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ADVANCED BIOLOGICAL FILTERS (FBA)

Juin 2011

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ambiente
tecnología
consultores

at

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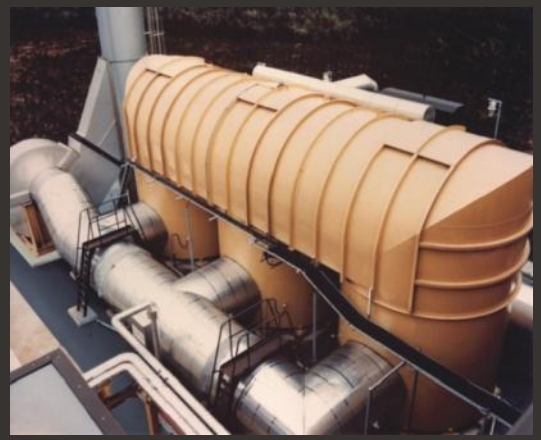
Expert

Assessment and treatment

Air pollutans



VOC and odor

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Company experience

- ✓**More than 150 studies related to stablish the odor impact of several types of industries and also of Environmental Plants**

- ✓**Engineering projects *of high efficiency* Odor Removal Treatment *in a very demmanding environments***

- ✓**Has the capability to supply High Efficiency Odor Removal Systems: Regenerative and Recuperative Thermal oxidisers, Advanced Biofilters, Biotrickling, Non Thermal Plasma,…**

- ✓**Markets: Chemical plants, Pharmaceutical plants, Automotive, Petrol Refinery Stations, Food Industry, Environmental plants: Waste water treatment plants, Municipal Waste Treatment Plants, Composting plants, Biodigestion plants, landfills,…**

- ✓**Odor treatment capacity installed in Spain ≅2.000.000 m^3/h, in the world close to 15.000.000 m^3/h**

THE ODOR PROBLEMS

Why is necessary to treat and control odor emission

- This is a problem of increasing interest
- The sources of odors are varied: may be industrial, may be Environmental plants, or other (like farms, restaurants,...).
- Due to the urban pressure the activities that generate odor problems are in some cases located in vulnerable environments (close to villages or to houses,..)
- Unclear boundaries and sometimes unrealistic odor emission limits or odor inmission limits can cause lots of troubles between the activity that generates the odor emission and the neighborhood
- The concentration of different industrial activities and environmental plants that may cause odor emission make the odor problem more complicated as the different odor emissions are mixed and superimposed and it is difficult to find out which company or companies are the main responsibles of the odor episodes

Why is necessary to treat and control odor emission

- When one industrial or environmental activity starts it must have all the needed enough ventilation and needed odor treatment systems to avoid any odor complaints.
- How is it possible to avoid odor complaints since the first beginning?
  - Odor problems must be studied seriously and deeply before the activity starts (kind of activity, running parameters proces, raw materials used,...)
  - It must be considered very carefully ***the real*** capacities and the limitations of every odor treatment technology
  - The owner of the plant cannot expect to obtain high odor removal efficiencies with low profile odor treatment technologies even if these technologies are recommended in the BREFs documents or that the high efficiency results are offered by suppliers with poor knowledgement and/or that are not so honest
  - *"You should not take any wooden nickels"*

Why is necessary to treat and control odor emission

- It is very important that the odor control system presents the following characteristics in order to avoid complaints (it is not enough to demonstrate the achievement of the tipically required boundary limits like $3uo_E/m^3$ (P98) in ambient air provided by modeling):
  - High odor removal efficiency (for all the odor emissions that one particular activity can cause or generate)
  - High efficiency since first day and along all the operational life
  - Availability of the technology: larger than 98%

- *The main aim of our company is to solve efficiently and in the easiest way for any case the odor problems that our customer have, and if possible to prevent them since the first beginning. We apply for any case the more indicated high performance odor treatment technologie: Advanced Biofilters, Thermal oxidisers, Non Thermal Plasma, high propulsion devices,…*


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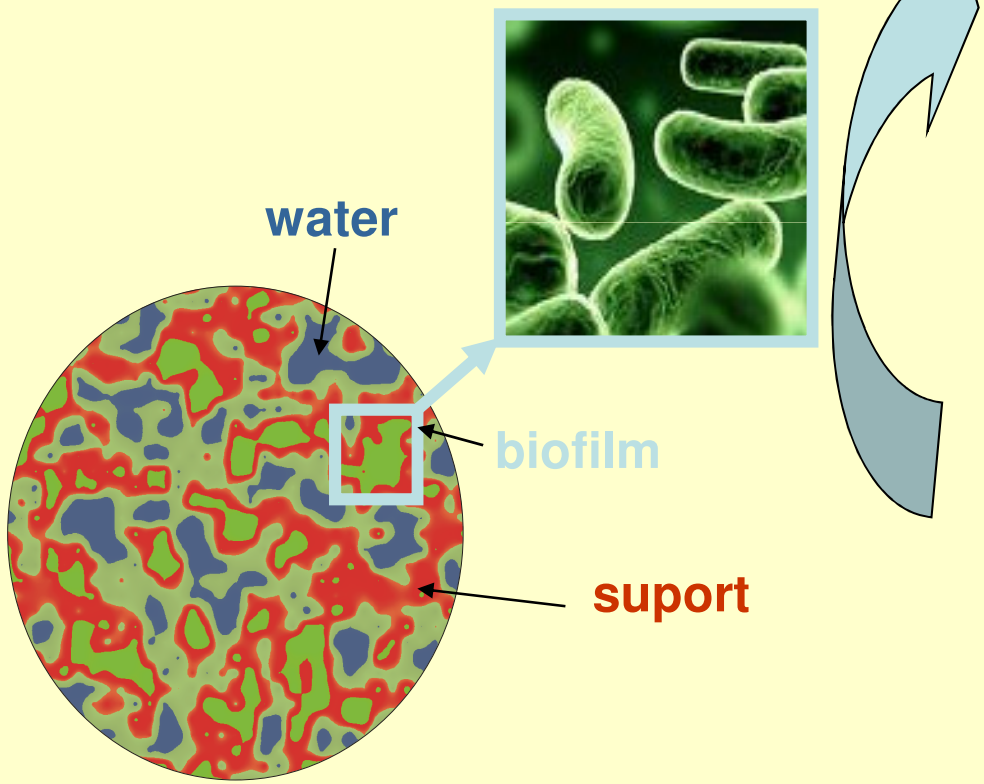
AIR BIOFILTRATION

Biodegradation of odorous compounds

The biodegradation happens in a fixed media that has a microbiologically active surface. The byproducts are mainly CO_2 and H_2O and the microorganisms are self regenerated



$H_2O+CO_2+CO_3^{2-}+SO_4^{2-}+$
$+NO_3^-+$ "by products"
Clean air

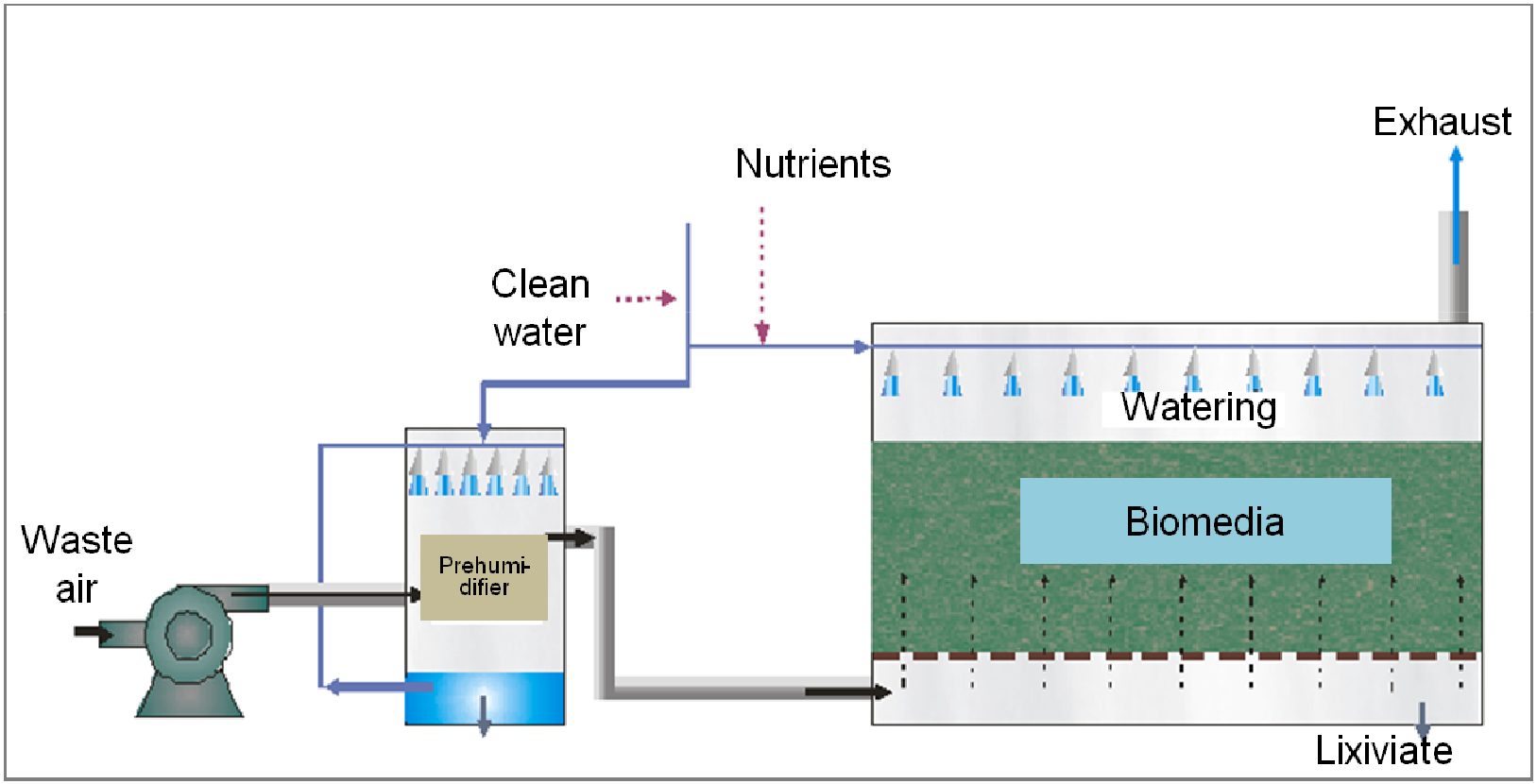
$COV+H_2S+NH_3$
Polluted air

There is no pollutant transfer as happens in scrubbers or carbon adsorption systems

FIELD APPLICATION OF BIOFILTER

INDUSTRIAL PROCESS	ENVIRONMENTAL PLANTS
Paint and coating industry	Sludge pumping stations
Slaughterhouses and similar activities	Sewage plants (water and sludge lines)
Meat and fish activities	Sludge plants
Food industry	Urban Waste plants
Perfume industry	Composting plants
Wood industry	Manure plant (slurry…)
Chemical, petrochemical, pharmaceutical and cosmetic industry	Biomethanization plants
Others: paper industry, printing, fodder, farm,…	Waste rendering plants

FBA diagram- Closed biofilter



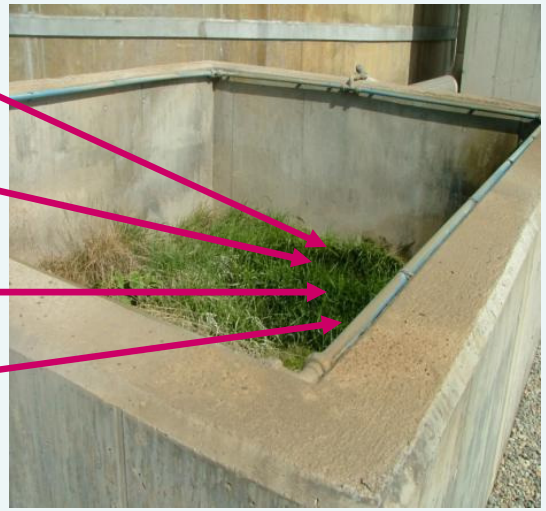
Conventional biofilter

Bark

Coconut fiber

Compost

Wood



Shells

Peat, heather

Features? Organic support biofilters 1/2

- Low morphology uniformity (channelling)
- Low-half superficial area, as a consequence low contact time and low specific efficiency.
- No possibility of sterilization. Since the first beginning presence of spurious microorganisms, low density of “useful” microorganisms and no possibility of using selected ones
- Maximum effectiveness after some weeks (from this point will start to decrease).
- Decrease of the mechanic resistance (less durability). Relatively low useful life (expected 2-3 years and really even less)

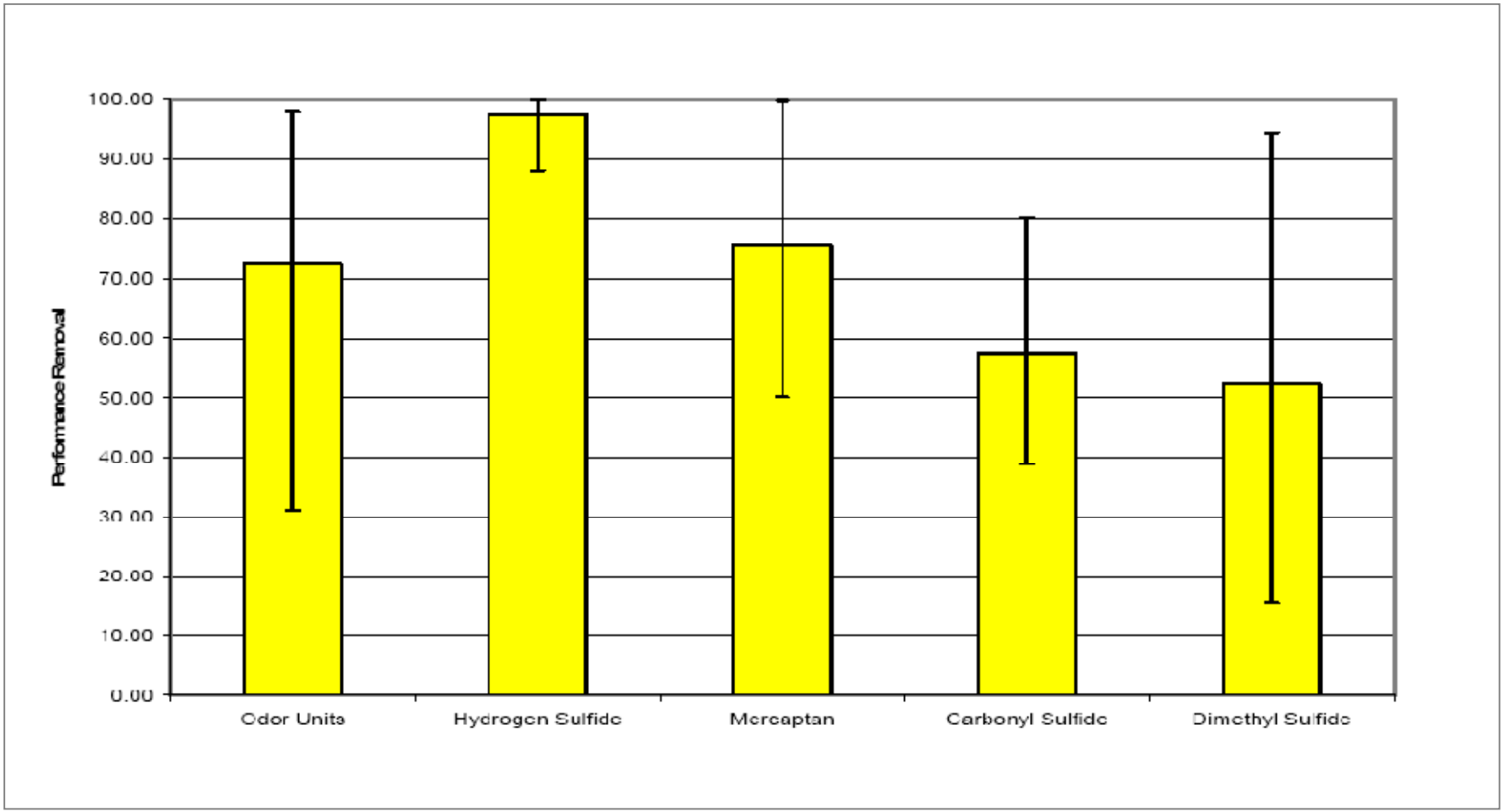
Features? Organic support biofilters 2/2

- High inherent odour (less capacity of performance of demanding limits)
- Increasing compacting (ΔP, channelling). Average pressure drop (initially around 1.000Pa at the end-of-life around 2.000Pa)
- Poor capacity of adsorption what implies low capacity to treat efficiently peak concentrations or changes of odorants

Difficulty (in fact impossibility) to guarantee honestly the demanding effectiveness required (<1000-1500UO_E/m^3) and/or useful availability of the technology larger than 98%.

Featuring/characteristics conventional organic biomedia

(3th IWA International Conference on Odour and VOCs–Barcelona 2008)



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ADVANCED BIOLOGICAL FILTERS (FBA) SUPPLIED BY STA

Atmos'Fair 2011- 22 Juin 2011

Sílvia Nadal

Characteristics FBA biomedia (1/2)

To avoid all the disadvantages explained above, it ***has been developed the biotechnologically advanced biomedia for the Advanced Biofilters.***

Advanced Biofilters are a real odor treatment technology not like conventional Biofiltration that are usually applied from an agriculture perspective

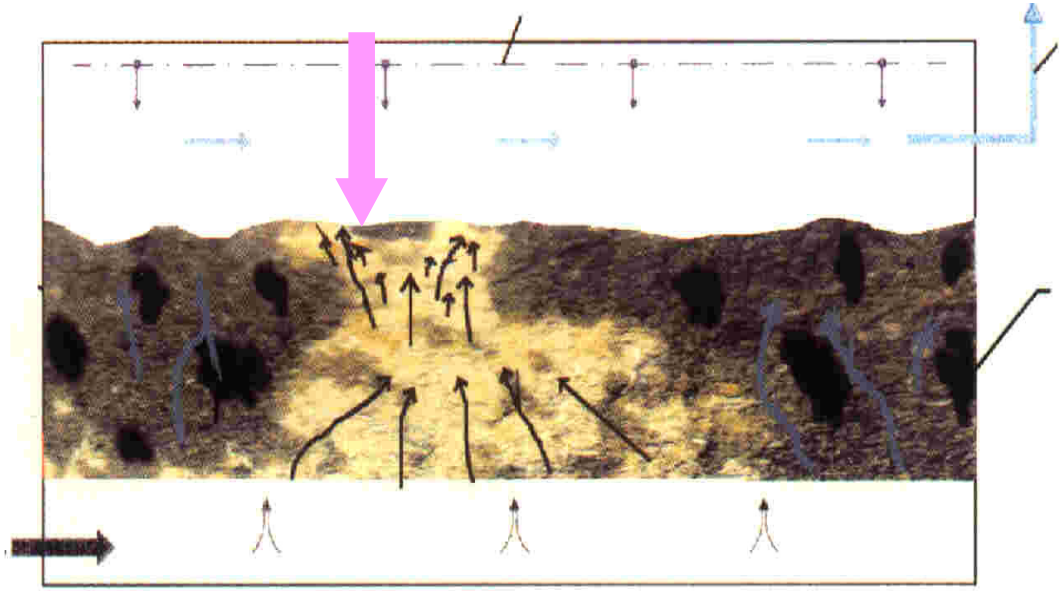
The ***inorganic phase gives the suitable mechanical resistance***, while the ***organic phase is an optimal media for the proliferation and fixation of the microorganisms population and acts as a effective adsorbent*** allowing the mitigation of the consequences from significant variations in the composition and concentration in the polluted air.

The biomedia is first sterilised (to destroy the existing bacteria, fungi,...) and then inoculated (in origin) with some ***microorganisms consortium genetically selected but from natural origin.***

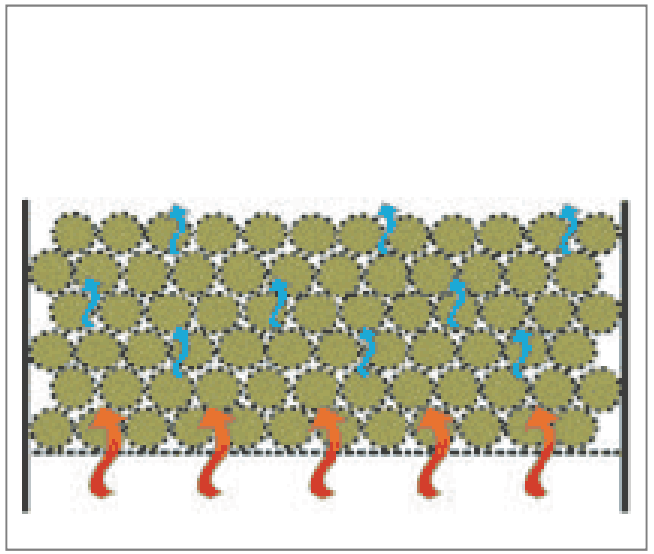
Advanced and conventional biomedia

AIR DISTRIBUTION

Preferential channeling in conventional biomedia



Homogeneous flow in our system



Characteristics FBA biomedia (2/2)

This fact promotes the existence of ***high concentration of "useful" specific microorganisms which means maximum depuration capacity with less footprint and maximum depuration efficiency from the first day of running***

The modified inorganic support ***keeps its structural properties (porosity, geometric distribution,..) along the time.***

To summarize it can be indicated that the benefits of advanced biofilters with modified inorganic support provide a maximum deodorization effectiveness guaranteed (≥95%), a very low inherent odour of the biomedia what allows a very low final odor concentration, and an extended useful life guaranteed (≥8 years), a low pressure drop (around 400 to 600Pa), with a total cost (investment+running costs) similar over the whole life of the system than the ones offered by conventional biofilters.

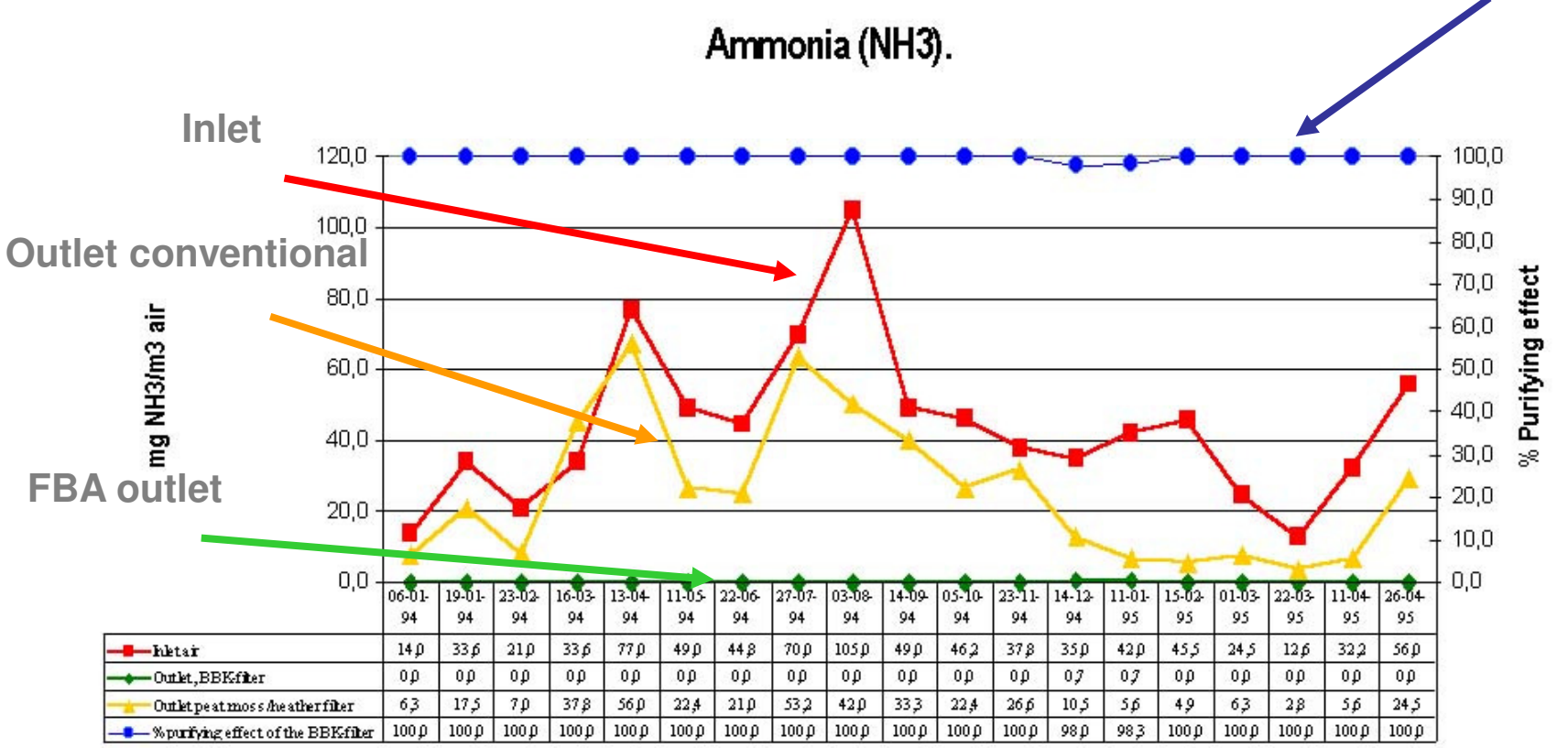
Cleaning efficiency of NH_3
FBA vs conventional biofilter

Efficiency % FBA

Inlet

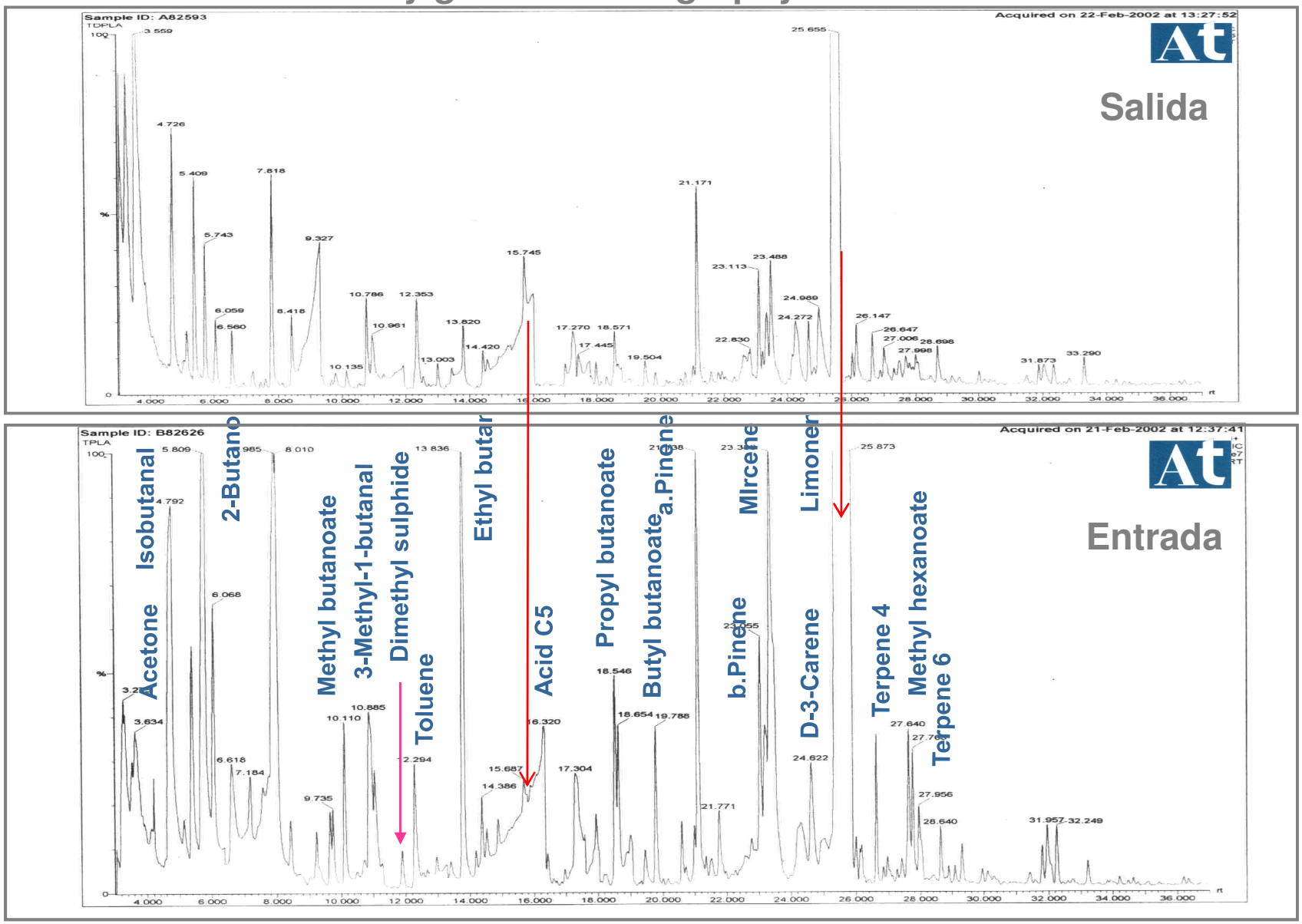
Outlet conventional

FBA outlet

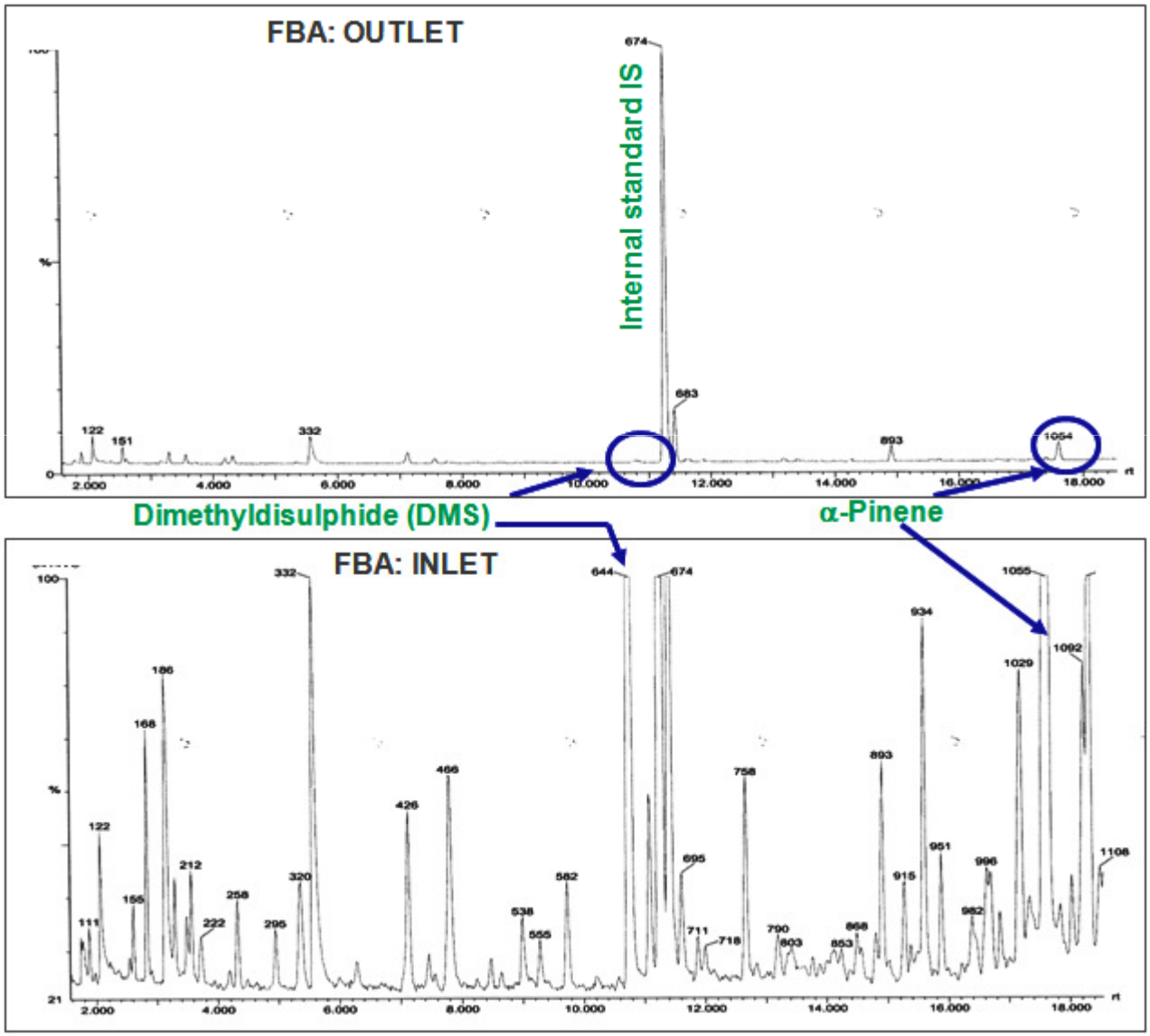


	06-01-94	19-01-94	23-02-94	16-03-94	13-04-94	11-05-94	22-06-94	27-07-94	03-08-94	14-09-94	05-10-94	23-11-94	14-12-94	11-01-95	15-02-95	01-03-95	22-03-95	11-04-95	26-04-95
Inlet air	14,0	33,6	21,0	33,6	77,0	49,0	44,8	70,0	105,0	49,0	46,2	37,8	35,0	42,0	45,5	24,5	12,6	32,2	56,0
Outlet, BBK-filter	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	0,7	0,0	0,0	0,0	0,0	0,0
Outlet peat moss/heather filter	6,3	17,5	7,0	37,8	56,0	22,4	21,0	53,2	42,0	33,3	22,4	26,6	10,5	5,6	4,9	6,3	2,8	5,6	24,5
% purifying effect of the BBK-filter	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	98,0	98,3	100,0	100,0	100,0	100,0	100,0

Inlet and outlet by gas chromatography in a conventional biofilter



Inlet and outlet by gas chromatography in our biofilter

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REFERENCES

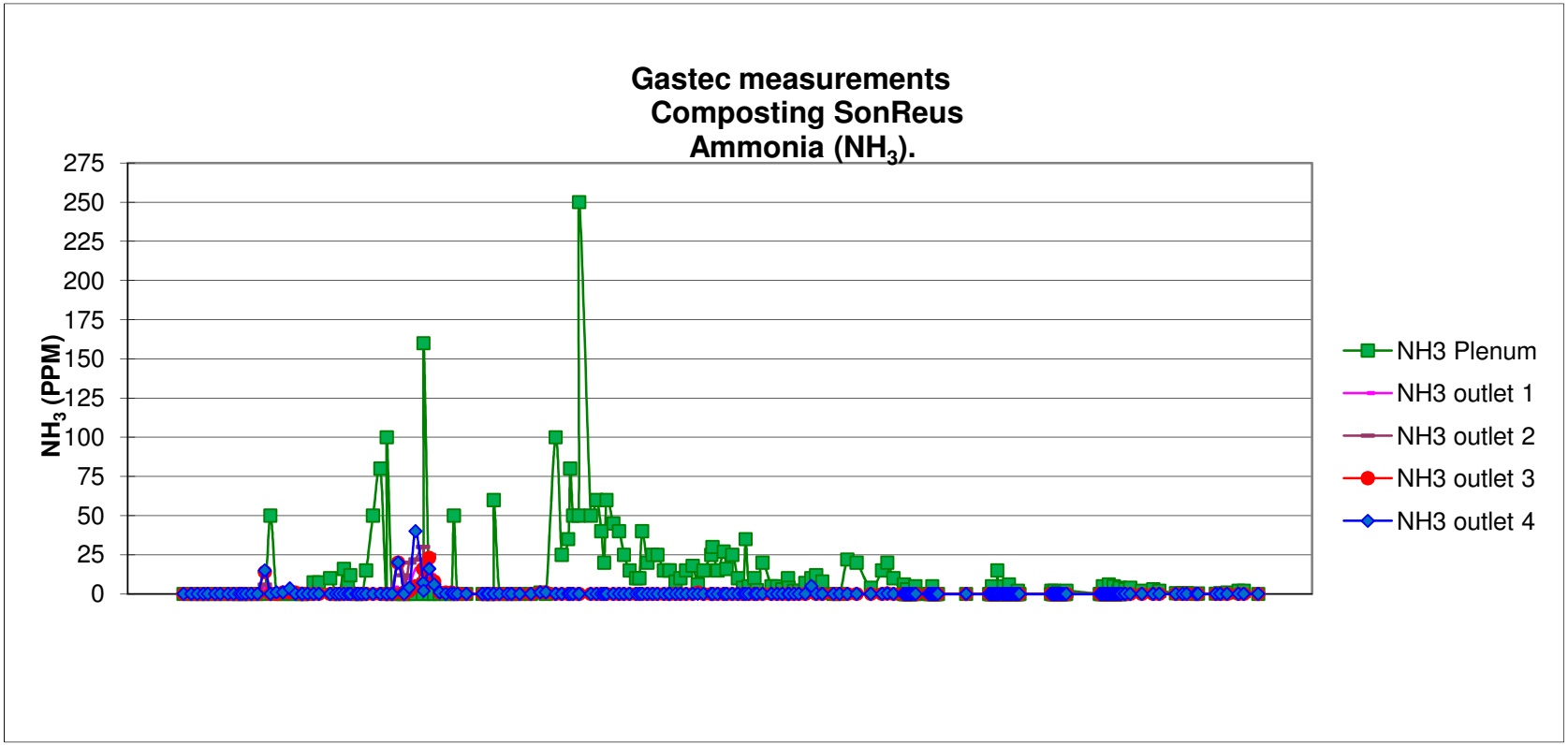
Advanced Biofilter (at Sonreus (Mallorca)

Parameter	Comment
Origin of the emission	Composting of wastewater sludges
Air flow (m3/h)	127.440
Installation data	2003 (8 years running without biomedia change)

Reference	Year 2004 Odor concentration (uo_E/m^3)	Year 2011 Odor concentration (uo_E/m^3)
Inlet (Sampling 1)	10.584	---
Outlet (Sampling 1)	**761**	**121**
Inlet (Sampling 2)	15.936	---
Outlet (Sampling 2)	**525**	**228**

Composting Plant Sonreus (Mallorca)

Results from the samples of ammonia concentration before and after the FBA installed in the composting plant Sonreus (Mallorca)



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Composting plant Sonreus (Mallorca)

LUGAR: SONREUS (MALLORCA)		COMPOSTING PLANT
Compounds detected (*)	**Inlet 1 microgram/m3 (**)**	**Outlet 1 micrograms/m3 (**)**
Acetona + sulfuro de dimetilo	22,3	<1,5
Disulfuro de carbono	5,4	1,3
Acetato de metilo	3,4	<1,5
2-Metilfurano	4,0	<1,5
Benceno	4,2	<1,5
3-Metil-2-butanona	22,6	<1,5
2-Pentanona	5,3	<1,5
3,3-Dimetil-2-butanona	9,1	<1,5
Disulfuro de dimetilo	234,1	<1,5
4-Metil-2-pentanona	13,9	<1,5
Tolueno	109,5	4,4
3-Metil-2-pentanona	8,1	<1,5
4,4-Dimetil-2-pentanona	15,4	<1,5
2-Hexanona	4,5	1,4
Etilbenceno	6,8	2,8
m+p-Xilenos	26,8	<1,5
o-Xileno	8,8	<1,5
Disulfuro de metil propilo+ Estireno	7,8	<1,5
Posible 3-Heptanona	4,2	<1,5
6,6-Dimetil-2-metilen-biciclo(3.1.1)heptano	30,3	<1,5
Posible ciclohexanometanol	9,9	<1,5
a-pineno	1851	22,6
Camfeno	71,6	<1,5
Desconocido	6,5	<1,5
Hidrocarburo aromático	17,8	<1,5

(*) Excluding lineal hydrocarbon (compound with low odour impact
(**) Concentrations relative an internal patron of toluene-D8
(***) For non detected compounds has been considered LQ(1,5mg/m3)

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Advanced Biofilters (at Ecoparc-2- Barcelona)

Parameter	Comment
Origin of the emission	Close composting process of Organic Part of Municipal waste
Air flow (m^3/h)	150.000
Installation data	2006 (5 years running without biomedia change)
Odor removal (uo/m^3)	Inlet=152.622 / Outlet=4.850(97%)

Parameter	Comment
Origin of the emission	Process of Municipal waste
Air flow (m^3/h)	360.000
Installation data	2008 (3 years running without biomedia change)
Odor removal (uo/m^3)	Inlet=12820 / Outlet=664(95%) **-800Muo/h less than the organic ancestor**

FBA

Advanced Biofilters at Ecoparc-1 (Barcelona) and Maresme

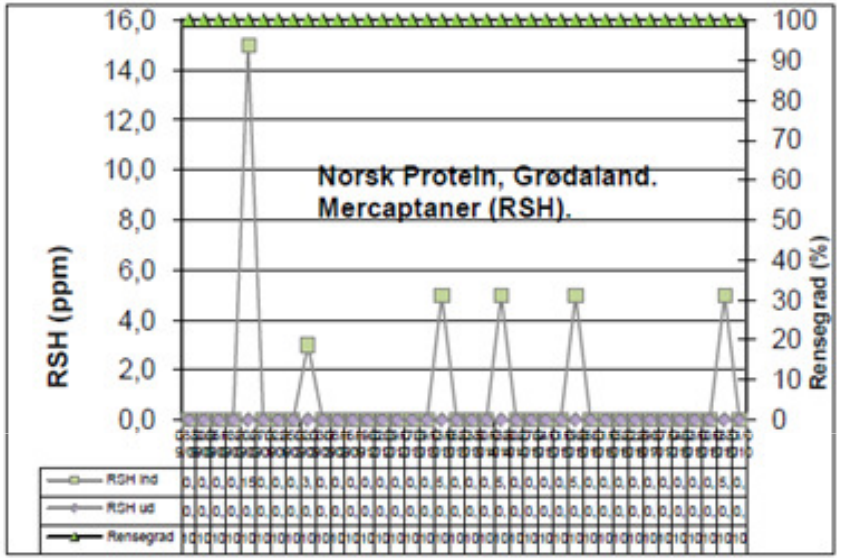
Parameter	Comment
Origin of the emission	Composting &biodigestion of Organic Part of Municipal waste
Air flow (m^3/h)	390.000
Installation data	2007 (4 years running without biomedia change)
Odor removal (uo/m^3)	Inlet=18.500 / Outlet=525

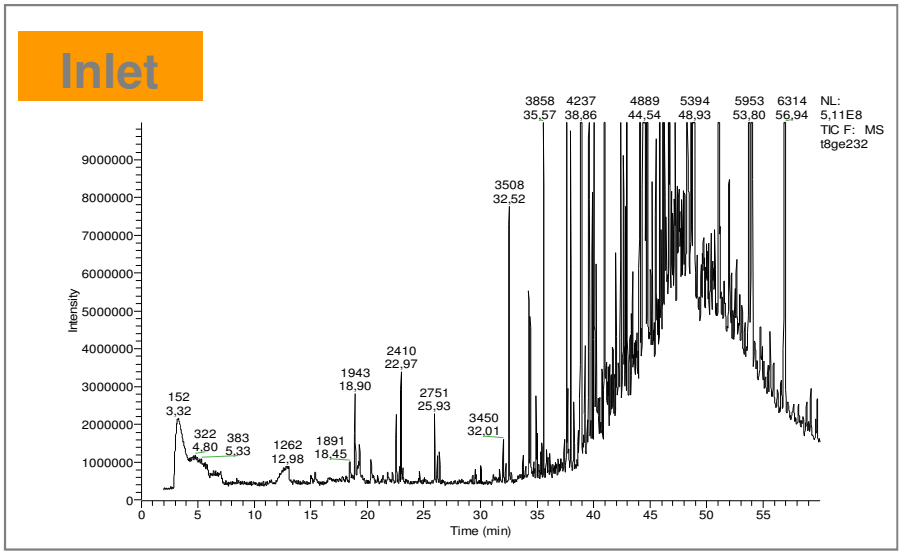
Parameter	Comment
Origin of the emission	Composting &biodigestion of Organic Part of Municipal waste
Air flow (m^3/h)	250.000
Installation data	2011 (start up)
Odor removal (uo/m^3)	Inlet= 14500 / Outlet=540 **Preliminary results**

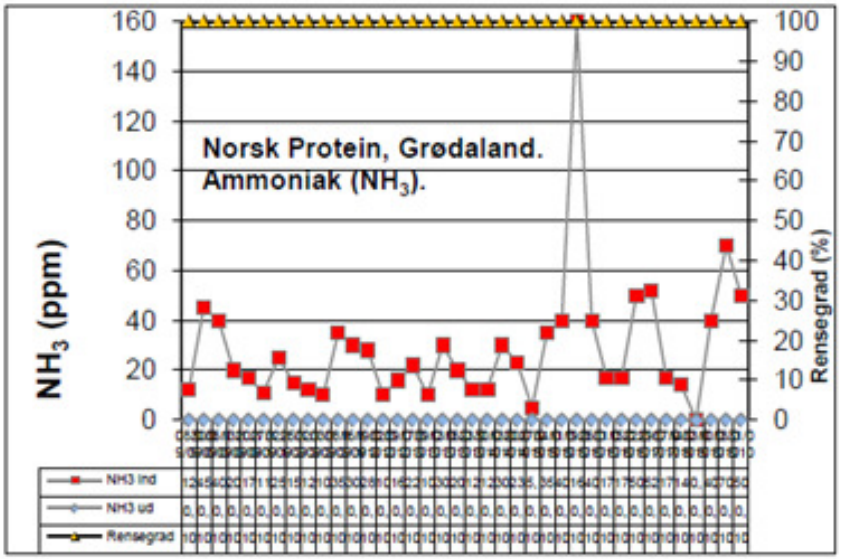
Advanced Biofilter (at Norsk Protein- Norway) 2009

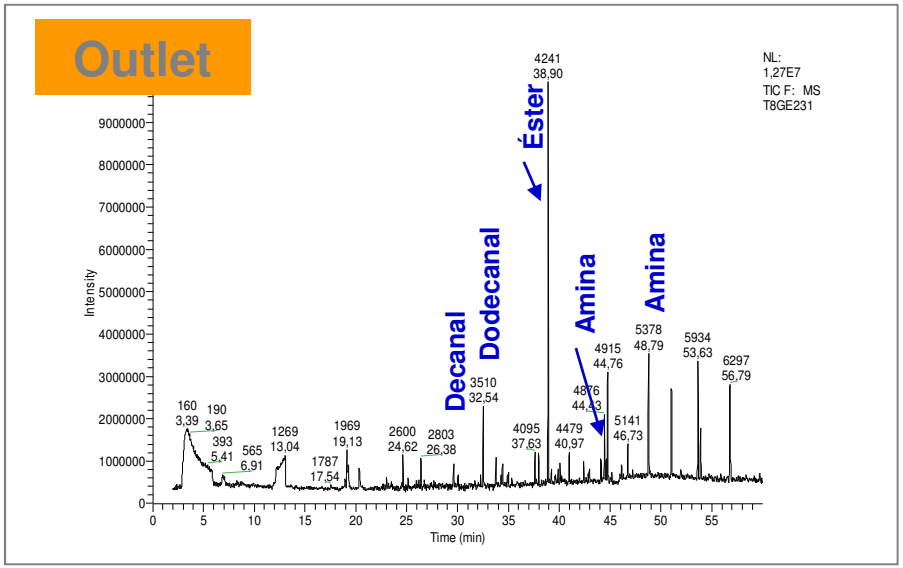
Parameter	Comment
Origin of the emission	Animal rendering
Air flow (m3/h)	55.000
Installation data	2009 (2 years running without biomedia change)
Odour concentration inlet	from 130.000 to 300.000uo/m^3
Odour concentration outlet	from 100 to 520uo/m^3

TIC- Chromatograms inlet and outlet FBA in a rendering plant

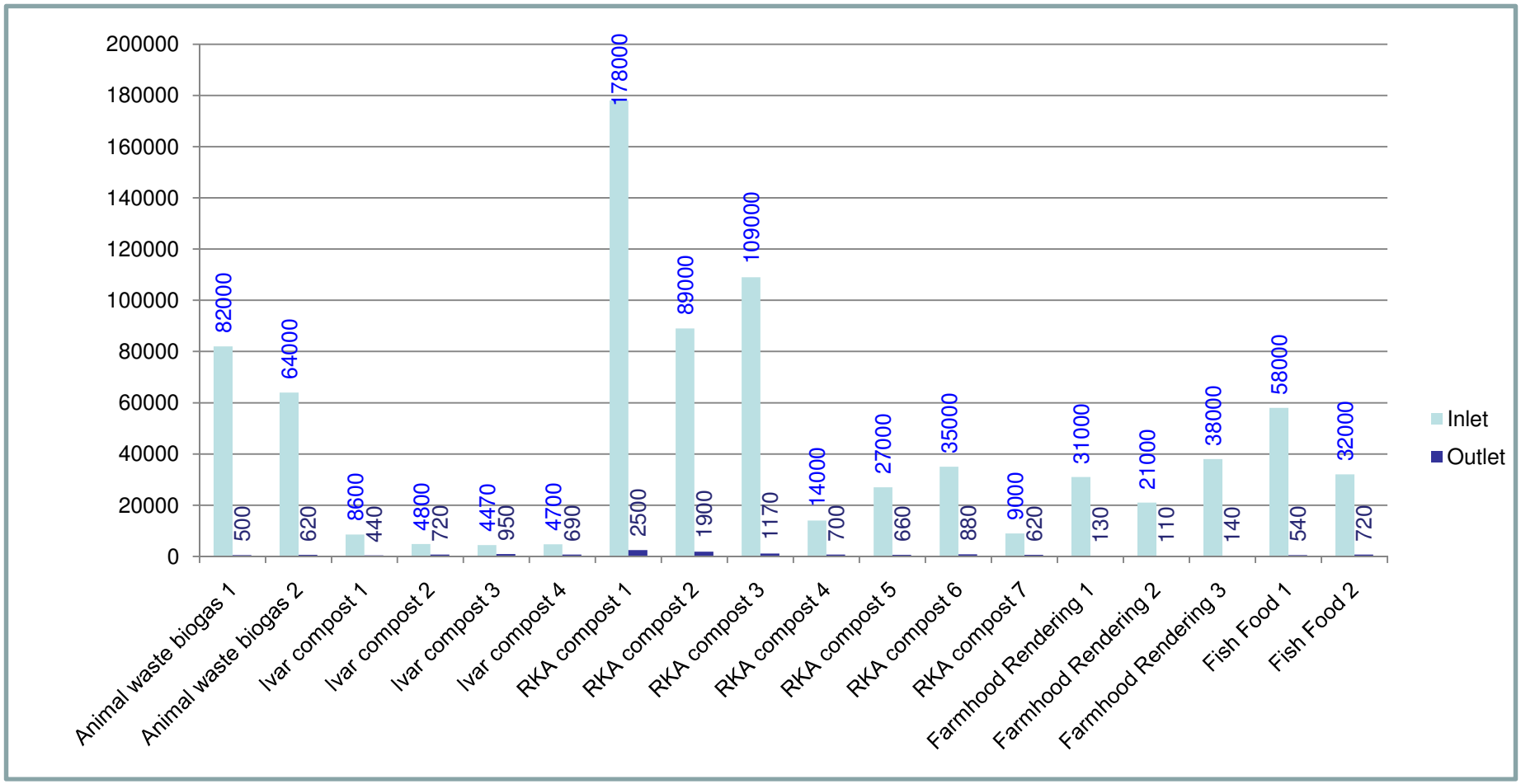








Results from different plants



FBA: Conclusions

- *Advanced Biofilters (with a mix of organic and inorganic support and preinoculated microorganisms) are a real odor removal (bio)technology*
- *Advanced Biofilters allow to treat very polluted air emission achieving very high odor removal efficiencies*
- *Advanced Biofilters offer odor removal efficiencies close to the ones that offer thermal oxidisers but with far lower running costs*
- *FBA are an environmental friendly technology as the involved consumptions (electricity, water,..) are lower than the ones that present conventional biofilters, thermal oxidisers, carbon filters or chemical scrubbers*