



PURE AIR SOLUTIONS

SULPHUS



Biological treatment of waste water odours

Sulphus 03.06.2014/06



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The SULPHUS: cheaper, greener, smarter and simple!

Dear reader,

Pure Air Solutions is the world's leading Odour and VOC control specialist. Our customer focus, industrial know-how and technological leadership has put us at the forefront of the industry. This trend will continue over the coming decades, as Pure Air Solutions further develops innovation solutions to improve the economic efficiency and environmental performance of air pollution control systems. Subsequently we have twice been awarded, in 2011 and in 2013, by the European Union with the most prestigious Marie Curie (FP7) grant for Research & Technological Development.

One of the flagships from our current product range is the SULPHUS technology, a compact bio-trickling filter designed to eliminate organic and inorganic odours from waste water treatment processes. The principle of its design is based on the requirements of the market. In 2009 we asked people around the globe, active in waste water treatment, what they wanted when it comes to the future of odour control. Their answer was clear: cheaper, greener, smarter and less stress!

Although the clothespin might match those requirements, Pure Air Solutions believes that the industry as a whole must advance solutions that will meet today's and tomorrow's demands of the market and society. Through innovation and out-of-the-box thinking we made it possible to achieve that in one single biological system, the SULPHUS. It's expectations are to improve to the global needs of a better environment and more sustainable world: no waste of money, no waste of time and no waste of energy and consumables.

We will prove that the purification results of the SULPHUS are at least equally or as good as lava filters, chemical scrubbers, activated carbon, thermal oxidizers and other conventional technologies. Due to its unique design the SULPHUS can treat H₂S and other (in)organic odours in one single reactor. And where its high level of standardisation already ensures low investment cost, the cost to operate and maintain the SULPHUS is extremely low:

- Forward-thinking materials enables lighter design, hence reduced civil engineering cost.
- The pressure drop generally is exceptionally low (<200 Pascal), resulting in reduced energy use.
- Intermittent spraying and typically using final effluent, ensures low water consumption.
- GRP vessels and synthetic packing media, provides at least a 25 year design life and no replacement cost.
- Uncomplicated control philosophy, thus minimal operation and maintenance work.

It is with great pleasure to present and outline the benefits of the SULPHUS to you in this product brochure.

We particularly bring to your attention the section within our brochure where we have provided sufficient information to enable you to select and configure your system based on your own data, emission and performance requirements, simplicity in itself. Once the correct system is selected, you can easily determine your anticipated water and energy consumption.

Cost-effective finally has a meaning!

André Schoonhoven
CEO of Pure Air Solutions



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WHEN THE NUMBERS COUNT

AVOID NUISANCE AND COMPLAINTS

In most situations action is required to capture and then eliminate the organic and inorganic odours from wastewater process air streams. Headworks, sludge treatment and pumping stations are examples of sources where waste water odours usually are recognized. Typically waste water odours are related to Hydrogen Sulphide (H₂S), which gives the smell of rotten eggs. Also Mercaptans and other organic compounds (VOC's) are often produced. This results in complaints from communities in the surrounding area and can lead to negative publicity and media attention.

COST-EFFECTIVE FINALLY HAS A MEANING

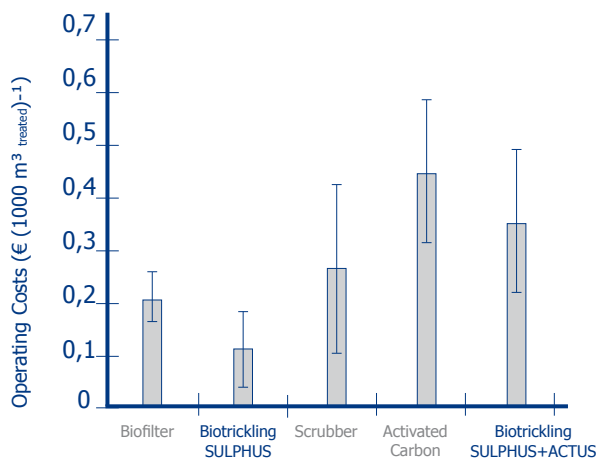
With the SULPHUS Pure Air Solutions has a biological solution that is extremely cost effective when it comes to odour treatment. While being cost-effective no concessions are made on quality, reliability and performance.

The SULPHUS is a compact biotrickling filter that can eliminate H₂S with 99% and other odours with 95% removal efficiencies. This extreme high performance is achieved without the use of expensive chemicals or large amounts of costly carbon.

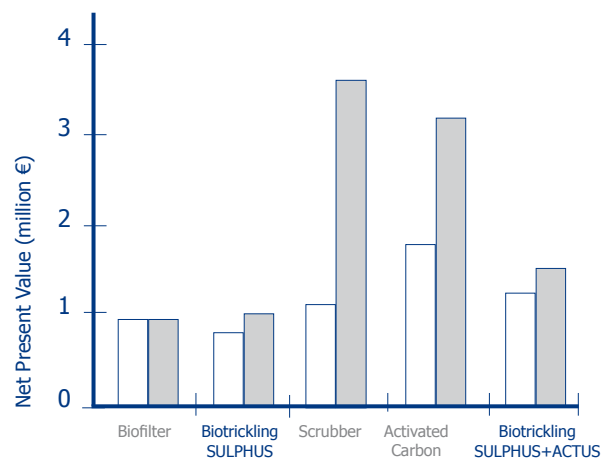
The Sulphus is fully corrosion resistance and has an original fully synthetic packing which will last for >10 years. The SULPHUS reactor vessel is fabricated in a GRP and factory assembled for fast and easy (Plug & Play) installation. The winded media of the SULPHUS, so-called OdourPacks, is made from durable, synthetic materials which are light in weight, therefore the cost for civil works and foundations are significantly reduced.

By adopting a lean and mean engineering approach the SULPHUS requires minimum attention, control and maintenance during operation. For effective and consistent removal of waste water odours the SULPHUS needs the smallest amount of water and power. Subsequently the cost to operate the system is low.

The graphics below show the operating costs and Nett Present Value (NPV) of the SULPHUS in comparison to other technologies.

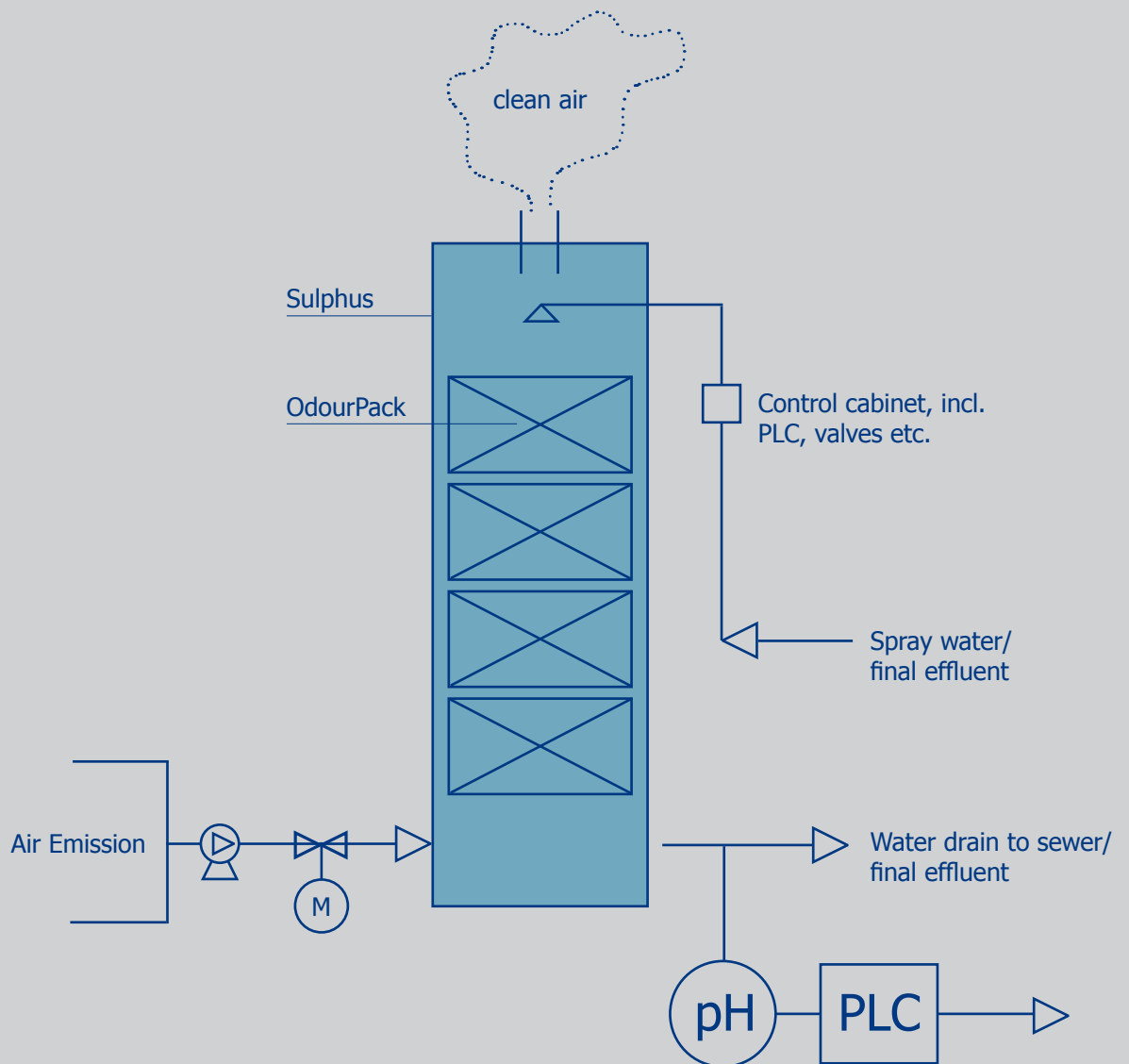


Graphs taken from: Estrada Jose et al. (2011); A Comparative Analysis of Odour Treatment Technologies in Wastewater Treatment Plants. Environmental Science & Technology, 45 (3) 1100–1106



Based on: The Net Present Value (NPV) evaluated for a 5000 m³/h odorous emission containing 20,9 mg H₂S/m³ (white bars) and 105 mg H₂S/m³ (gray bars), a design useful life of 20 years, and an interest rate of 5% (Estrada, et al., 2011).

Proces flow diagram Sulphus



WHEN THE NUMBERS COUNT

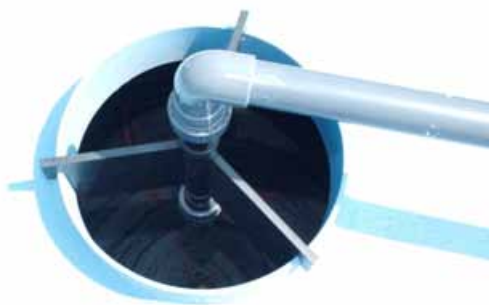
THE ODOURPACKS, IT'S ALL IN THE DETAILS

The key element of the enhanced performance and success of the SULPHUS is the internal packing, the so-called OdourPacks, which consists of a winded synthetic media.

The OdourPacks are grafted with microorganisms that decompose the various odour sources. By means of the transportation channels the air is pushed through the OdourPacks in plug flow, eliminating the risk of air channeling. This results in an outstanding removal efficiency utilising a small surface area combined with an extremely low pressure drop (energy cost).

STAND-ALONE OR WITH CARBON POLISHER

In most situations the SULPHUS can function as a stand-alone unit, achieving outlet concentrations below 0,5 ppm on H₂S. For complete odour removal the SULPHUS can be equipped with an integrated Activated Carbon polishing stage, the so-called ACTUS. Since the ACTUS is used only to deal with any of the residual odours, the Carbon Media lifetime is much longer than in conventional stand alone Carbon Adsorber Units. With our preference for high-quality materials, we use Norit Activated Carbon (refer to page 28).



SIMPLE MECHANISMS FOR EASY CONTROL

In the SULPHUS a pH gradient is created to remove hydrogen sulphide (H₂S) as well as other (in) organic odours. This gradient is maintained by the CombiControl with simple, straightforward, control mechanisms. Subsequently the SULPHUS requires extremely small amounts of utilities (water, power) and a minimum of attention.

ADVANTAGES, IT AL COMES DOWN TO COST

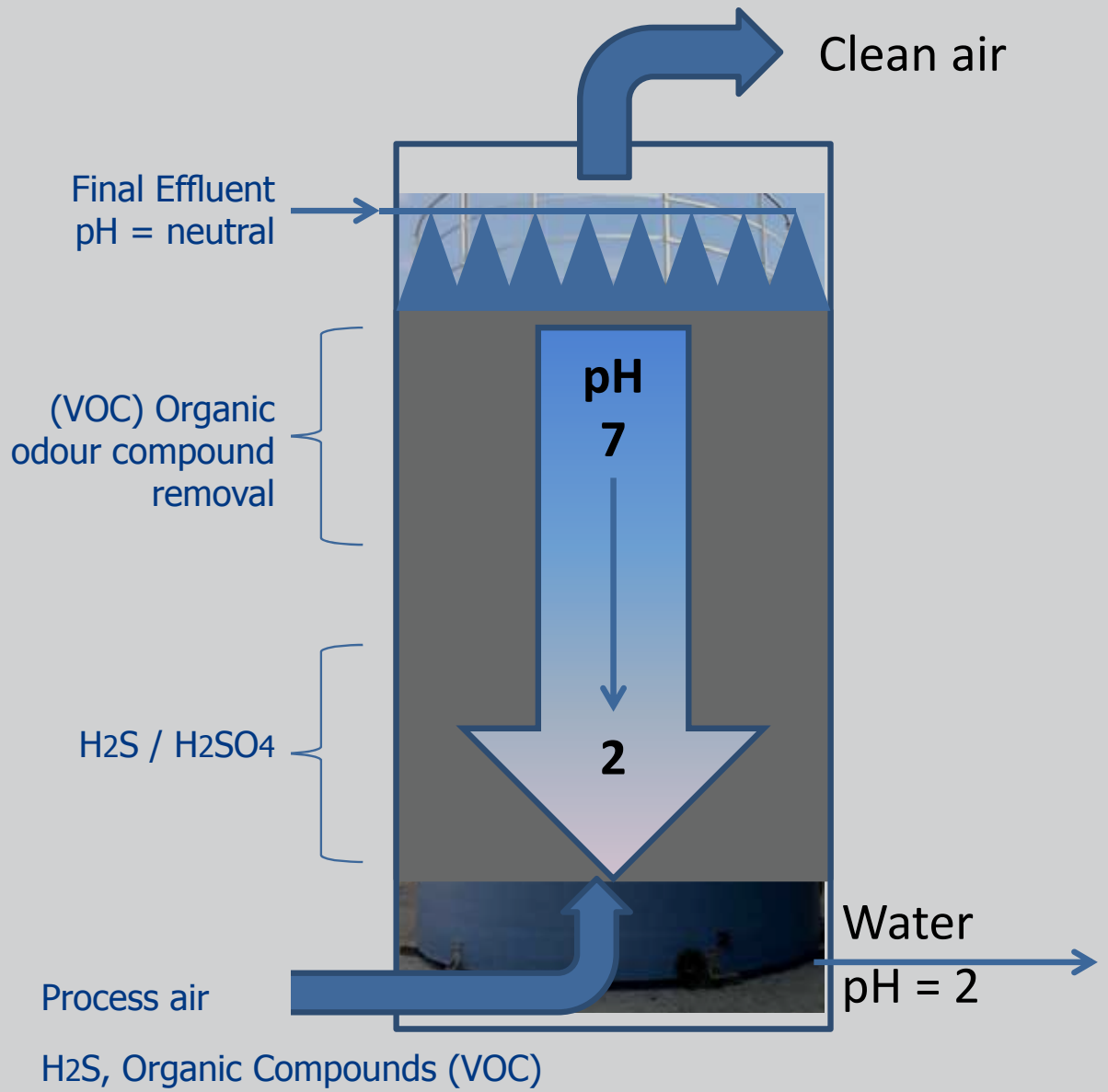
SULPHUS System, with lean engineering and design:

- ☑ Complete elimination of waste water odours
- ☑ Modular concept for high flexibility
- ☑ Plug & play assembly for easy installation
- ☑ Use of robust, durable synthetic materials
- ☑ No use of chemicals and oxidising agents
- ☑ Light weight, minimising civil works and cost

SULPHUS OdourPack, synthetic winded media:

- ☑ Very reliable 365d/365d performance
- ☑ Large loadings and void space - 400 m²/m³
- ☑ No risk of air channelling - fugitive emissions
- ☑ Open structure - extreme low pressure drop
- ☑ pH gradient with low water usage





RAPID, ROBUST AND NO COMPLAINTS

HIGH ODOUR REMOVAL EFFICIENCY ON BOTH H2S AND (IN)ORGANIC ODOURS

The SULPHUS is specifically designed for the treatment of odours from wastewater processes. The multilayer media beds - with synthetic packing – have a large void space and specific surface area to treat low and high odour loads.

The CombiControl System maintains an optimum pH gradient and water holding capacity. This ensures effective removal of H2S and (in)organic odours, like mercaptans and VOC's, in one single reactor. Typical results are an outlet concentration of <0,5 ppm H2S and <1500 odour units OUE.

In optimum situations the required outlet concentration is reached in just a few days. For complete odour removal the SULPHUS can be equipped with the ACTUS, an incorporated Activated Carbon Media polishing stage.

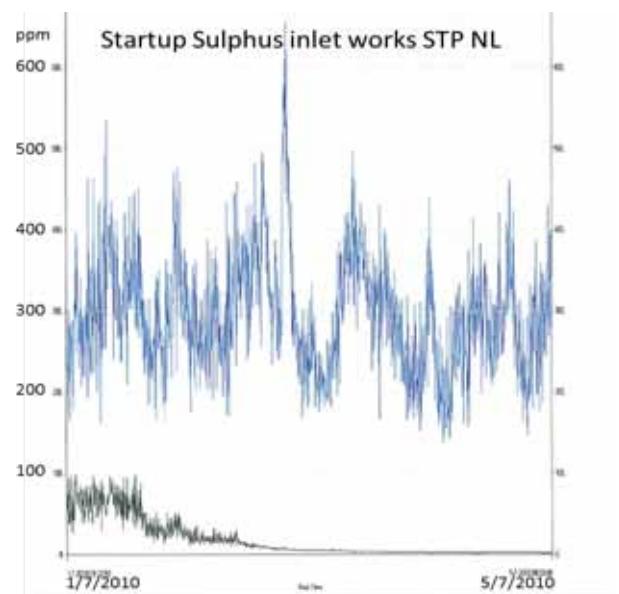
REQUIRED OUTLET CONCENTRATIONS, SOONER THAN FAST

The high performance of the SULPHUS is usually achieved within a month. The table(below) shows the performance on odour removal (excl. H2S) at a WWTP in The Netherlands. During a half year research study, performed in cooperation with Veolia Water Netherlands BV, four odour measurements were undertaken by PRA ODOURNET according to the EN 13725 and NER2 force choice mode at standard conditions.

Day at WWTP	Odour conc. Inlet air	Odour conc. Outlet air	Odour Removal Efficiency , %
Harnasch Polder (NI)	OU /m ³ _E	OU /m ³ _E	%
57	23.042	933	96
65	7.035	309	96
107	8.373	494	94
Average	12.816	579	>95

The SULPHUS treated an emission with mercaptans and other odorous organic compounds, at a residence time as low as 19 seconds. In optimum situations the removal efficiency of 99% on H2S and required outlet concentration was reached in just a few days. The graph (below) shows the performance of the SULPHUS during the start-up period, so-called the commissioning period. The odours were emitted from an inlet works of a Sewage Treatment Plant in the Netherlands. With average inlet concentrations fluctuating around 300 ppm H2S – and peaks up to 650 ppm H2S – this air stream is typical of 'contaminant loading' values found in some waste water air streams.

The graph below shows that in a period of 5 days the SULPHUS has met the required outlet concentration. At start-up on the 1st of July the outlet concentration is still around 100 ppm H2S. By the 5th of July it can be seen that the SULPHUS already has achieved a steady outlet concentration of <0,5 ppm H2S with removal efficiencies of 99%.



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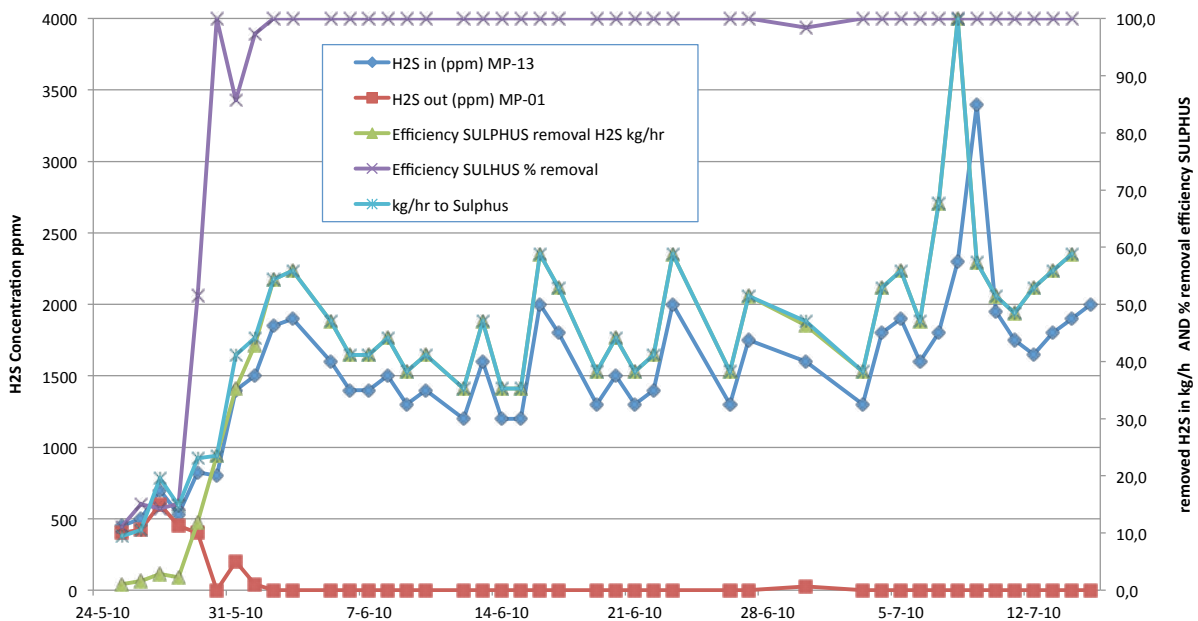
HIGH H2S LOADS, THAT CALLS FOR A SULPHUS

In extreme circumstances the SULPHUS has proven to be an excellent solution for waste water odour treatment. The SULPHUS technology was adopted on one of the main Waste Water Treatment Plants in the United Arab Emirates dealing with inlet concentrations of H2S around 2,000 ppm, the SULPHUS reduced the H2S emitted to an outlet concentration of <0,5 ppm H2S (please refer to the graph).

After the initial start-up period of 10 days the SULPHUS again demonstrates excellent results. It eliminated an average load of 50 kg/H2S per hour. As a result the SULPHUS proved to be a stable, robust system in the following months after start up. Extreme H2S loads at this WWTP are not common, nevertheless it clearly demonstrates that the SULPHUS technology is capable of dealing with H2S loads of 100 kg/ hour. Thus, provides further confirmation that for nearly every wastewater process air stream the SULPHUS is the ultimate solution.



Efficiency & capacity of SULPHUS system





RAPID, ROBUST AND NO COMPLAINTS

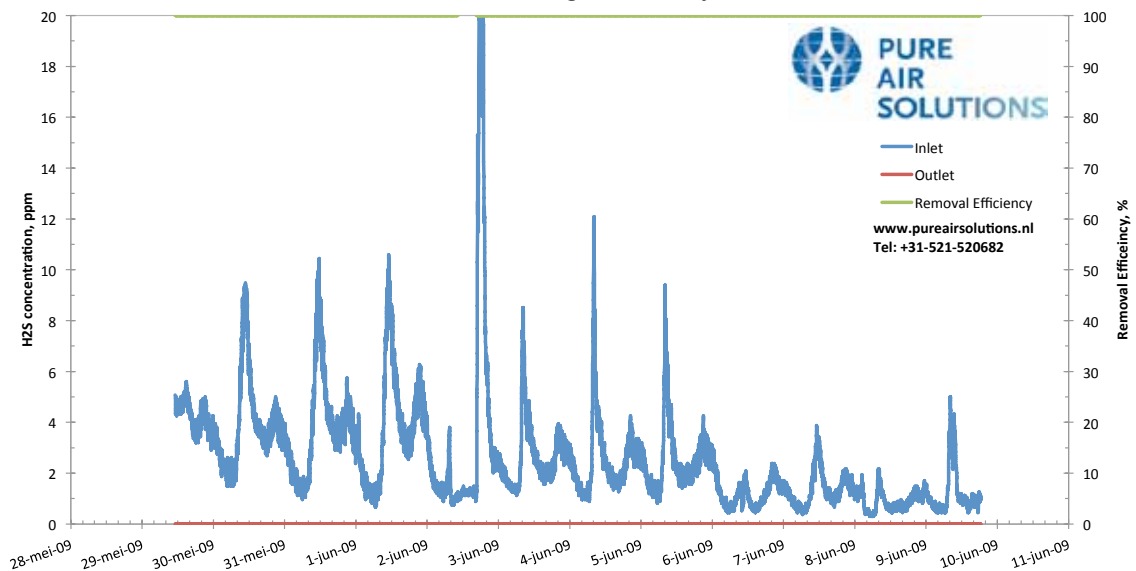
LOW H2S LOADS, THAT CALLS FOR A SULPHUS TOO

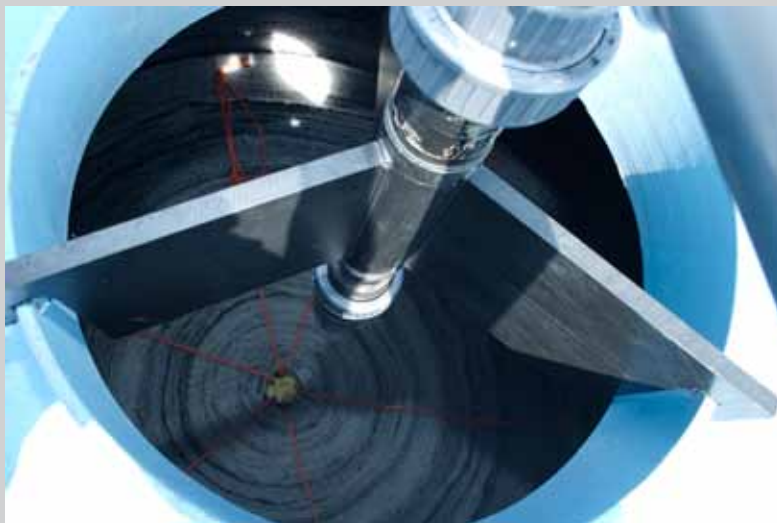
For odours emitted from wastewater pumping stations the SULPHUS also is the perfect solution. Often the acceptable level of odours around pumping stations is zero, and usually both the air volume and odour concentration is relatively low. Now there is a reliable treatment solution with minimum O&M requirements, low operating costs and no need for continually replacing media unlike e.g. carbon adsorbers which require media replacement when it is 'spent'.

The SULPHUS is a modular system and supplied in GRP reactors with various diameters and heights. Even a small single layer of SULPHUS will consistently remove more than 99% percent of the H2S and more than 95% of all the odours in these type of airstream. Thus the SULPHUS can replace carbon adsorption systems, which require regular carbon media replacement and therefore have a much high cost of ownership.

The Geert Huizinga pumping station in Groningen (Netherland) is located in a crowded commercial area, just opposite to the Martini Plaza Conference & Exhibition centre. The skid-mounted compact SULPHUS (see pictures on page 10) consistently removes more than 99.5 percent of the H2S and more than 95 percent of all the odours in the airstream. The SULPHUS has a very low-profile and a neat look, which is ideal for the sensitive location. Since the installation the unit has demonstrated that it has extremely low operating costs, required minimum maintenance and had years of consistent treatment with zero odour complaints from the community.

SULPHUS met "Odourpack" Pumstation "Geert Huizinga", Gemeente Groningen.
Resultaten H2S meting 29 mei - 10 juni 2009





SIMPLE, DESIGN YOUR OWN SULPHUS

THE DESIGN IS UNIQUE, THE POSSIBILITIES ARE ENDLESS

The SULPHUS is a biotrickling filter with structured packing, so-called OdourPack. To create maximum flexibility the Odourpack is available in 3 different diameters ranging from 2200 mm up to and 3500 mm. In addition the Odourpacks have a standard height of 1 meter and can be stacked up to 9 units. Therefore the SULPHUS has a modular structure, which provides a made-to-measure solution adaptable to the emission characteristics and customer's requirements.

Please refer to the graphs on page 19 to 27 where you can configure your own SULPHUS by selecting:

- 1: Emission sources
- 2: Total air flow
- 3: H₂S concentration



Height = layers of Odourpack structured packing



Example SULPHUS type selection and OPEX calculation

Design data:

- Air from head works of a STW, targeting H₂S
- Airflow is 15.000 m³/h
- Concentration H₂S is 80 ppm on average

Selection of Sulphus type:

1. Because target is H₂S only, use the blue graphs (page 19-21)
2. Single reactor is lowest in CAPEX
3. Result is SULPHUS 3500-6

Calculating the OPEX:

1. Use pressuredrop graph:
Approximate 1.100 Pa* pressuredrop

Energy costs can be calculated following the standardized formula:

$$P = \frac{[\text{FLOW}]}{3600} * \frac{[\text{dP}]}{1000}$$

$$\eta$$

Where:

P = power (kW)

FLOW = Airflow (m³/h)

dP = Pressure drop (Pa)

η = efficiency fan (%) = 0,7

$$\text{EU} = [\text{HOURS}] * P$$

Example SULPHUS type selection and OPEX calculation

Where

EU = Yearly energy usage (kWh)

HOURS = production hours per year (h)

P = Power (kW)

$$[\text{COST}] = [\text{CP}] * \text{EU}$$

Where:

COST = Yearly cost of electrical energy

CP = Cost price of 1 kW (2013 NL prices Euro 0,21/kW)

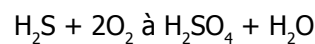
EU = Yearly energy usage (kWh)

*Note that this pressure drop includes only the reactor.

2. Use water usage graph:

Water usage is related to the formation of sulphuric acid (H₂SO₄)

at the degradation of the H₂S, following:



a. Calculate first the hourly Inlet load:

$$\text{IL} = \frac{[\text{H}_2\text{S}] * c * [\text{FLOW}]}{1.000.000}$$

Where:

IL = Inlet load (kg H₂S/h)

FLOW = Airflow (m³/h)

C = Conversion factor ppm H₂S to mg H₂S/m³ = 1,4

$$\text{IL} = 1,68 \text{ kg H}_2\text{S/h}$$



Example SULPHUS type selection and OPEX calculation

Read from the graph about the waterusage:
Three values can be seen:

1. at a set point pH of 1,4 the water usage will be 1,5 m³/h
2. at a set point pH of 1,7 the water usage will be 3 m³/h
3. at a set point pH of 1,9 the water usage will be 5 m³/h

So, at situations where water usage is a problem, a careful look at the pH set point is advised. A lower pH set point will increase the acid region in the reactor. This may cause a lower removal of organic components. At using the system and evaluating the necessary odour removal the pH set point can be optimized.

Choices in selecting the right Sulphus type relating to OPEX savings:

1. Mainly pressure drop is a substantial variable determining OPEX costs. Savings can be achieved by putting reactors in parallel instead of in series:

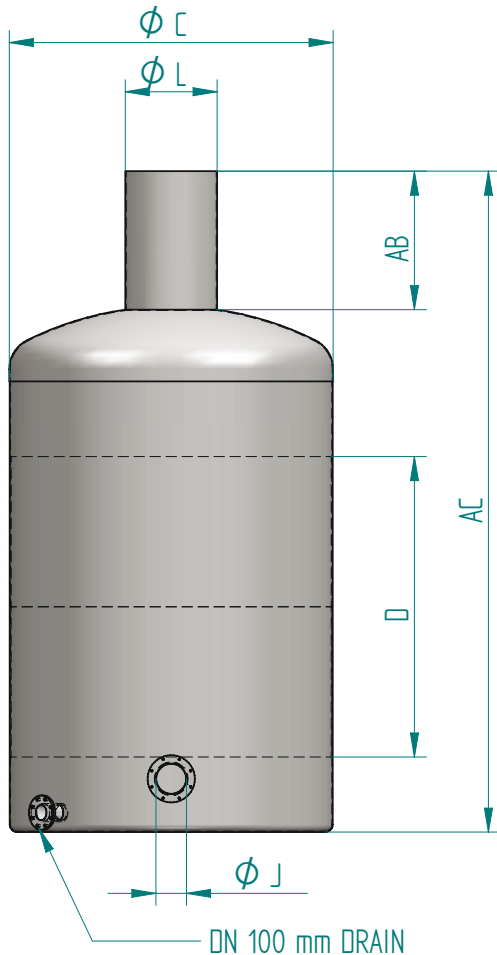
In this example 1 reactor Sulphus 3500-6 is chosen. With the design parameters in this example there is also a choice to choose 2 reactors Sulphus 3500-3.
With this design the pressure drop decreases to 350 Pa. This will save approximately 70% of the energy costs. In this example approximately 8.200,- Euro/year.

2. Actus. The Actus has a relative high pressure drop. Is this device strictly necessary? Choosing extra residence time could increase safety for the odour removal and reduce the OPEX considerably.



Product overview SULPHUS

A	C	D	J	L	AB	AC	AH	AI
System type	Diameter (mm)	Layers (No/m)	Nominal Diameter Air Inlet [mm]	Nominal Diameter Air Outlet [mm]	Height air outlet piece (mm)	Total height Sulphus (mm)	Weight transport [kg]	Weight operational [kg]
2200-1	2,150	1	300	800	1,000	3,900	1,600	1,900
2200-2	2,150	2	400	800	1,000	5,000	2,200	2,800
2200-3	2,150	3	400	800	1,000	6,000	2,700	3,700
2200-4	2,150	4	500	800	1,000	7,200	3,400	4,700
2200-5	2,150	5	500	1,000	1,000	8,000	3,900	5,500
2200-6	2,150	6	600	1,000	1,000	9,200	4,500	6,400
3000-1	3,000	1	400	1,000	1,000	4,600	2,900	3,500
3000-2	3,000	2	500	1,000	1,000	5,700	3,800	5,100
3000-3	3,000	3	600	1,000	1,000	6,900	4,800	6,700
3000-4	3,000	4	700	1,000	1,000	8,200	5,800	8,400
3000-5	3,000	5	700	1,000	1,000	9,200	6,700	9,900
3000-6	3,000	6	700	1,200	1,000	10,000	7,500	11,400
3500-1	3,500	1	400	1,200	1,000	4,900	3,700	4,600
3500-2	3,500	2	500	1,200	1,000	6,000	4,900	6,600
3500-3	3,500	3	600	1,200	1,000	7,200	6,100	8,700
3500-4	3,500	4	800	1,200	1,000	8,700	7,500	11,000
3500-5	3,500	5	800	1,500	1,000	9,300	8,500	12,800
3500-6	3,500	6	900	1,500	1,000	10,400	9,600	14,800



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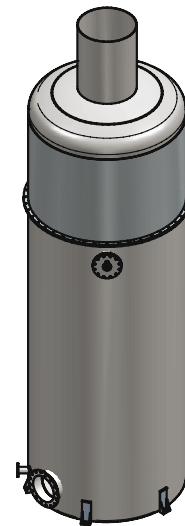
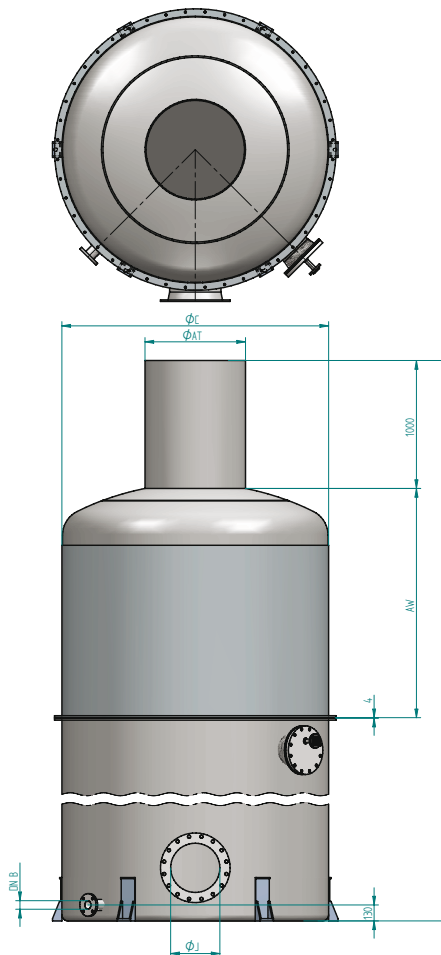
	NAME	DATE	TITLE
DRAWN	P. Beltman	01/21/13	Sulphus
CHECKED			SUBJECT
ENG APPR			Product overview
MGR APPR			
			SIZE DWG NO A2 Sulphus_2013
			Material: SCALE: Weight: 9635 kg SHEET 1 OF 1

Last Modified Date: 1/21/2013 © EXCLUSIVE COPYRIGHT BY PAS



Product overview SULPHUS+ACTUS

A	B	C	D	J	AT	AW	BB	BA	BC
System type	Nominal Diameter Drain [mm]	Diameter (mm)	Layers (No/m)	Nominal Diameter Air Inlet [mm]	Nominal Diameter Air Outlet [mm]	Actus height [mm]	Total height Sulphus including Actus [mm]	Total weight transport Sulphus and Actus [kg]	Total weight operational (excl stairs) [kg]
2200-1	65	2150	1	300	800	1700	5600	1950	2250
2200-2	65	2150	2	400	800	1700	6700	2250	2950
2200-3	100	2150	3	400	800	1900	7800	2760	3860
2200-4	100	2150	4	500	800	2000	9200	3380	4880
3000-1	100	3000	1	400	1000	2000	6600	3570	4270
3000-2	100	3000	2	500	1000	2000	7700	4170	5570
3000-3	100	3000	3	600	1000	2200	9100	5180	7280
3000-4	100	3000	4	700	1000	2300	10300	6080	8980
3500-1	100	3500	1	400	1200	2200	7100	4720	5720
3500-2	100	3500	2	500	1200	2200	8200	5420	7420
3500-3	100	3500	3	600	1200	2300	9500	6760	9660
3500-4	100	3500	4	800	1200	2500	11100	8100	12000



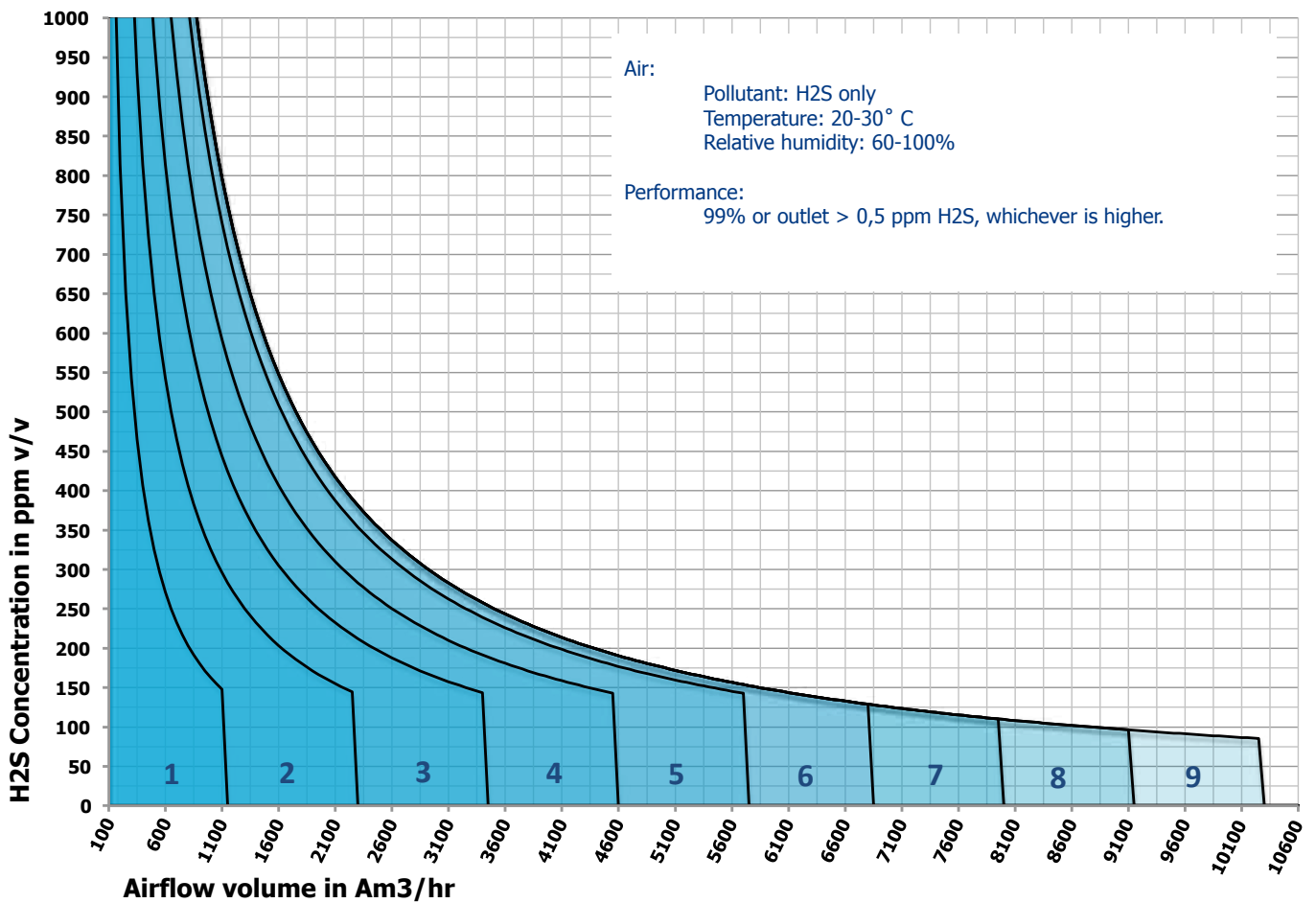
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DRAWN	NAME	DATE	TITLE
CHECKED	PAS Eng.	05/20/13	Sulphus & Actus
ENG APPR			SUBJECT
MGR APPR			Product Overview
PURE AIR SOLUTIONS		SIZE	DWG NO.
		A2	Sulphus_Actus_2013
		Material:	REV 0
		SCALE:	Weight: 4075 kg SHEET 1 OF 1

Last Modified Date: 5/20/2013

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Selection graphs: SULPHUS H2S removal only

Pure Sulphus Odourpack Selector: Diameter 2200 mm; No. of layers : 1 up to 9

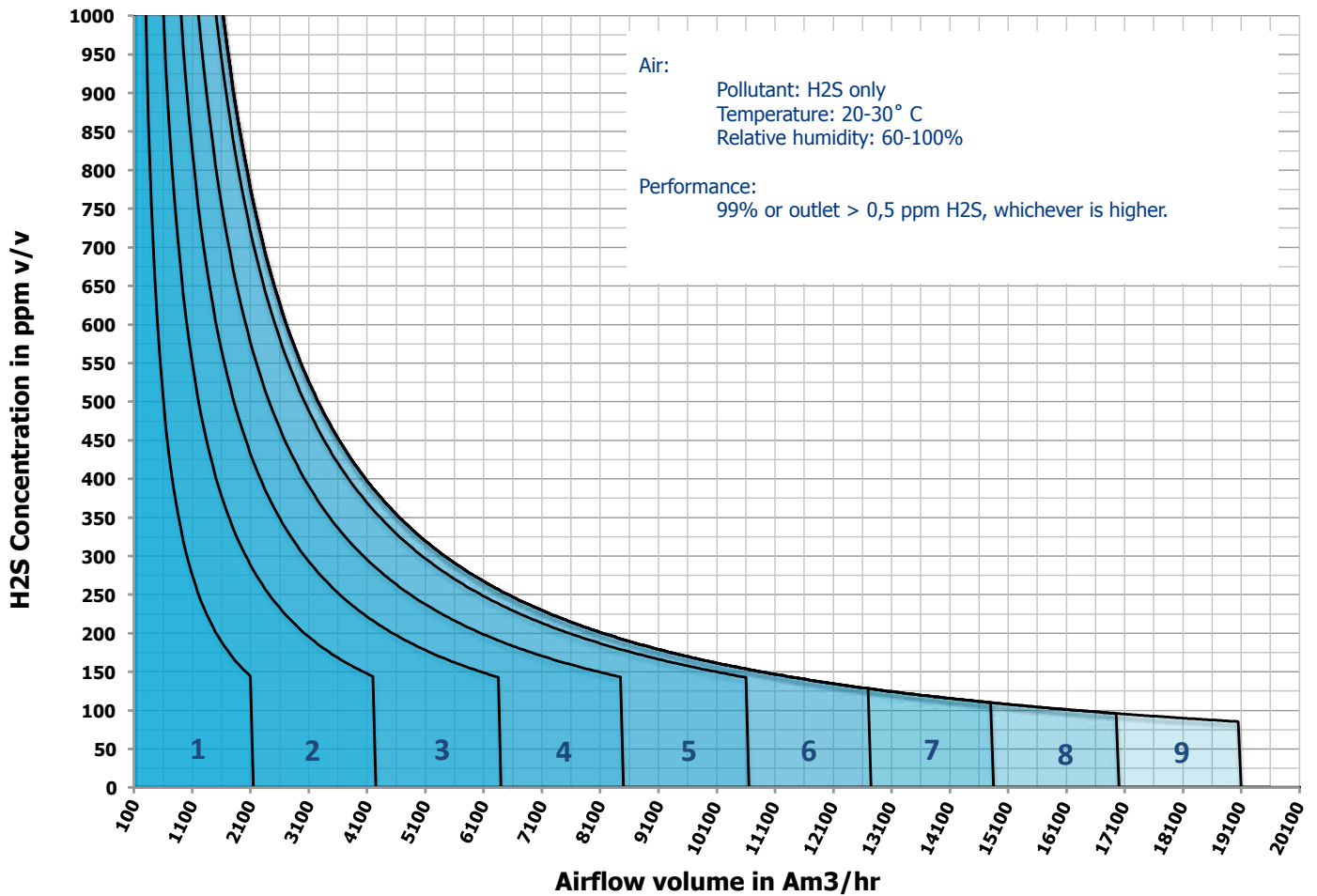


Pure SULPHUS Odourpack Selector: Diameter 2200mm



Selection graphs: SULPHUS H2S removal only

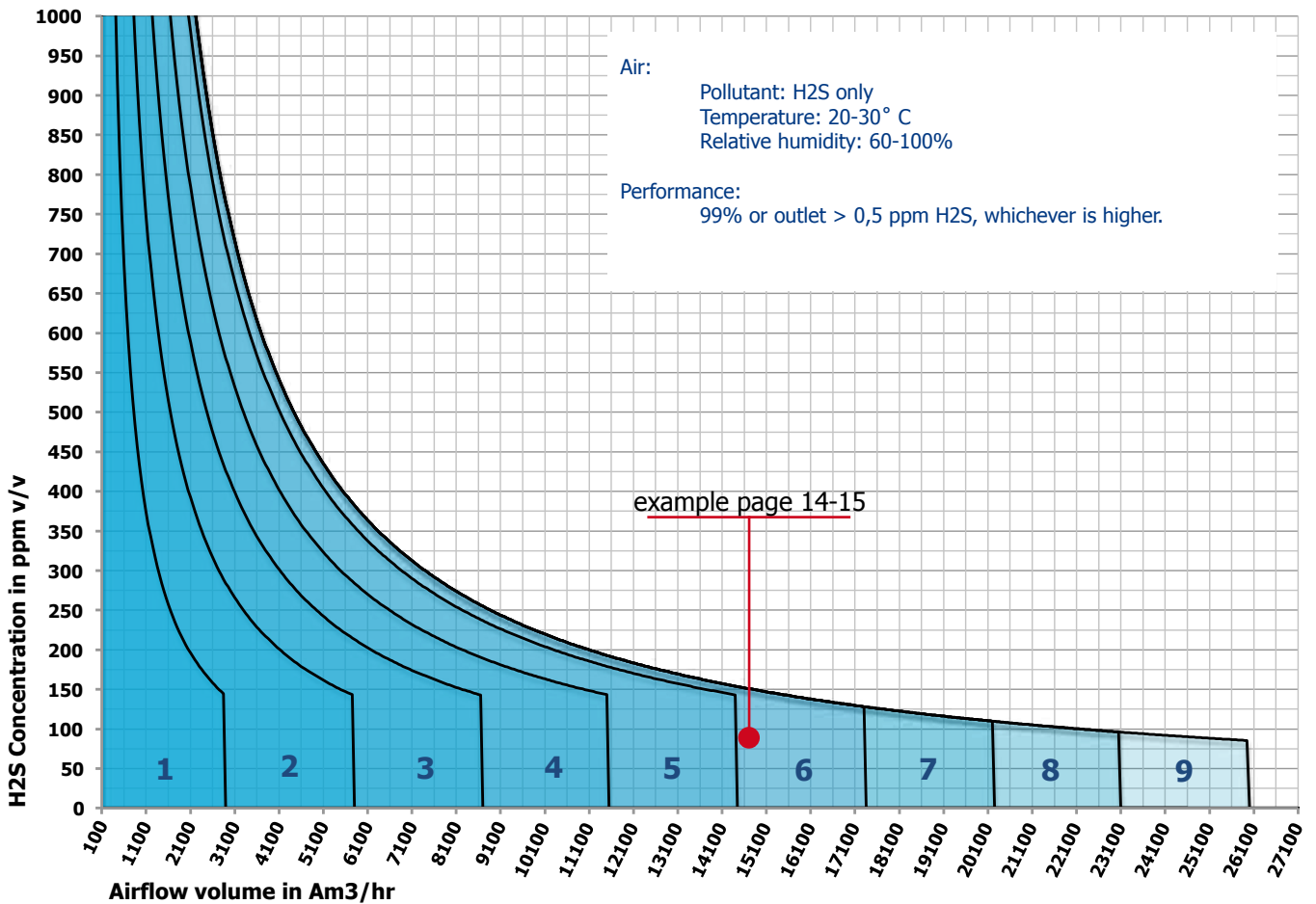
Pure Sulphus Odourpack Selector: Diameter 3000 mm; No. of layers : 1 up to 9



Pure SULPHUS Odourpack Selector: Diameter 3000mm

Selection graphs: SULPHUS H2S removal only

Pure Sulphus Odourpack Selector: Diameter 3500 mm; No. of layers : 1 up to 9

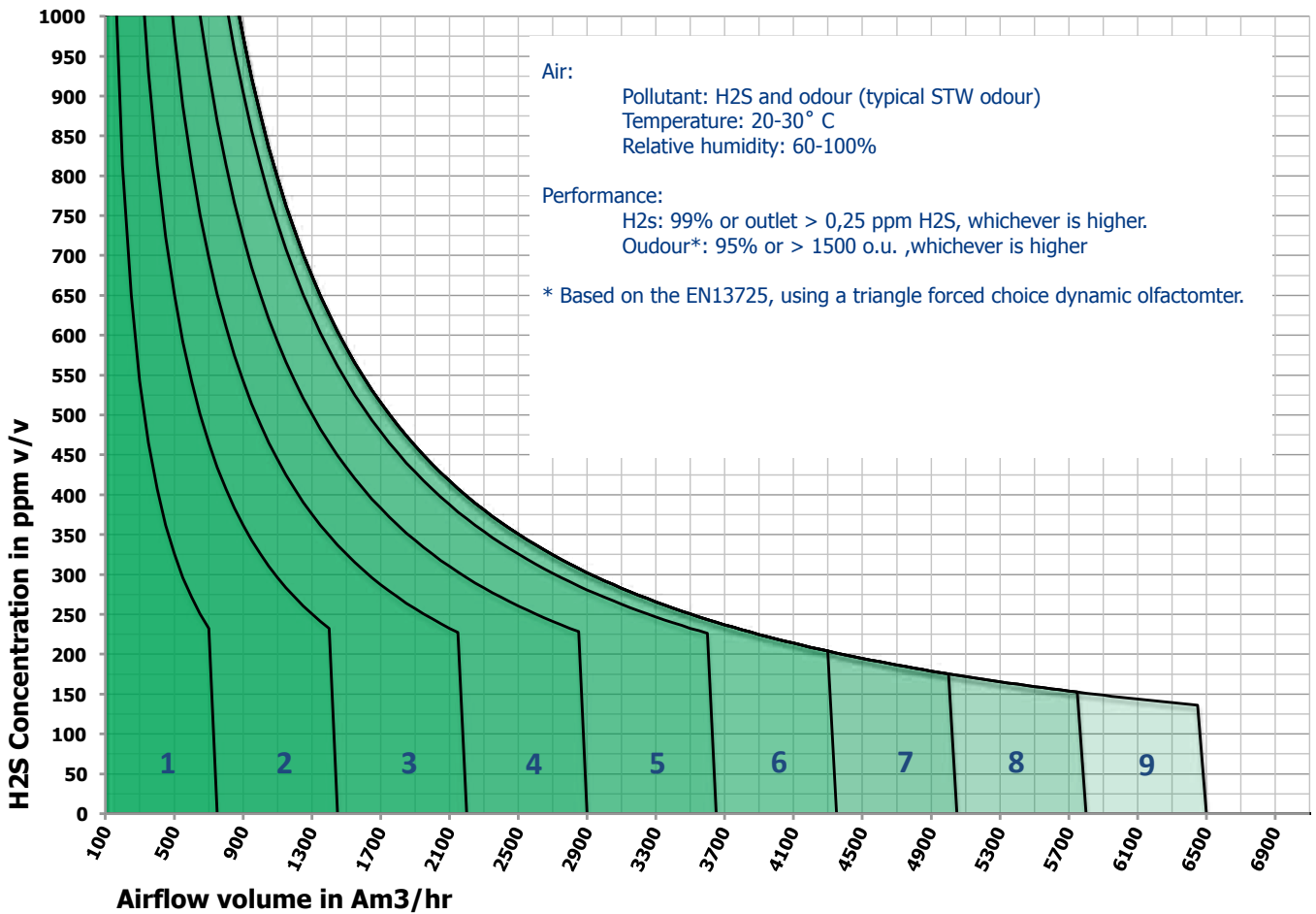


Pure SULPHUS Odourpack Selector: Diameter 3500mm



Selection graphs: SULPHUS H₂S and organic odour removal

Pure Sulphus Odourpack Selector: Diameter 2200 mm; No. of layers : 1 up to 9

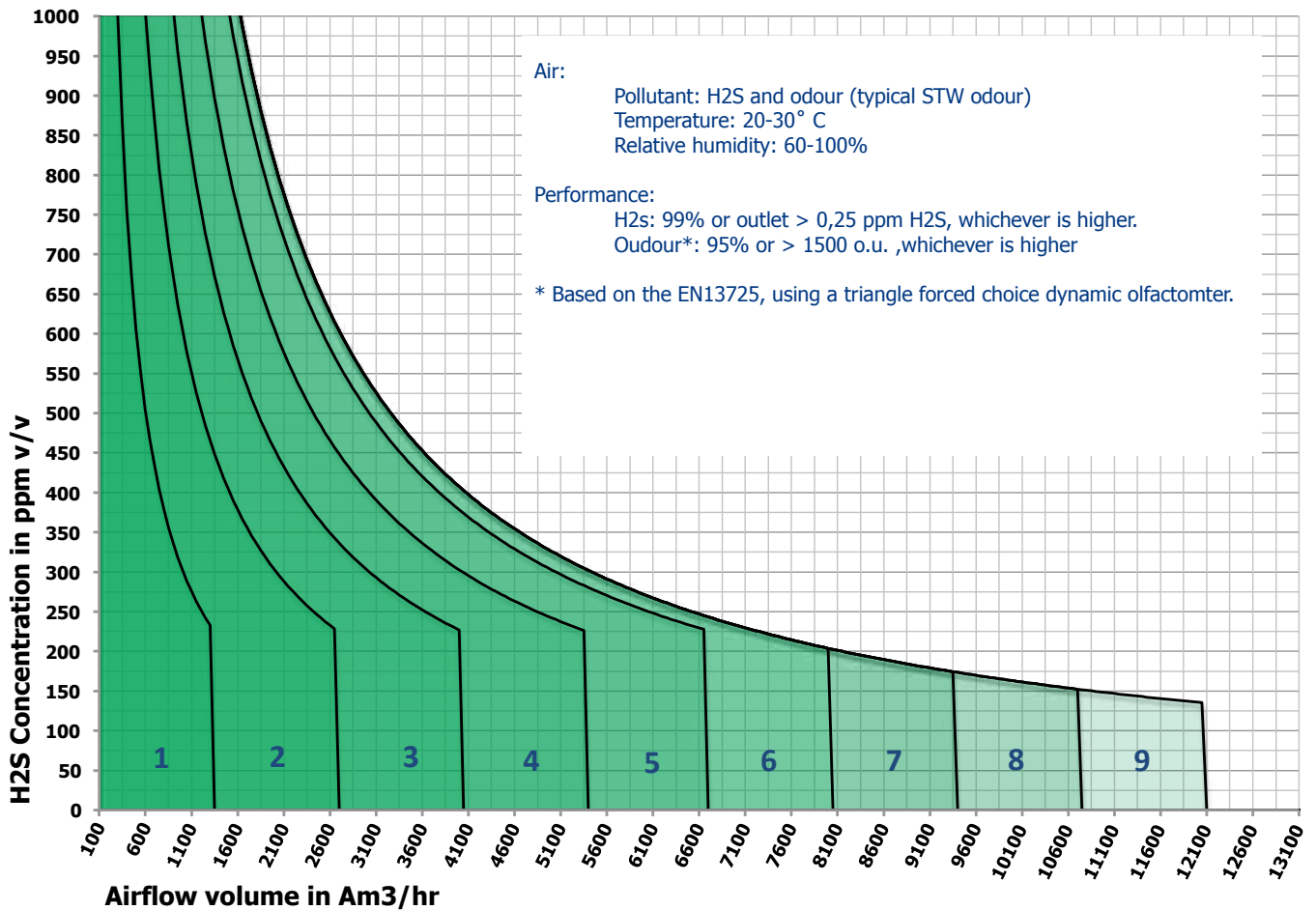


Pure SULPHUS Odourpack Selector: Diameter 2200mm



Selection graphs: SULPHUS H₂S and organic odour removal

Pure Sulphus Odourpack Selector: Diameter 3000 mm; No. of layers : 1 up to 9

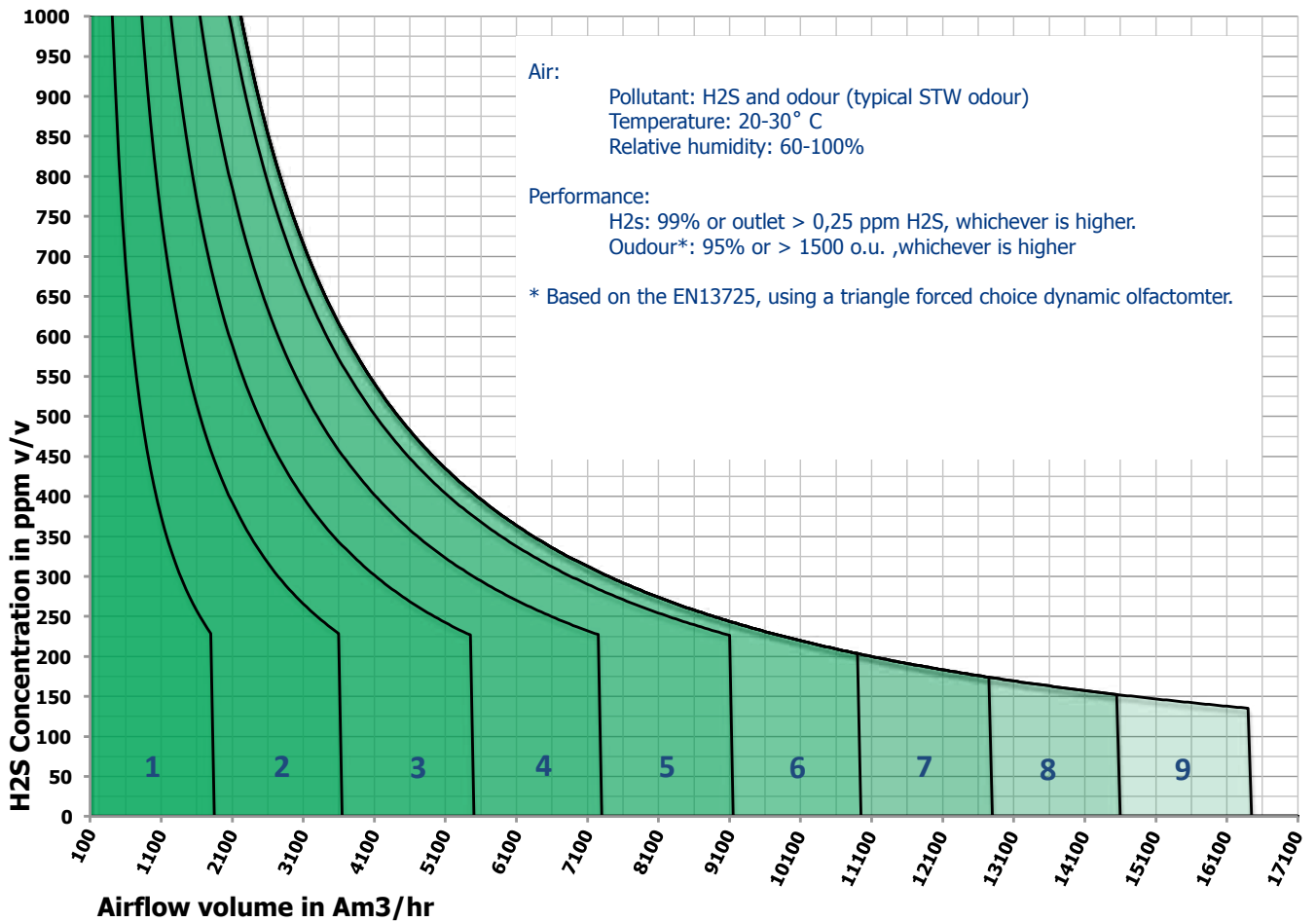


Pure SULPHUS Odourpack Selector: Diameter 3000mm



Selection graphs: SULPHUS H₂S and organic odour removal

Pure Sulphus Odourpack Selector: Diameter 3500 mm; No. of layers : 1 up to 9

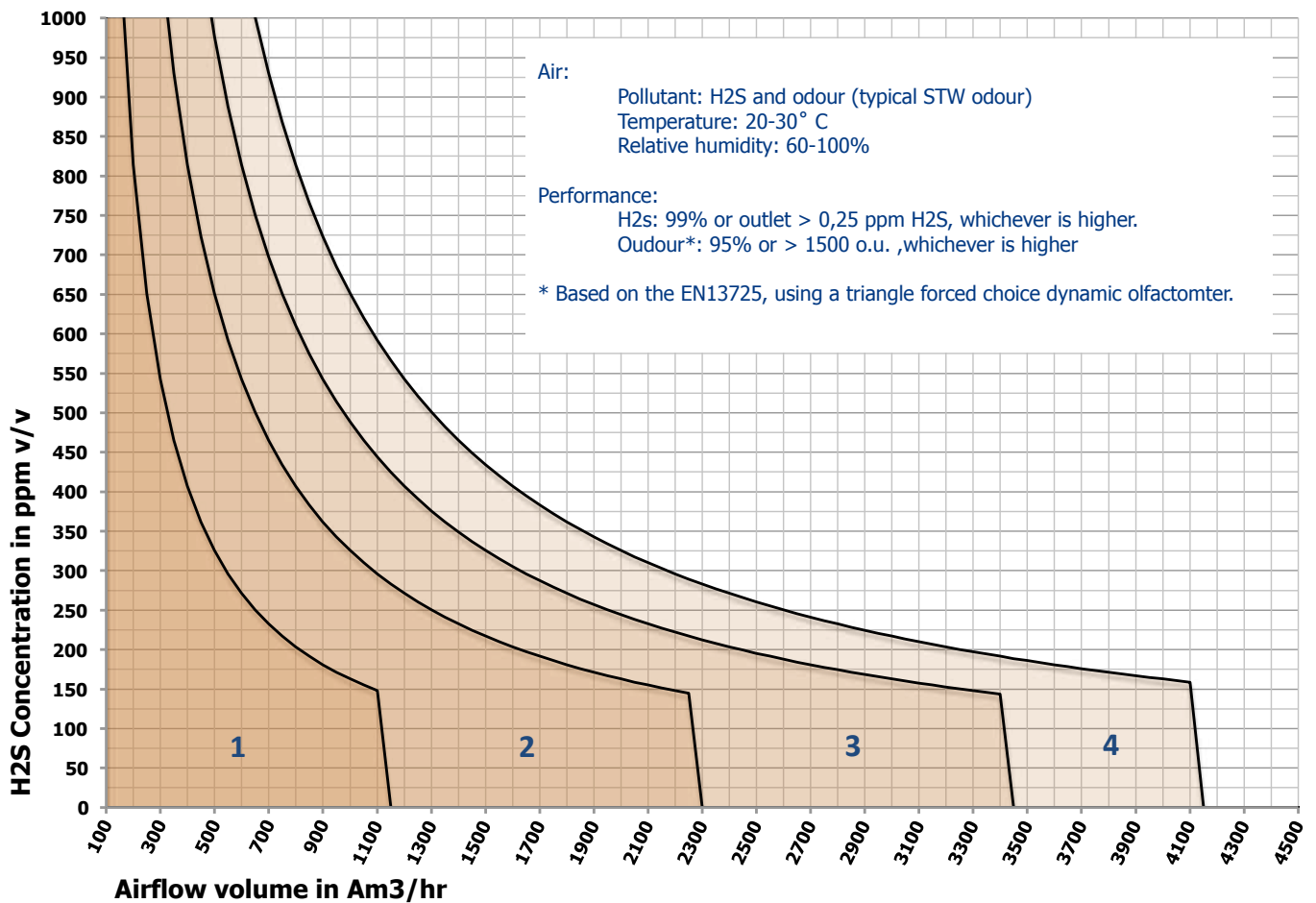


Pure SULPHUS Odourpack Selector: Diameter 3500mm



Selection graphs: SULPHUS + Actus

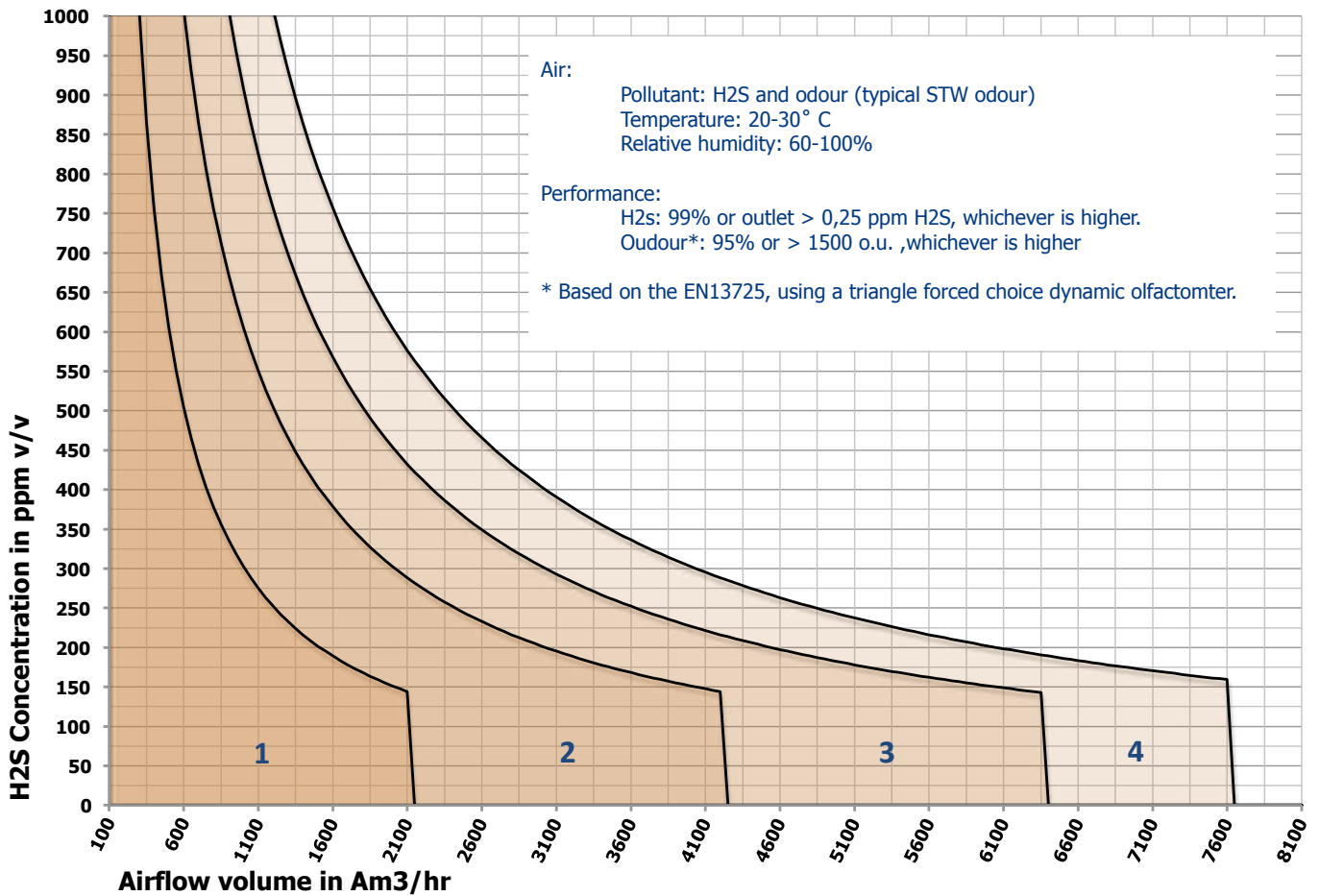
Pure Sulphus - Actus Odourpack Selector: Diameter 2200 mm; No. of layers : 1 up to 4



Pure SULPHUS Odourpack Selector: Diameter 2200mm

Selection graphs: SULPHUS + Actus

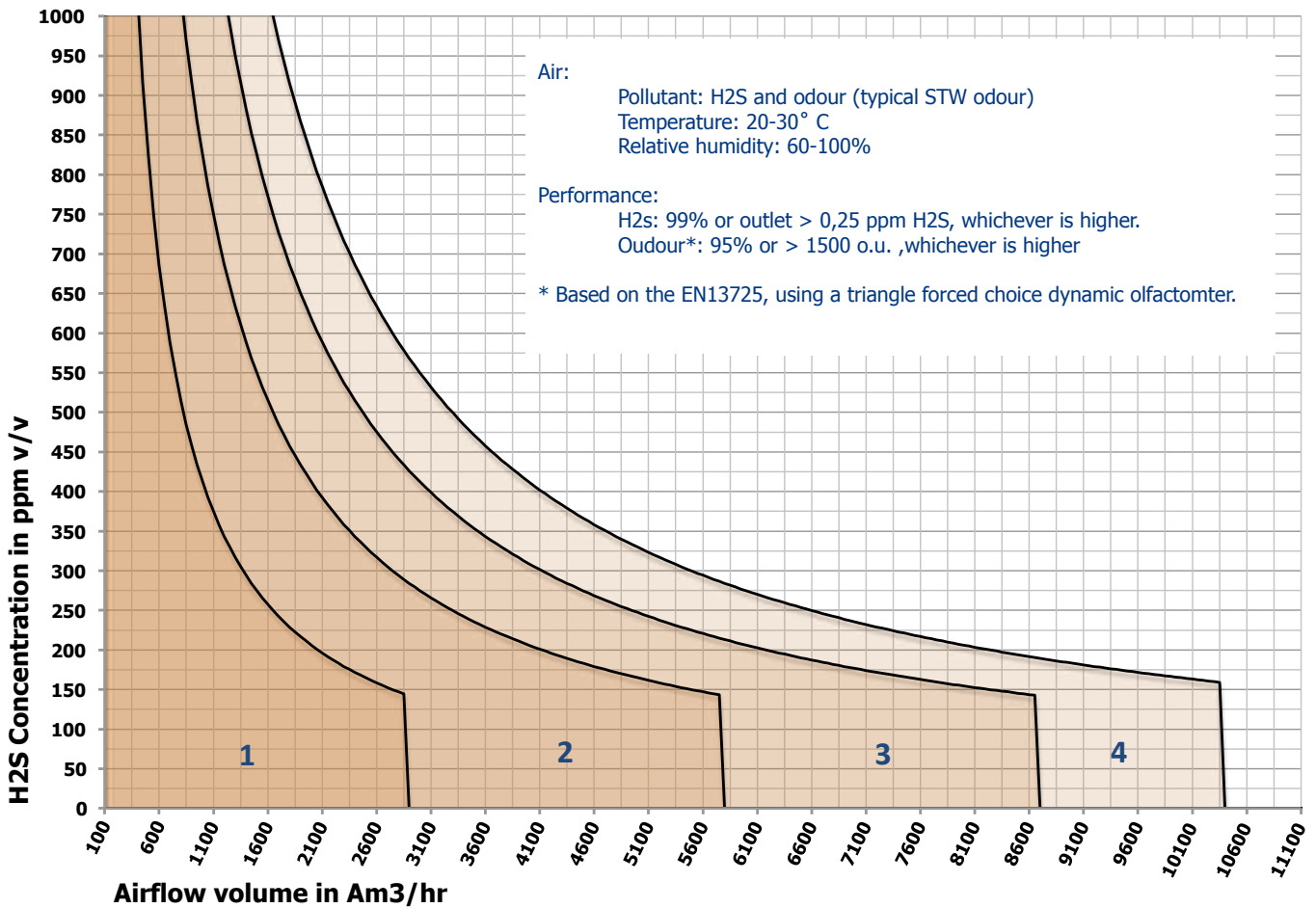
Pure Sulphus -Actus Odourpack Selector: Diameter 3000 mm; No. of layers : 1 up to 4



Pure SULPHUS Odourpack Selector: Diameter 3000mm

Selection graphs: SULPHUS + Actus

Pure Sulphus - Actus Odourpack Selector: Diameter 3500 mm; No. of layers : 1 up to 4



Pure SULPHUS Odourpack Selector: Diameter 3500mm



Actus - Norit inside

Pure Air Solutions promote cost-effective solutions, with zero concessions on quality and sustainability. Therefore, we always strive for the best possible return on our installations. To achieve this we select the most appropriate materials and work with preferred suppliers who have satisfied our QA procedures and therefore meet our standards. For the Actus we have specified the quality of Norit, as they are one of the leading companies in the field of activated carbon. With Norit RST as a final polishing stage inside the SULPHUS, we can ensure the optimum performance.

Norit Digital Library

taken from Norit

Summary

Why should Norit RST portfolio be chosen:

- High H₂S adsorption capacity level
- Made of renewable material
- No impregnation
- Water regenerable allowing long life times
- High siloxanes and VOC adsorption level

Properties Norit RST		
Impregnated		No
Oxygen necessary		Yes
• minimum concentration O ₂ : H ₂ S	Molar basis	4 : 1
Relative humidity necessary		Yes
• working range	%	40 – 100
• optimum	%	60 – 70
H ₂ S adsorption capacity	g/100 g	36
Adsorbed H ₂ S water regenerable		Yes
• regenerability * ¹	%	60 – 80
• preferable H ₂ S range for optimal regeneration	ppm	< 10
• applicable H ₂ S range for regeneration	ppm	10 – 100
Empty bed contact time	s	3 – 6
Superficial velocity		
• RST 3	cm/s	5 – 30
• RST 4	cm/s	5 – 40
BTEX * ²	g/100 g	22
D5 Siloxane (1 ppm, 20 °C)	g/100 g	38
Mercaptans * ³	g/100 g	2
Apparent density	kg/m ³	350

Table 1: overview properties Norit RST.

*¹ Results on regenerability analyzed by Norit R&D. Testing conditions: H₂S inlet concentration 100 ppm; air temperature 20 °C; atmospheric pressure; relative humidity 80 %. Regeneration cycle: water flow approx. 1 bed volume per hour during 5 bed volumes, water temperature 20 °C.

*² Benzene, toluene, ethyl benzene and xylene concentration 10 ppm each, 20 °C

*³ Ethyl mercaptan concentration 1 ppm

Note: All data and suggestions regarding the use of our products are believed to be reliable and given in good faith. However, they are given without guarantee, as the use of our products is beyond our control, and are not to be construed as recommendation or instigation to violate any existing patent. Any product quality information given was valid at the time of issuance of the publication. However, we maintain a policy of continuous development and reserve the right to amend product quality aspects without notice.

Caution: For health and safety related aspects of a Norit activated carbon, please refer to the corresponding Material Safety Datasheet (MSDS), which is available on request.

This technical bulletin (issue 11-11) replaces previous issues

Norit
leading in purification

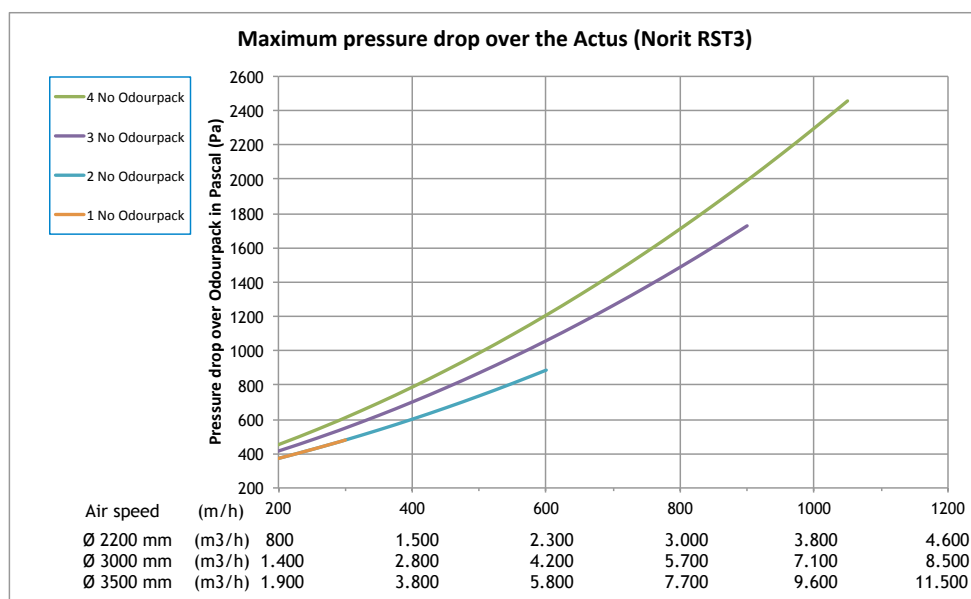
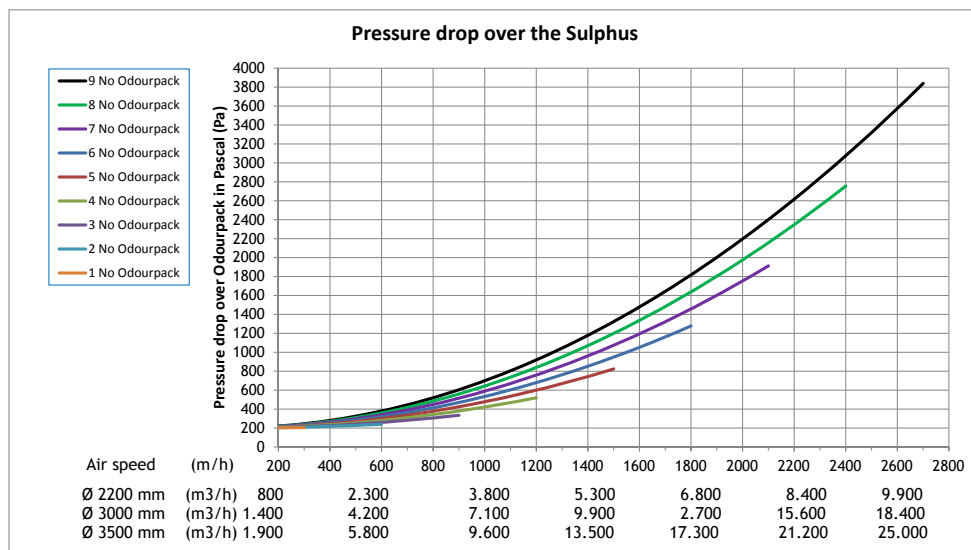
Activated Carbon



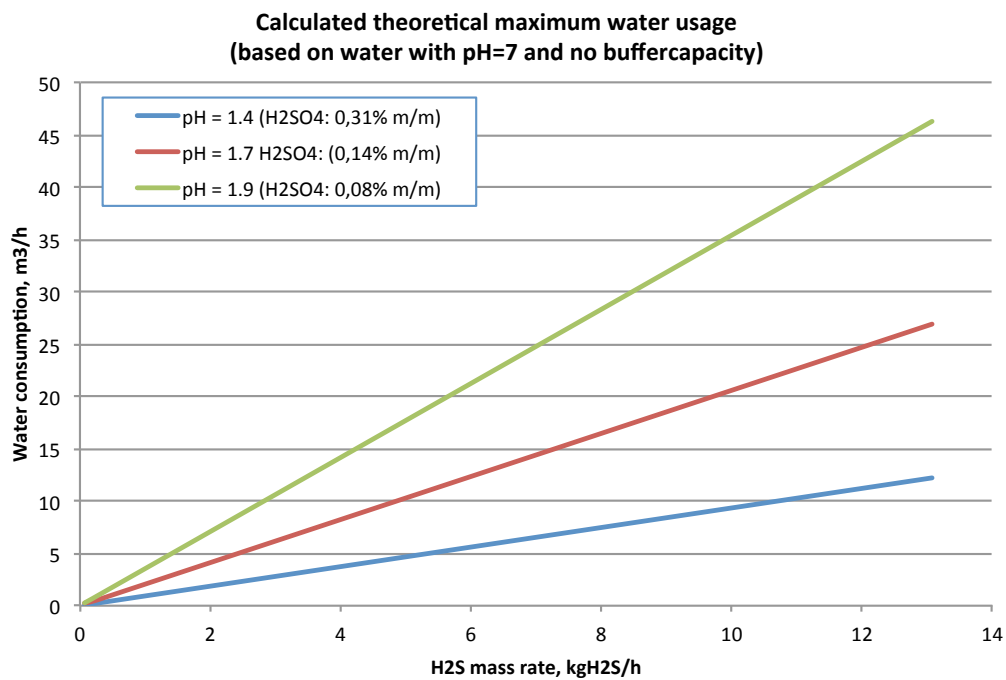
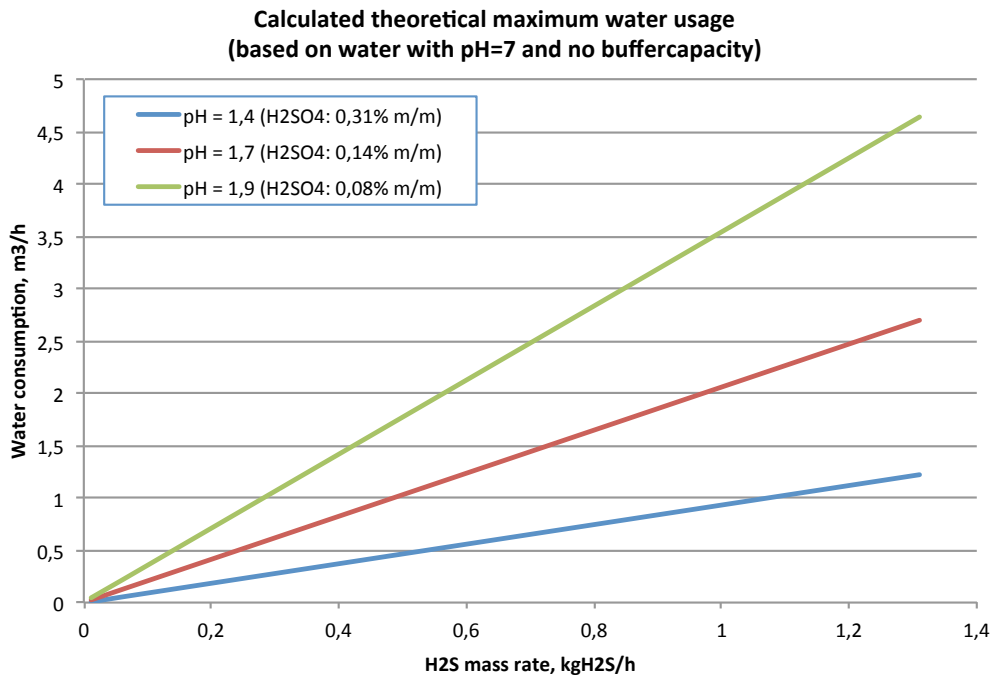
Energy and water consumption

The pressure drop over the SULPHUS which is shown in the graph is the maximum pressure drop achieved during spraying of the media. The spraying of the media is performed less than 10-15% of the time. This means that at a maximum of e.g. 1800 m/hr the pressure drop for 6 odourpacks would be < 300 Pa.

As can be read from the graphs below, it can be more cost-effective to install smaller units instead of one larger unit, depending on economic requirements.



Water, one required utility that is hardly used





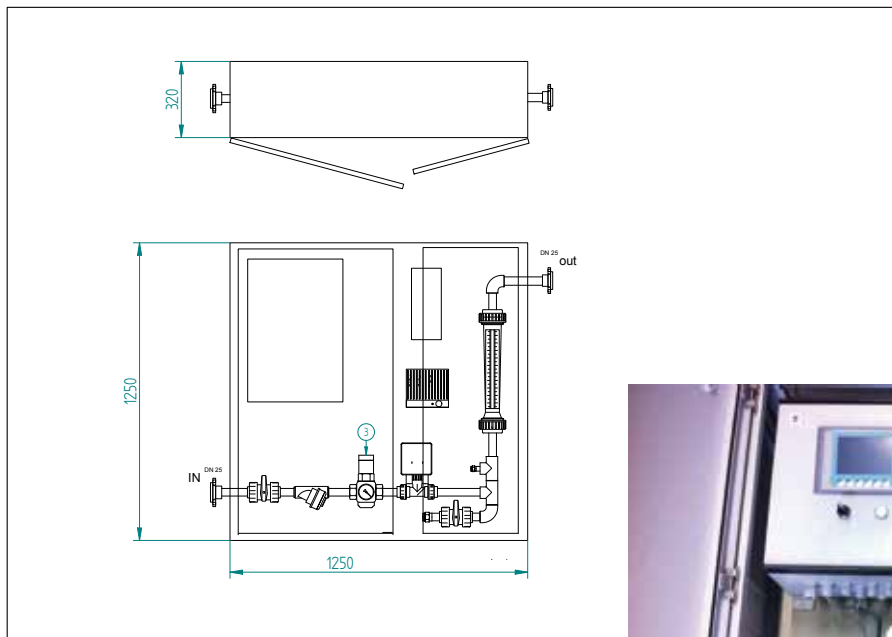
Supply range for maximum flexibility

The SULPHUS is a standard technology supplied as a full system, fabricated and housed in a GRP reactor vessel which means it can be factory assembled for Plug & Play installation (Full System). If preferred, the SULPHUS can be supplied and limited to the delivery of OdourPack(s) and Combi-Control. Based on an engineering package and instructions by Pure Air Solutions, then the reactor is fabricated locally and assembled (on site) by the client or system integrator. The Combi Control Panel is mounted on the GRP reactor vessel. The SULPHUS is fully automated with PureControl and can function as stand-alone units or integrated into the plant control system.

It can also be quickly and easily installed, and incorporates simple mechanisms for reliable control. In the SULPHUS a pH gradient is created to remove hydrogen sulphide (H₂S) and other organic odours. This gradient is maintained by the PURE CombiControl with simple control mechanisms. Operation of the SULPHUS requires small amounts of utilities (water, power) and a minimum of attention and maintenance.

You can order three different configuration and control lines:

ELEMENTAL	Minimum control (basic requirements to control the parameters.)
STANDARD	Basic control + automatic PH stabilization. (to control the consume of water.)
ADVANCED	Integrated control panel. (telemetric control by our engineers to ensure the perfect performance of the system.)





Configuration and control

Housing

	ELEMENTAL	BASIC	ADVANCED
FRP reactor housing	-	V	V
Chemical resistant barrier/resin	-	V	V
Oudourpack filtermedia	V	V	V
Air channeling protection	V	V	V
Pressure controlled winded media	V	V	V
Inspection hatch spraying	-	V	V
Reactor housing blue RAL 5024	-	V	V
Reactor housing choice colour	-	O	O
Media hoistable per pack	V	V	V
Drain connection flange	-	V	V
Flange outlet air	-	O	O
Flange inlet air	-	V	V

Process control

	ELEMENTAL	BASIC	ADVANCED
Homogenous spray pattern	V	V	V
Spraying system	V	V	V
Basic control cabinet	V	V	V
Advanced control cabinet	O	O	V
pH controlled spraying	O	O	V
Manual valve inletduct	O	O	O
Waterflow indicator	V	V	V
PLC controlled	V	V	V
Automatic valve	V	V	V
Pressure control regulator	V	O	O
Strainer	V	V	V
FRP cabinet	V	V	V
Electrical cabinet integrated in watercabinet	V	V	V
pH meter	O	O	O
pH control	O	O	V
Water release valve for emptying the waterpipes	V	V	V
Remote monitoring set	-	-	V

Ancillaries

	ELEMENTAL	BASIC	ADVANCED
Nutrient dosing ready	V	V	V
Nutrient dosing skid	O	O	O
Actus	O	O	O
Fan (chemical resistant)	O	O	O

V = included
O = optional



Retrofitting existing chemical scrubbers to SULPHUS

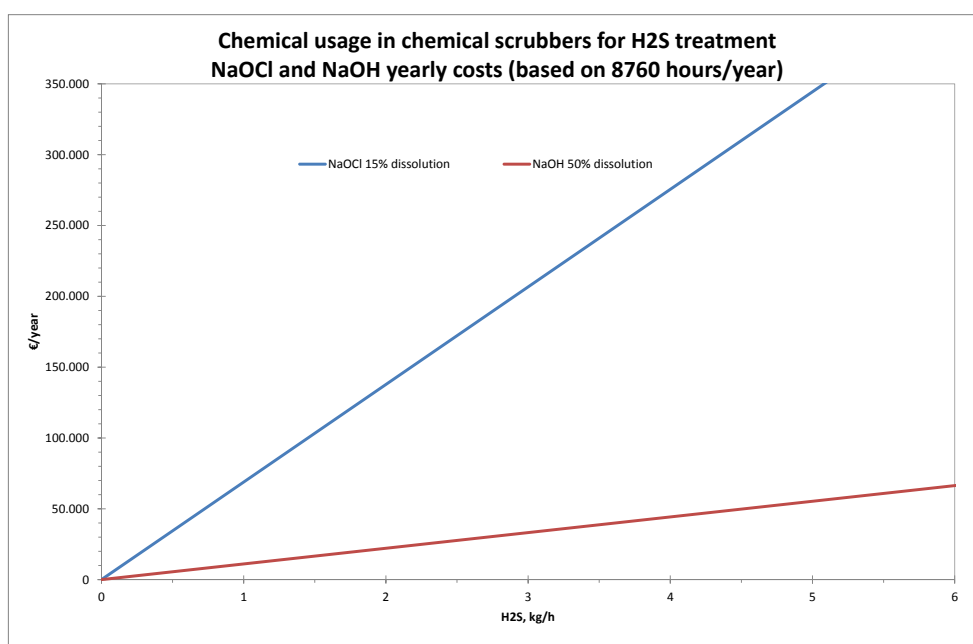
In the past decades controlling H₂S was usually achieved in wet or chemical scrubbers in which H₂S is either absorbed in a caustic solution or absorbed and oxidized in a caustic-hypochlorite or caustic-peroxide solution. Indisputably chemical scrubbing in packed-bed towers is an established technique and an effective solution to reduce waste water odours. However, chemical scrubbing suffers from important drawbacks such as high operating costs, generation of halomethanes that are known air toxics and the requirement for hazardous chemicals which pose serious health and safety concerns.

The SULPHUS can replace chemical scrubbers and be a safer, much more economical technique for odour control. The conversion of chemical scrubber simply consists of replacing the existing packing with OdourPacks, replacing the liquid recycle pump with a smaller one, disconnecting the chemical feeds and, finally modifying the controls of the reactor.

An overall cost-benefit analysis of the SULPHUS compared with a chemical scrubber with identical air emission shows that the total annual savings in operating costs, essentially chemicals and electricity, are around € 50.000 per year. The estimated commercial cost of converting a chemical scrubber to a SULPHUS is between € 40.000 – €60.000, which implies a payback time of 1 year.

It is difficult to generalize all chemical scrubbers, because the costs of conversion and the operating cost savings depend on each application (size, concentration of H₂S, chemical feed, etc.). Still it is very valuable - meaning lots of savings on chemicals and electricity per year - to convert an average chemical scrubber to the SULPHUS.

An estimated >100.000 scrubber for odour control operate at publicly owned treatment works around the world and could potentially be converted to the SULPHUS. If one assumes that 25–40% of the chemical scrubbers worldwide can be converted with OdourPacks, would result in net energy and chemical savings of approx. 2 billion euro per year. And note that environmental health and safety benefits are not factored in the above.





Used references

Information, graphs and pictures used in this brochure come from the following SULPHUS projects at waste water treatment plants:

Iraq | 1x SULPHUS 2200-3 and ACTUS to treat 3.400 m³/h with 100 ppm H₂S at Baquba Main Town Pump Station.

Spain | 2x SULPHUS 3500-6 to treat 18.000 m³/h with 65 ppm H₂S of waste air coming from the thickener of the WWTP at paper mill company of ENCE.

Spain | 2x SULPHUS 3000-4 to treat 10.000 m³/h with 100 ppm H₂S of waste air coming from the sludge treatment and sludge storage building of the WWTP at paper mill company of ENCE.

The Netherlands | 1x SULPHUS 2200-2 to treat 2.500 m³/h with 250 ppm H₂S at biogas production and upgrade systems of Flotech.

The Netherlands | 1x SULPHUS 3500-2 to treat 3.000 m³/h with 250 ppm H₂S at biogas production and upgrade systems of Flotech.

The Netherlands | 1x SULPHUS 3500-3 to treat 3.500 m³/h with 250 ppm H₂S at biogas production and upgrade systems of Flotech.

The Netherlands | SULPHUS 2300-1 RWZI treating 900 m³/h with 1 ppm H₂S at WWTP Harnaschpolder

The Netherlands | SULPHUS 2200-1 treating 900 m³/h with 25 ppm H₂S at pompstation Geert Huizinga Groningen

The Netherlands | 1x SULPHUS 3500-3 treating 1500 m³/h with 400 ppm H₂S at Trobas Gelatine.

United Kingdom | 1x SULPHUS 4000-6 treating 23.900 m³/h with 79,5 ppm H₂S STW of Blackburn Meadows.

United Arab Emirates (UAE) | 8x SULPHUS 3500-6 treating 15.000 m³/h with 2.000 ppm H₂S at the STW of Ajman.



Notes

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