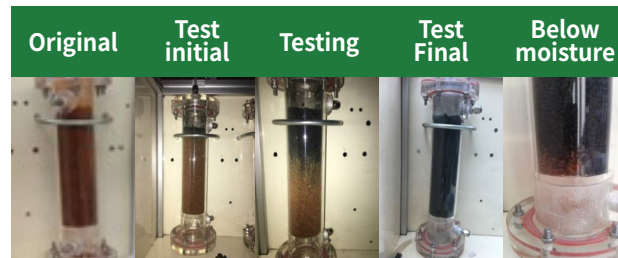
- Applications of biogas : Manufacture of ultra-low sulfur components(0.5 ppm or less) for fuel cells(SOFC)
- Process gas concentration : less than 0.5 ppm in H₂S, not detected in siloxanes (confirmation of stable processing performance)
- Sample location : The input and output testbed
- Field test conditions : 3 m³ /hr, average H₂S concentration (4,722 ppm), operating hours (1,032 hr)
- H₂S removal capacity : 26 wt% or over
- Siloxanes removal capacity : about 5 wt% (space velocity 375 hr⁻¹)
- ※ H₂S and siloxanes removal rate : 99.99% or over (official test report attachment)

◆ Biogas Pretreatment Process Field Test : Result IV

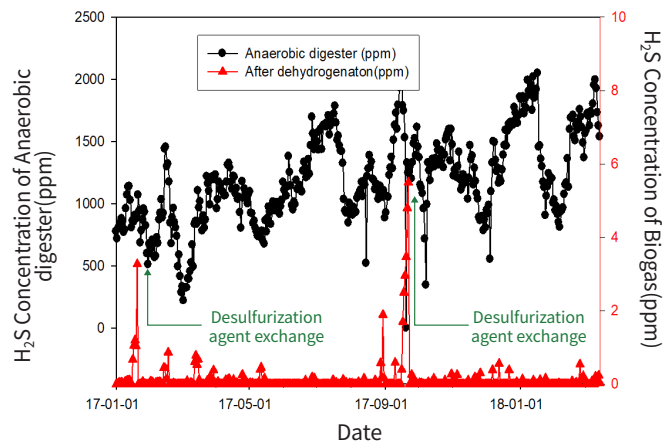


Hongcheon Eco-friendly Energy Town

- Sewage treatment capacity : 100m³/day
- Biogas generation : 3,600m³/day
- Hydrogen sulfide(H₂S): about 1,500 ppm
- Siloxanes : about 5 mg/m³



· Hongcheon Biogas Field Test Picture & Graph

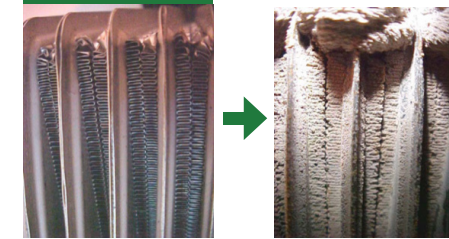


- Sample cycle : 0.5 hr or 1 hr
- Sample location : Moisture removal tower at the rear of the digestive
- Biogas flow method : down-stream

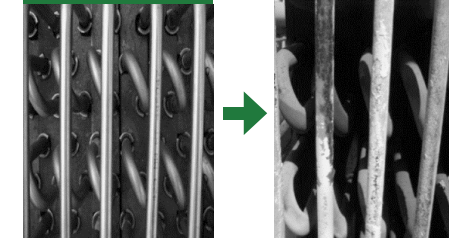
- Applications of biogas : City gas production (less than H₂S 5ppm)
- Sample cycle : twice a day (average value application)
- Sample location : The front and rear end of the desulfurization tower
- Analysis method : Desulfurization tower - Portable hydrogen sulfide analyzer (Bio 5000), Rear end of desulfurization tower - NDIR(Automatic analysis)
- Operation result : 3,600 m³/day, average H₂S concentration (about 1,500ppm), usage period(8 months), March 2016 ~ currently in supply
- when breakthroughing, removal capacity : 33wt%
 - Simultaneous removal of siloxanes

◆ Siloxanes Removal Property (Lab Test)

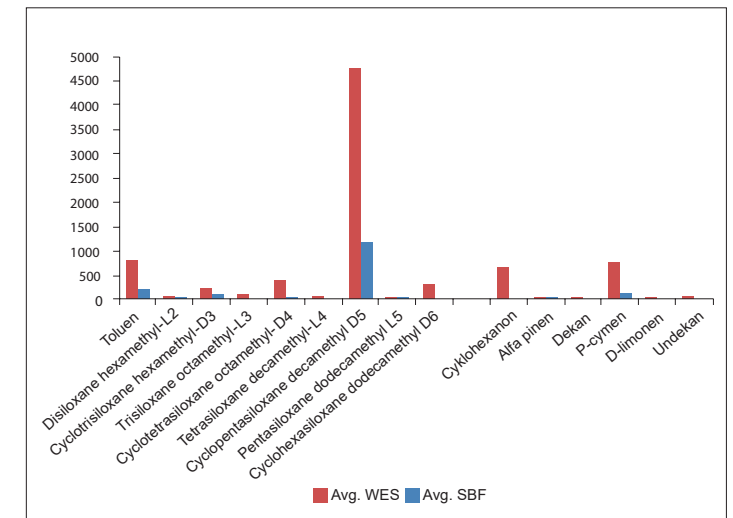
Gas turbine



Boiler



Siloxanes removal rate (Sweden SBF analysis results)



◆ Lab Test Results

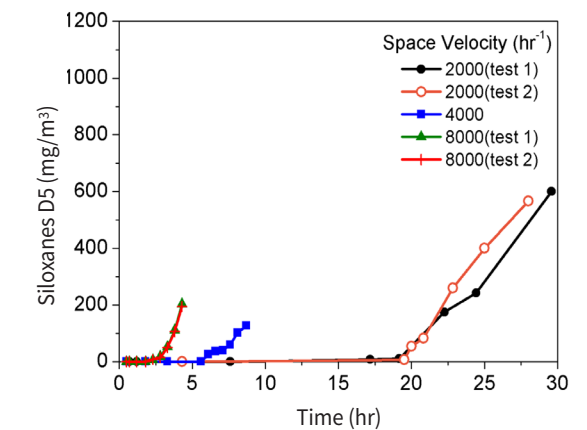
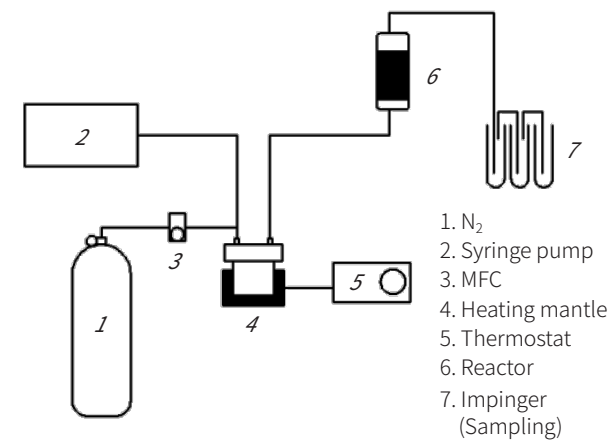
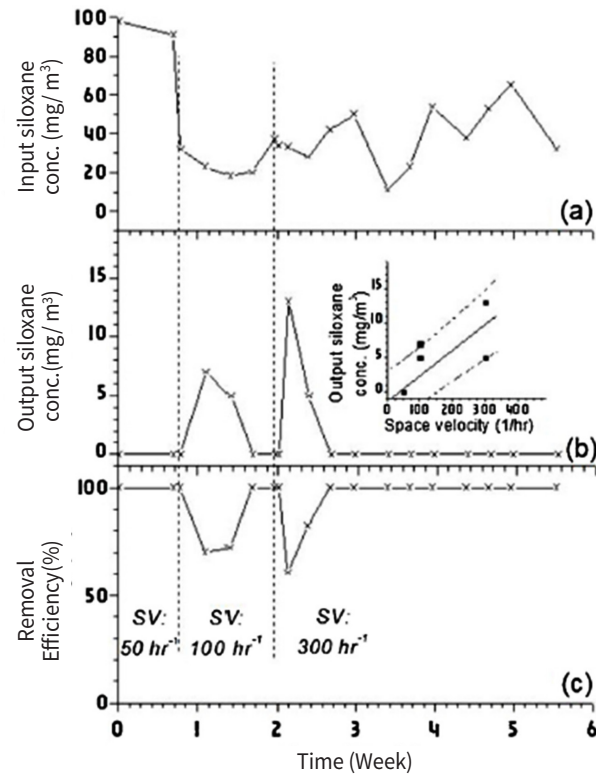


Fig. Siloxanes breakthrough curve according to space velocity

- Sample cycle : 30 min
- Sample location : Reactor rear end
- Sample method : Methanol absorption method (flow rate 300ml/min, collection time : 30min)
- N₂(carrier gas) : 300 ml/min, average siloxanes concentration : 2,063 mg/m³
- Average breakthrough removal capacity : 12.73 wt%

◆ Siloxanes Removal Property(Field Test Application)

· Seoul/Tancheon Water Regeneration Center delivery & field experiment



Reference : Chemical Engineering Research and Design 163 (2020) 149-156

- Applications of biogas : Electrical power generation (siloxanes 1mg/m³ or less)
- Sample location : The input and output testbed
- Sample method : Methanol absorption method (flow rate 300ml/min, collection time 30min)
- Operation result : 3 L/min, average siloxanes concentration (41 mg/m³), operation time (986 hr)
- when breakthroughing, removal capacity : Total 4.8 g adsorption → 1.1 wt% absorption
 - when the flow rate was changed, the siloxane was leaked but finally stabilized after 3-4 days

◆ Major Construction & Delivery of Products

Division	Place	Technology	Volume (m ³ /day)	Buyer	Remarks
Digestion Gas	Hongcheon/ Eco-friendly energy town	Dry desulfurization method (DeHyS-250)	3,600	Hongcheon/ Kangwoncitygas	March 2016 ~ in delivery
Digestion Gas	Chungju/Food Bio-energy center	Dry desulfurization method (DeHyS-250)	8,000	Chungju/ Seojinenerge	January 2018 ~ in delivery
Digestion Gas	Seoul/ Tancheon Water Regeneration Center	Dry desulfurization method (DeHyS-250)	40,000	Seoul water regeneration facility Corp.	September 2019 (construction & delivery)
LFG	Incheon Metropolitan Area Landfill MAGA Corp.	Dry desulfurization method (DeHyS-250)	86,400	Metropolitan Area Landfill MAGA Corp.	August 2020 (construction & delivery)
	Step 2. sludge drying facility				
	Step 3. sludge drying facility		187,200		
Digestion Gas	Iksan/sewage treatment plant	Dry desulfurization method (DeHyS-250)	13,000	Iksan/Environment management Corp.	December 2021 (construction & delivery)
Digestion Gas	Cheongyang/Chilseong Energy	Dry desulfurization method (DeHyS-250)	12,000	Korea Environment Corporation / Chilsung energy farming corp.	December 2020 (construction & delivery)
	Tsingyang/Yeoyang Farm		3,600		
Digestion Gas	Changwon/ Foodwaste Water Bio-energy facility	Dry desulfurization method (DeHyS-250)	16,560	Korea Environment Corp.	December 2021 (construction & delivery)
Digestion Gas	Eumseong/ livestock manure biogasification facility	Dry desulfurization method (DeHyS-250)	5,760	Korea Environment Corp.	under construction



Eco-friendly energy town (Hongcheon)



Food Bio-energy center (Chungju)



Tancheon water regeneration center (Seoul)



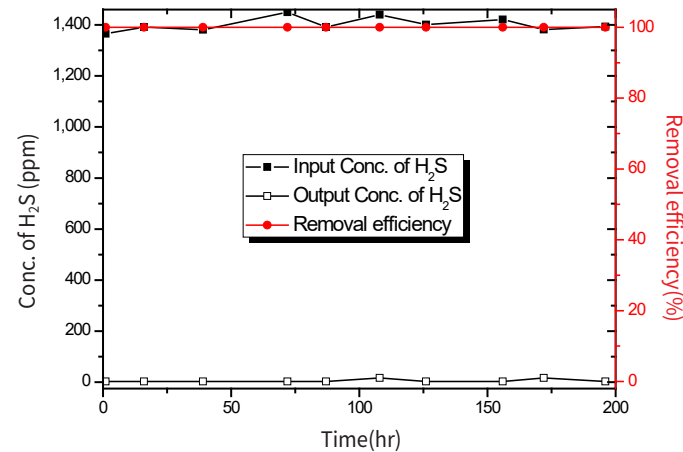
Metropolitan Area Landfill Management Corp. (Incheon)

◆ Biogas Pretreatment Facility Construction (Seoul/Tancheon)



Seoul Water Regeneration Center

- Sewage treatment capacity : 950,000 m³/day
- Biogas generation : 40,000m³/day
- Hydrogen sulfide (H₂S) : about 2,000 ppm
- Siloxanes : about 150 mg/m³



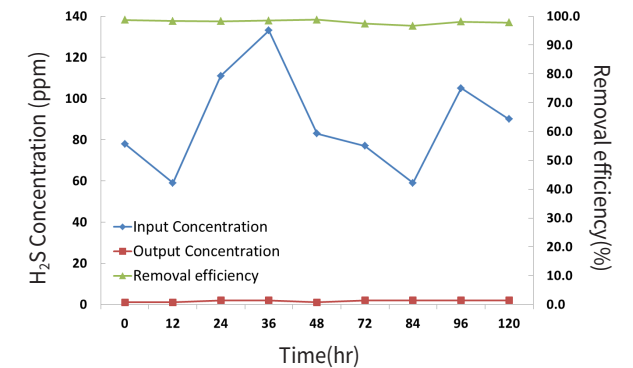
- Applications of biogas : Production of biogas for power generation and boiler
- Hydrogen sulfide process gas concentration : 1ppm or less in H₂S (99.5% or more removal rate)
- Siloxane removal rate : 95% or more (Standard : D5)
- Sample position : the rear end of the adsorption tower of the pilot plant, and the rear end of the dehumidification tower
- Construction started in September 2019, Completed on 5 December 2019 and is currently in operation

◆ Biogas Treatment Facility Construction (Incheon)



SUDOKWON Landfill Site MGMT Corp.

- Landfill gas(2nd stage) : 86,400 m³/day
- Landfill gas(3rd stage): 187,200 m³/day
- Hydrogen sulfide (H₂S) : about 500 ppm
- Siloxane : about 25 mg/m³



- Applications of biogas : sludge drying
- Hydrogen sulfide process gas concentration : H₂S 1ppm or less (99.5% or more in removal rate)
- Siloxane removal rate : [standard : D5 over 95%][front(9.47) / rear (0.05)]* mg/m³
- Sample location : the front of the dehumidifier and the rear of the dehumidifier
- Construction started in July 2020, Completed on 31 August 2019 and is currently in operation
- * Certificate KTL

◆ Patent Status

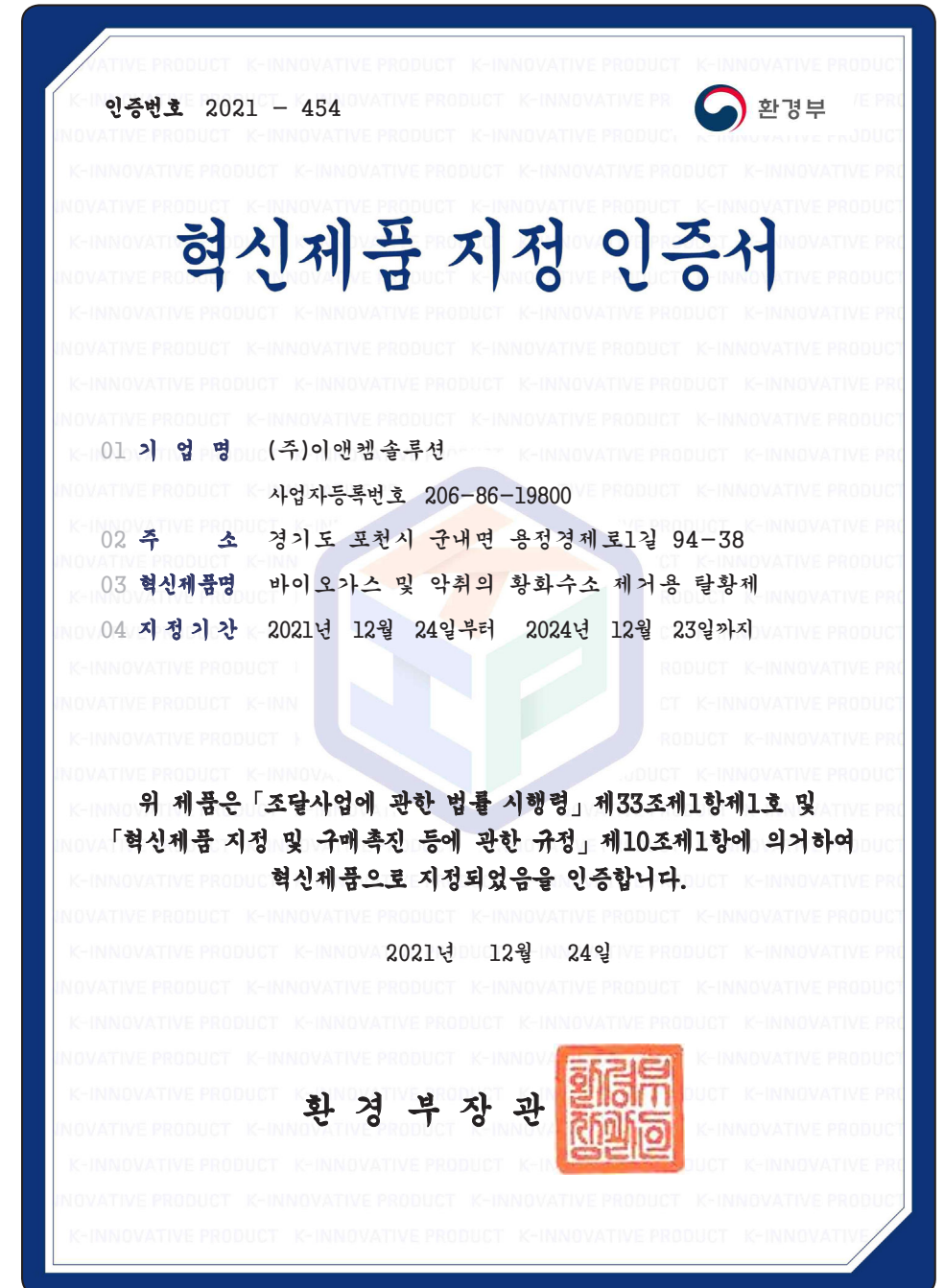
No.	App/Reg Number	Patent name	Reg date (YMD)	Re marks
23	10-2022-0012058	Catalyst for hydrogen sulfide removal using oxidation/reduction reaction and hydrogen sulfide removal method	22.01.27	App
22	10-2300634	High efficiency treatment system of hazardous gas using two-stage heat exchangers	21.09.03	Reg
21	10-2021-0140229	Continuous separation system for carbon dioxide	21.10.20	App
20	10-2021-0117701	Biogas treatment equipment using iron hydroxide powder	21.09.03	App
19	10-2021-0067780	Organic waste treatment method and treatment system using amorphous iron hydroxide	21.05.26	App
18	10-2021-0002740	Biogas treatment equipment of detachable dry scrubber type	21.01.08	App
17	10-2020-0065805	Method for manufacturing arsenic adsorbent using iron-containing mine drainage	20.06.01	App
16	10-2020-0065804	Manufacturing method of amorphous iron sulfide catalyst for heterogeneous Fenton oxidation reaction	20.06.01	App
15	10-2270488	Biogas adsorption equipment	21.06.23	Reg
14	10-2367558	Ultra-low concentration hydrogen sulfide-containing clean biogas production system	22.02.22	Reg
13	10-2196559	Clean biogas production system containing ultra-low concentration hydrogen sulfide	20.12.22	Reg
12	10-1875682	All-in-one dry adsorption system	18.07.02	Reg
11	10-1974594	Manufacturing method of inorganic adsorbent for phosphorus removal using acid mine drainage sludge	19.04.25	Reg
10	10-1822411	Method for manufacturing an adsorbent for removing sulfur compounds using acid mine drainage sludge	18.01.22	Reg
9	10-1932634	TCE removal system	18.12.19	Reg
8	10-1754953	Adsorbents for removing hydrogen sulfide and siloxane and their preparation methods	17.06.30	Reg
7	10-1684296	Ammonia continuous recovery system using sequential method	16.12.02	Reg
6	10-1653382	Manufacturing method of complex adsorbent for ammonia removal	16.08.26	Reg
5	10-1616059	Adsorbents for simultaneous removal of hydrogen sulfide and siloxane	16.04.21	Reg
4	10-1549566	Manufacturing method of activated carbon fiber sheet using scrap carbon fiber	15.08.27	Reg
3	10-1532350	High-purity synthetic gas generator	15.06.23	Reg
2	10-1197486	Slurry drying apparatus	12.10.30	Reg
1	10-0528672	Method of manufacturing ZSM-5 using variable temperature under organic template exclusion	05.11.08	Reg

◆ Trademark Registration status

No.	App/Reg Number	Design	Reg date	Re-marks	No.	App/Reg Number	Design	Reg date	Re-marks
10	4020210161336	CATALITE	21.08.05	App	5	401274794	DeHySil	17.08.07	Reg
9	4020210003874	DSULFER	20.01.08	App	4	401274793	Basorb	17.08.07	Reg
8	4020200209226	COMPLOX	20.11.19	App	3	401274792	Acisorb	17.08.07	Reg
7	4020200209225	MIRESORB	20.11.19	App	2	401191946	DeHyS	16.07.22	Reg
6	401360698	DeSiloxs	18.05.17	Reg	1	401191945	디하이스	16.07.22	Reg

◆ Innovative Product Perform Certification

: Desulfurization agent for removing hydrogen sulfide from biogas and odor



◆ Performance Certification
: Adsorbents for simultaneous removal of hydrogen sulfide and siloxane

22-CII0227

성능인증서

- 제조업체명 : (주)이앤켐솔루션
- 대표자성명 : 김신동
- 소재지 : 경기도 포천시 군내면 용정경제로1길 94-38
- 수검공장 : 경기도 포천시 군내면 용정경제로1길 94-38
- 인증품목 : 바이오가스로부터 황화수소 및 실록산 제거용 흡착제 [디하이스(DeHys)-200, 디하이스(DeHys)-250]
- 성능검사 규격기준 : 회사제시 규격
- 인증유효기간 : 2022. 03. 13. ~ 2025. 03. 12.
- 인증품목의 용도 : 공공기관 납품용

성능인증

「중소기업제품 구매촉진 및 판로지원에 관한 법률」 제15조 및 같은 법 시행규칙 제11조4항에 따라 위와 같이 성능인증을 합니다.

2022년 05월 09일

중소벤처기업부장관인

◆ Certified Test Report (Hydrogen sulfide removal rate : 100%)

시험성적서 (TEST REPORT)

klt 한국산업기술시험원
Korea Testing Laboratory

시험서 번호 : 22-000671-01-1
Report No.
페이지 (1) / (총 2)
Page of Pages

1. 의뢰자 (Client)
기관명 (Name) : (주)이앤켐솔루션
주소 (Address) : 경기도 포천시 군내면 용정경제로1길 94-38
의뢰일자 (Date of Receipt) : 2022. 01. 05.

2. 시험성적서의 용도 (Use of Report) : 품질관리용

3. 시험대상품목/시험/시험명 (Test Sample)
제품명 (Description) : 바이오가스
제조회사 (Manufacturer) : * * *
모델명 (Model Name) : * * *
제조번호 (Serial Number) : * * *
기타 (Remark) : 시료채취일 (1/5)

4. 시험기간 (Date of Test) : 2022년 01월 05일 ~ 2022년 01월 06일

5. 시험장소 (Location of Test)
■ KTL 고정시험실 (주소 : 서울특별시 구로구 디지털로26길 87 (구로동))
□ 현장시험

6. 시험규격/방법 (Test Standard/Method) : KS I ISO 19739

7. 시험결과 (Test Results) : 일부 시험결과 참조
비고 (Note) : 1. 이 성적서는 의뢰자가 제출한 시료에 한하여, 법의 및 기타법령의 근거 등으로의 사용을 금합니다.
2. 이 성적서는 원본의 유효성이, 원본과 대조본의 사본 및 전자인쇄본 등은 유효하지 않습니다.
(본문에서 KTL이 붙은 글씨에 대해 고객상담 문의는 02-860-1664로 문의하십시오.)
3. 이 성적서의 인쇄를 스킴하여 성적서의 유효성을 확인하십시오. KTL 로고, 유효기간의 동일성을 고객 상담을 통해 klt.com/customer-klt.com의 '인쇄' 항목 확인을 반드시 요구하십시오.
4. 본 성적서는 전자서명(KS/KR 1700) 혹은 봉인(KS/KR 1700)의 유효성을 확인하십시오.

확인
Affirmation
성명 (Name) : 김영민

기술책임자 (Technical Manager)
성명 (Name) : 임은주

2022. 01. 07.

한국산업기술시험원

서울특별시 구로구 디지털로26길 87 (구로동) 87, Digital-ro 26-gil, Guro-gu, Seoul, KOREA | Tel: 02-860-1664 Fax: 02-860-1699

FP104-05-00

* 위 마크는 후부 전자확인용 대조 프로그램에서 원본대조시 사용되는 코드입니다.

klt 한국산업기술시험원
Korea Testing Laboratory

시험서 번호 : 22-000671-01-1
Report No.
페이지 (2) / (총 2)
Page of Pages

시험결과 (Test Results)

항목	시험명	총원 탈황량 input	총원 탈황량 output	단위 (분자명법)
황화수소		851.67	0.00	μmol/mol (ppm) (GC/PPFD)

1. 시료채취장소 : 상원도 홍원군 북방면 소재곡길 12
홍원천환경에너지타운

2. 시료채취일 : 2022년 01월 05일

<시료채취>

FP104-06-00

* 위 마크는 후부 전자확인용 대조 프로그램에서 원본대조시 사용되는 코드입니다.

◆ Certified Test Report (Hydrogen sulfide removal capacity : 41.76 wt%)

◆ Certified of New Excellent Technology : NET

시험 성적서 (TEST REPORT)

ktl 한국산업기술시험원 Korea Testing Laboratory

신고서 번호 : 16-067456-01-1
Report No.
페이지 (1) / (총 5)
Page of Pages

1. 의뢰자 (Client)
기관명 (Name) : (주)이엔켐솔루션
주소 (Address) : 경기도 포천시 가산면 가산로194번길 47-36
의뢰일자 (Date of Receipt) : 2016. 11. 16.

2. 시험성적서의 용도 (Use of Report) : 품질관리용

3. 시험대상품목/물질/시료명 (Test Sample)
제품명 (Description) : 황화수소 흡착용 및 과과시험
제조사 (Manufacturer) : (주)이엔켐솔루션
모델명 (Model Name) : 수산화철계 흡착제
제조번호 (Serial Number) : * * *
기타 (Remark) : * * *

4. 시험일자 (Date of Test) : 2016년 11월 29일 ~ 2016년 12월 05일

5. 시험규격/방법 (Test Standard/Method) : 후면 시험방법 참조

6. 시험환경 (Testing Environment)
온도 (Temperature) : (20.0 ± 5.0) °C 습도 (Humidity) : (50 ± 20) % R.H.

7. 시험결과 (Test Results) : 별첨결과 참조 (Refer to the attached results)

비고 (Note) : 1. 이 성적서는 의뢰자가 제공한 시료에 대한 시험결과이며, 이 시험결과는 의뢰자만이 인정합니다. (The test results are valid only for the test samples supplied by the client. Our clients' results are not valid for other clients' samples without approval of the KTL in advance.)

확인 (Affirmation)
의뢰자 (Name): 홍길환
기술책임자 (Name): 김경철

2016. 12. 06.

한국산업기술시험원

서울특별시 구로구 디지털로26길 87 8F, Digital-ro 26-gil, Guro-gu, Seoul, KOREA | T: 02-660-1696 Fax: 02-660-1699
FP204-01-03

시험 결과 (Test Results)

ktl 한국산업기술시험원 Korea Testing Laboratory

신고서 번호 : 16-067456-01-1
Report No.
페이지 (2) / (총 5)
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□ 시험 결과 요약

시험항목	시험기준	시험결과
과과점에서의 흡착율	- 황화수소 과과시험을 통하여 과과점까지의 흡착량(g)을 측정하여 시험에 사용된 흡착제량(g)으로 나누어 흡착율(wt%)로 환산한다.	과과점에서의 흡착율 : 41.76 wt% (%g/g)

1. 시험개요
- 시험목적 : (주)이엔켐솔루션에서 제작한 수산화철계 흡착제를 황화수소 과과시험을 통해 과과흡착율을 확인함.
- 시험항목 : 황화수소(H₂S) 19.9 %mol/mol 가스를 이용한 과과점흡착율
- 시험장치 : 수산화철계 흡착제, GC/PDDDS Science, DS7200
MFC Controller 4CH (KRO-4001), MFC 1% H₂S 500 ccm, N₂ 100 ccm (KOFLOC 3660model), 저용(AND, HR-200), 황화수소(H₂S) 19.9 %mol/mol 표준가스(유니온 가스), 시험조건(온도 : 15-25 °C, 습도 : 30-70 %R.H.)

2. 시험방법
19.9 %mol/mol H₂S 가스와 N₂ 가스를 MFC를 이용하여 0.100, 10.400, 10.200, 10.150, 10.100 비율로 GC/PDD에 주입하여 분석 후, 정량분석을 통해 검량선을 구한다.
과과시험을 하기 위해 반응기에 시브를 위치하고 흡착제(수산화철계)를 2.2572 g을 투입한다. 반응기에 19.9 %mol/mol 황화수소 가스를 14.4 ml/min으로, 질소가스를 15 ml/min으로 일정하게 흘리면서 배출되는 가스를 GC/PDD를 통하여 실시간 분석한다.(분석주기:5 분(분석시간 4 분, 안정화시간 1 분), Sample loop volume: 0.5 ml). GC분석을 통하여 얻은 면적 값을 검량식에 대입하여 배출된 황화수소 가스 농도를 구하고 시간에 따른 배출가스 농도변화를 도식화한다. 과과 점에 다다를 때까지의 흡착된 황화수소의 양을 구하여 해당조건에서의 과과 점까지의 흡착율을 구한다.
- Tubular type adsorption bed 규격
직경 : 1 cm, 흡착제층두께 : 6 cm, 흡착제층 부피 : 4.71 cm³

FP204-02-02

제607호

신기술인증서

1. 기술명: 바이오가스내 황화수소 제거를 위한 산성광산배수 슬러지 재활용 탈황제 제조 및 적용 기술

2. 기술 보유자
가. 성명(법인명): ㈜이엔켐솔루션 / 한국광해광업공단
나. 생년월일(법인등록번호): 110111-3772690 / 141271-0009059
다. 주소(법인인 경우 소재지): 경기도 포천시 군내면 용정경제로1길 94-38 / 강원도 원주시 혁신로 199

3. 기술 개요
* 철성분을 다량 함유하고 있는 폐탄광 산성광산배수로부터 무기성 슬러지가 폐기물로 처분되고 있어, 이 폐기물을 재활용하여 비결정성 수산화철계 탈황제를 제조하고, 이를 적용하여 바이오가스 내에 포함된 황화수소를 제거하는 기술

4. 신기술 범위
* 산성광산배수슬러지로부터 비결정성 수산화철계 탈황제를 제조, 생산하는 폐기물 재활용 기술
* 탈황제를 적용하여 바이오가스 내 황화수소를 제거하는 기술

5. 유효기간 : 발급일로부터 8년('22.04.28. ~ '30.04.27.)

6. 기 타
* 환경신기술은 유효기간 내에서만 인정됩니다. 유효기간 연장이 필요한 경우는 기간 만료일 120일 전까지 유효기간 연장신청서를 제출하시기 바랍니다.

「환경기술 및 환경산업 지원법」 제7조, 같은 법 시행령 제18조의5제1항 및 같은 법 시행규칙 제6조제3항에 따라 위의 기술을 환경 분야 신기술로 인증합니다.

2022년 04월 28일

환경부장관



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