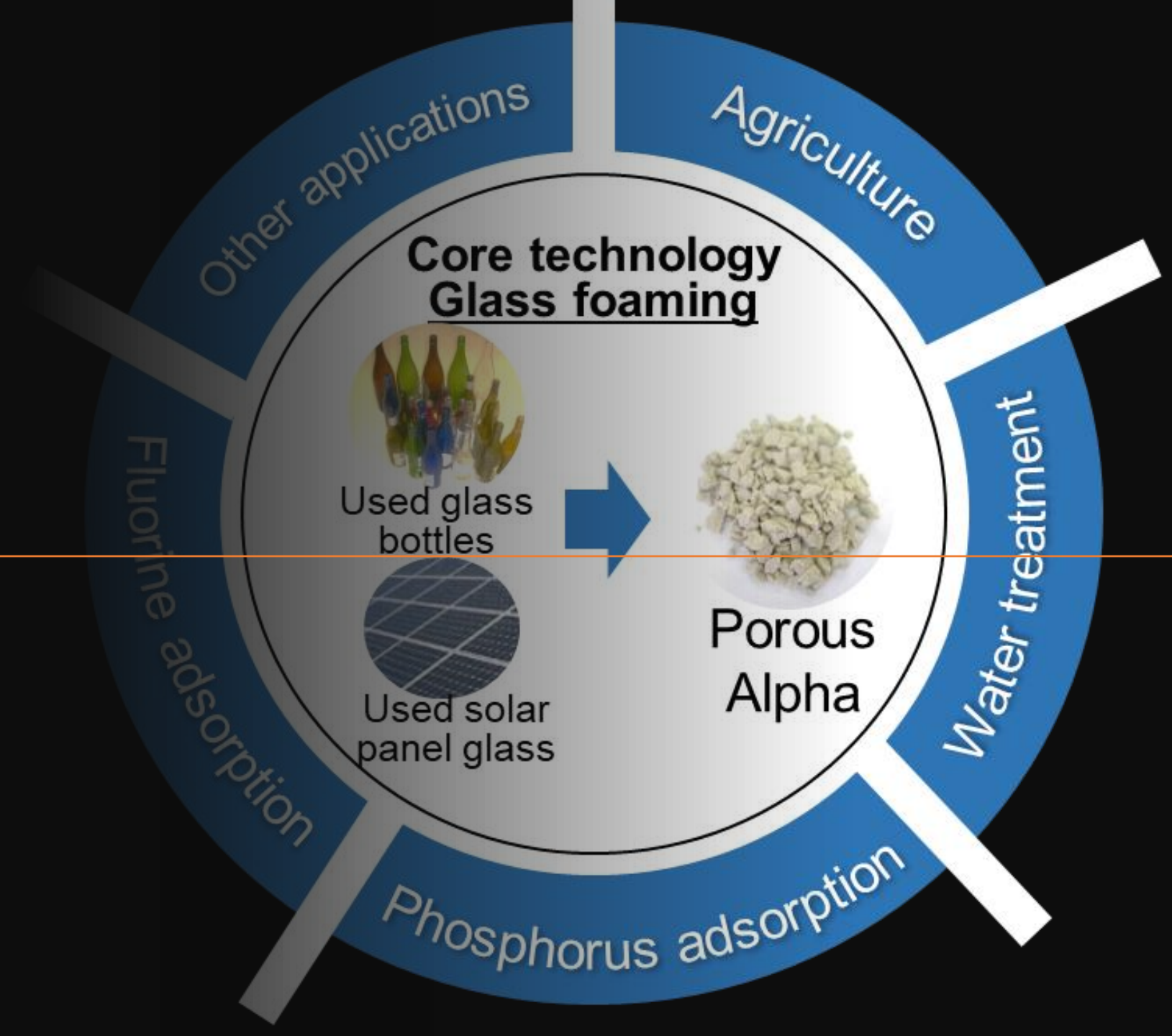
Porous Alpha

ONE SOLUTION

MULTIPLE APPLICATIONS

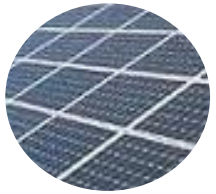
AIR TREATMENT: BIOFILTRATION



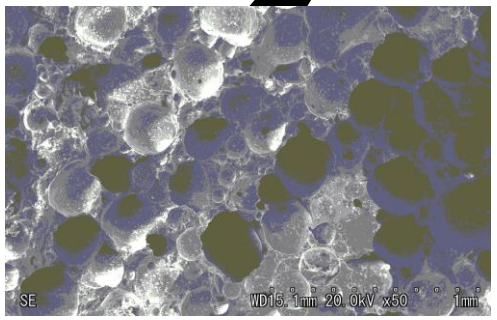
Our technology is centered at foamed glass “Porous Alpha” from used glass, developing its application

Used Glass bottles

Glass in outdated solar panel



Porous Alpha



Electron microscope image of Porous Alpha

Transformed for each application

Application

- Air treatment as biofilter media
- Water treatment: Adsorption and recovery of fluorine
- Water treatment: Adsorption and recovery of Phosphorus ion
- Water treatment: Biofiltration
- Soil conditioning: improving water retention capacity and aeration capacity
- Weed prevention for solar park
- Rooting media for hydroponics
- …etc.

BETTER 2 EARTH

TottoriResourceRecycling Global

Porous Alpha is made by burning of mixture of pulverized glass and foaming agent

Glass waste

Production line of Porous Alpha (Illustrative)

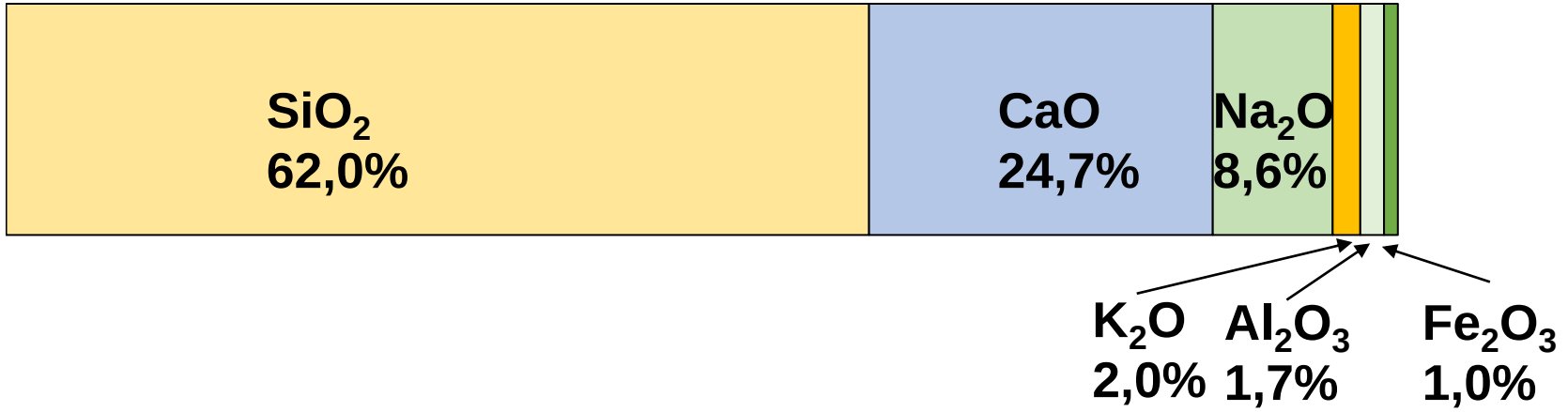
Crushed glass

Powder glass

Foamed glass
= Porous Alpha

Porous Alpha is mainly composed of silica and calcium oxide, similar to the chemical composition of natural sand

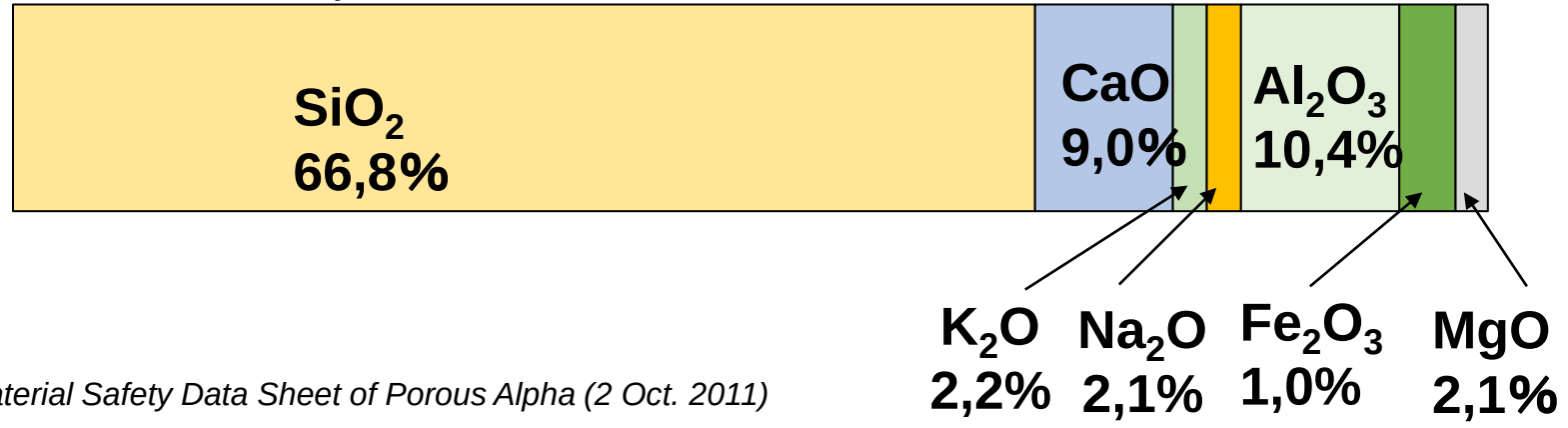
Main chemical composition of Porous Alpha*



Other minor components (less than 1%)

Ti, Cr, Mn, Ni, S, etc

Chemical composition of natural sand in Taklamakan Desert in China



** Material Safety Data Sheet of Porous Alpha (2 Oct. 2011)*

Physical characteristics is as follows

Based on Material Safety Data Sheet of Porous Alpha , Oct 2011

- Visual appearance: Achroma or light green etc.
- Odor: Odorless
- True density: ca 2,5 g/c㎥
- Size density: 0,9 ≈ 1,2 g/c㎥
- Grain size: 50 ≈ 2.000 μm (Median 700μm)
- Grain shape: Abrasive infinite shape
- pH: Max. pH 10,3 or pH 7(after water washing)
- Solubility: Not identified
- Softening temperature: 720 ≈ 730℃(unresolved)
- Volatile: not identified

Porous Alpha has three uniqueness which are the base for our diversified applications

Uniqueness	Competitors' products	Merit by the uniqueness
1 No-elution of heavy metal	Heavy metal elution is not avoidable	▸ Range of acceptable raw material (glass) is wider than competitors' products ▸ Widen range of application by safety nature - Usable for agriculture as soil conditioner - Not contaminating the treated water when used as water treatment agent
2 Coexistence of Interconnected and closed pore	Only closed pores	▸ Possible to contain diversified matter and microbes - Diversified microbes for deodorizing - Water and air for soil conditioner ▸ Air and water are permeable - Perform as water treatment agent by sinking in water
3 Adjustable specific gravity and pore size	Constant specific gravity	▸ Adjustable to the requirement by application and environment

Under the Japanese regulation, Porous Alpha can be used as a soil for agriculture without environmental impact

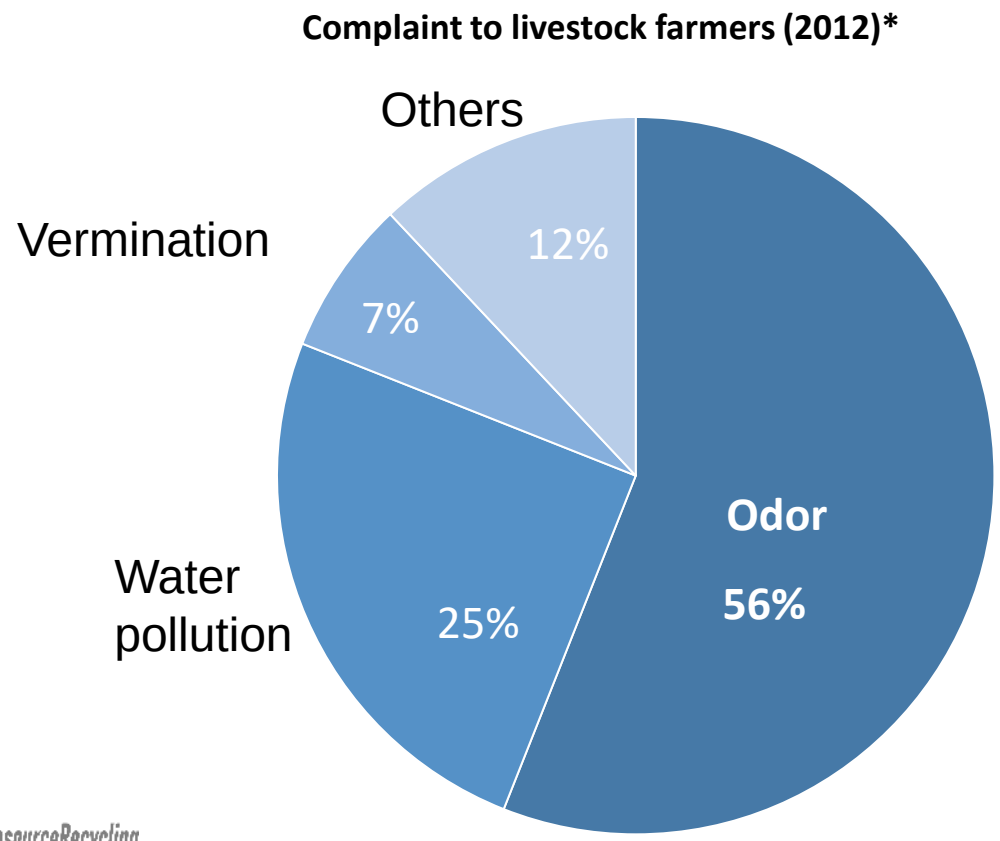
Result of leaching test based on the “Environmental regulation regarding the soil pollution”, 23 August 1991, Ministry of Environment, analyzed by Tottori Health Association

No.	Item	Result	Criteria
1	Alkyl mercury	Not detected	Not detected
2	Total mercury	< 0,0005 mg/l	0,0005mg/l
3	Cadmium	< 0,001 mg/l	0,01mg/g
4	Lead	0,001 mg/l	0,01mg/l
5	Organophosphorus	Not detected	Not detected
6	Hexavalent chromium	0,014mg/l	0,05mg/l
7	Arsenic	< 0,001mg/l	0,01mg/l
8	Total cyanogen	Not detected	Not detected
9	PCB	Not detected	Not detected
10	Trichloroethylene	< 0,03 mg/l	0,03mg/l
11	Tetrachloroethylene	< 0,01 mg/l	0,01mg/l
12	Dichloromethane	< 0,02 mg/l	0,02mg/l
13	Carbon tetrachloride	< 0,002mg/l	0,002mg/l
14	1,2 – Dichloroethane	< 0,004 mg/l	0,004mg/l

No.	Item	Result	Criteria
15	1,1 – Dichloroethane	< 0,02mg/l	0,1mg/l
16	Cis1,2 – Dichloroethylene	< 0,04 mg/l	0,04mg/l
17	1,1,1 – Trichloroethane	< 0,3 mg/l	1mg/l
18	1,1,2 – Trichloroethane	< 0,006 mg/l	0,006mg/l
19	1,3 –Dichloropropene	< 0,002 mg/l	0,002mg/l
20	Thiuram	< 0,006 mg/l	0,006mg/l
21	Simazine	< 0,003 mg/l	0,003mg/l
22	Thiobencarb	< 0,02 mg/l	0,02mg/l
23	Benzene	< 0,01 mg/l	0,01mg/l
24	Selenium	< 0,001 mg/l	0,01mg/l
25	Fluorine	< 0,08 mg/l	0,8mg/l
26	Boron	< 0,1 mg/l	1mg/l
27	Copper	< 0,5 mg/kg	125mg/kg

Air treatment for livestock barn, food processing factory, composting facility is required for their business in Japan

- Deodorizing is one of the important business issues for livestock business



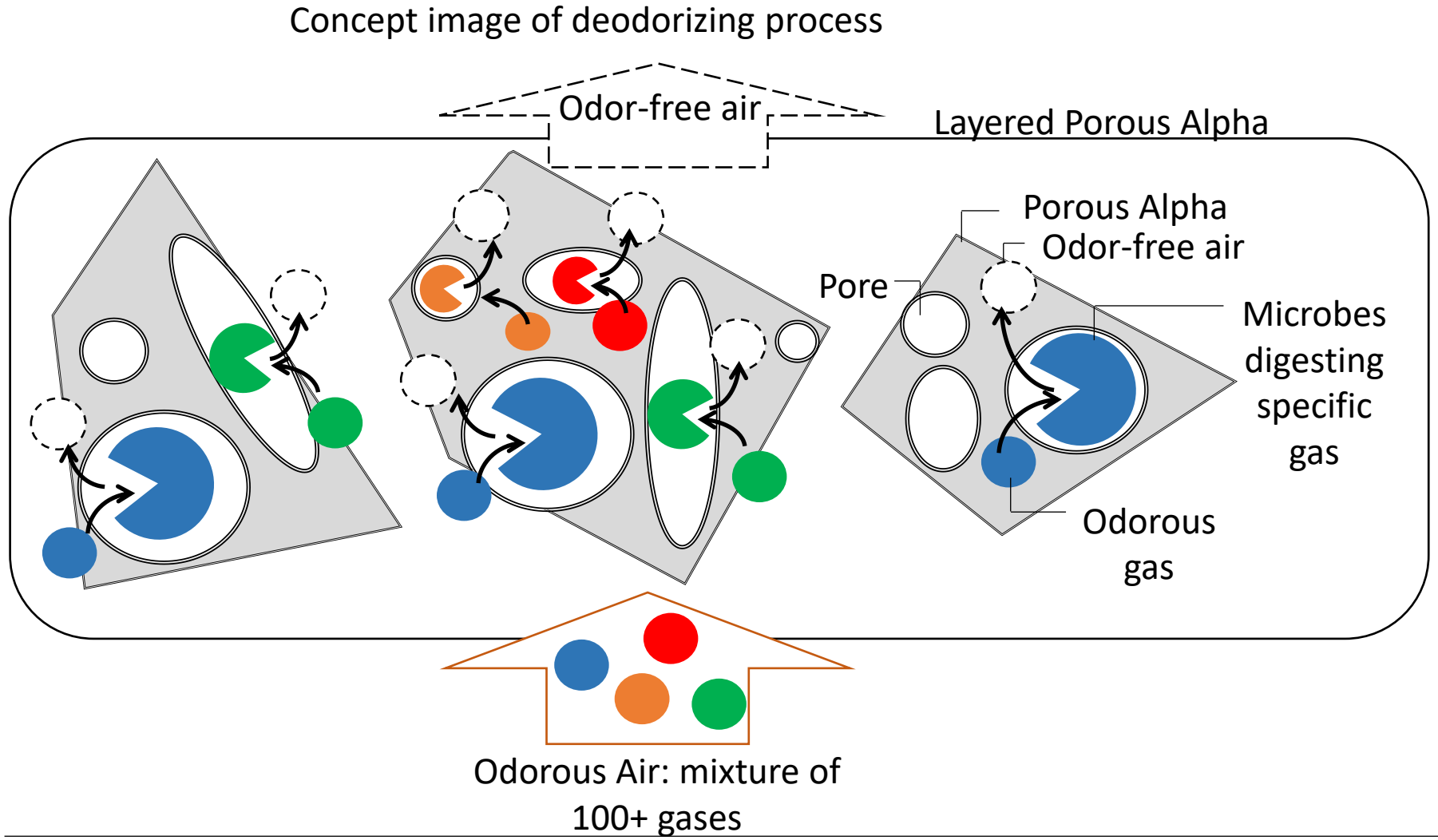
- Deodorizing is required in other industries
  - Food-processing facilities
  - Hotels - restaurants
  - Kitchen waste disposal facilities
  - Composting facilities
  - Feed manufacturing

Porous Alpha enables the low-cost air treatment solution

**Livestock Department, Ministry of Agriculture, Forestry and Fisheries*

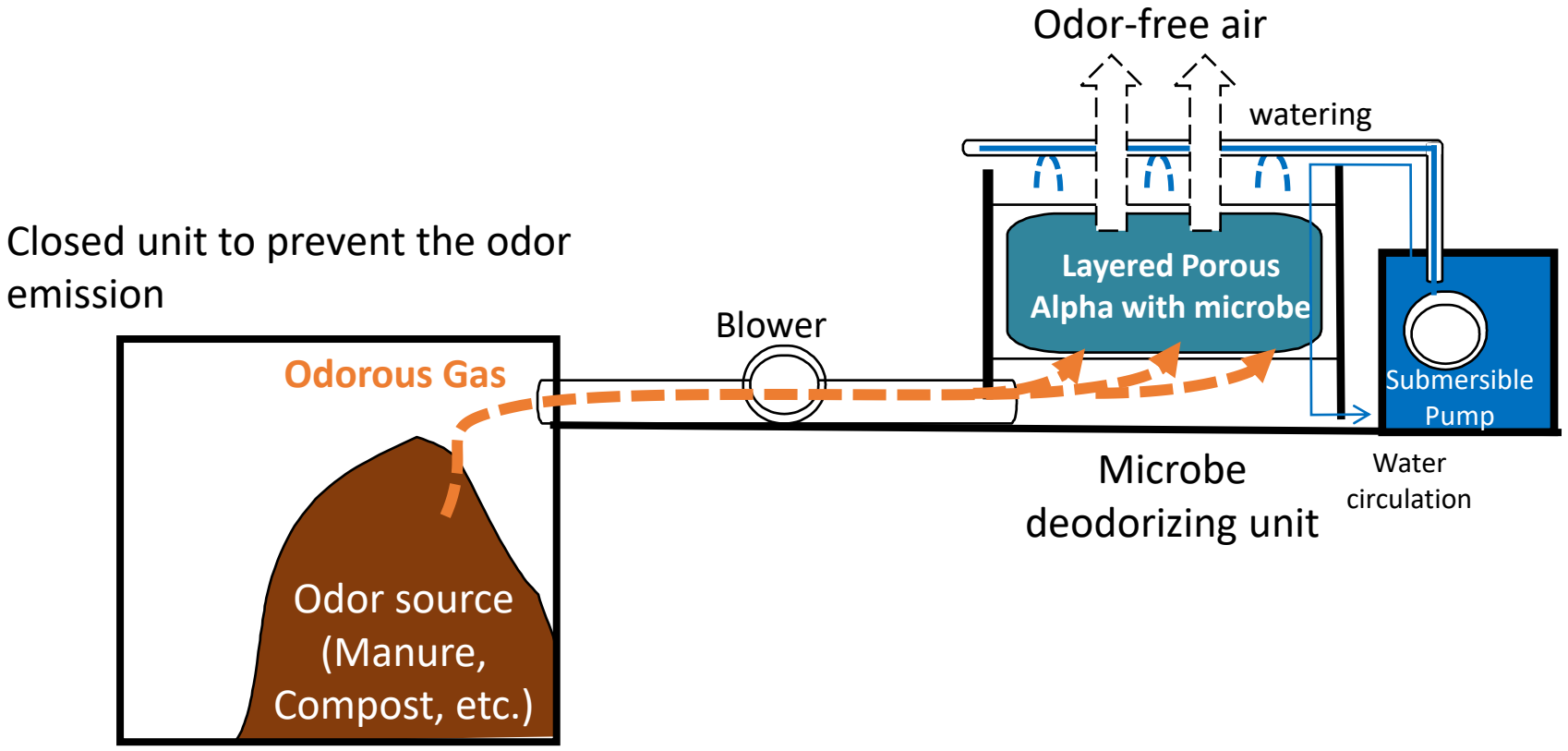
Microbes derived from manure, contained in **Porous Alpha**, digest gases in the interconnected pores

Diversified & interconnected pores in **Porous Alpha** is the source of high performance of deodorizing



Layered Porous Alpha with microbe deodorizes the odorous gas from livestock barn and composting facility

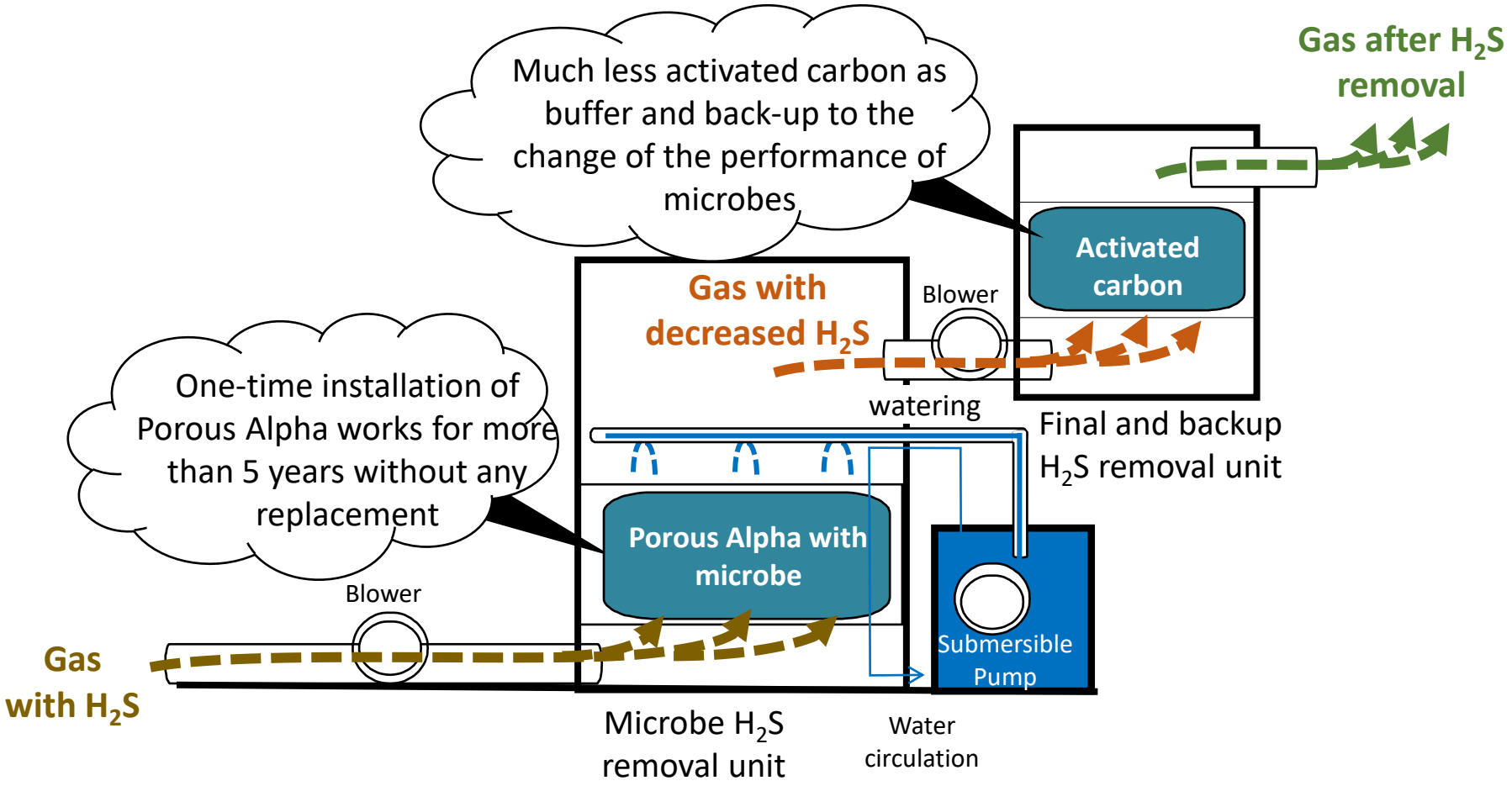
Conceptual figure of deodorizing system with Porous Alpha



For industrial purpose, the combination of **Porous Alpha** and activated carbon realises stable & cost effective H_2S removal

Compared to the solution with activated carbon which should be replaced frequently, it is possible to reduce the operating cost

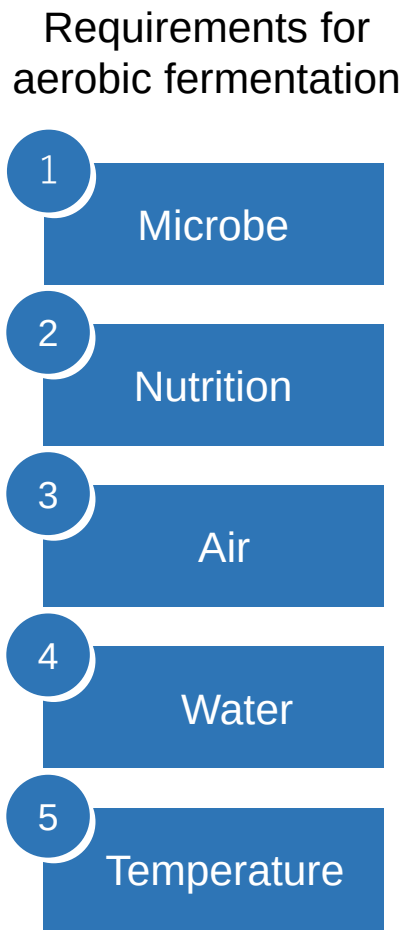
Conceptual figure of H_2S removal system with **Porous Alpha**



Deodorizing by Porous Alpha is suitable for aerobic fermentation

Our deodorizing solution is realized through digestion by microbe, i.e. **aerobic fermentation**

Aerobic fermentation requires five principal requirements which are suitably met in the application of **Porous Alpha**



How to realize

Source of odor is taken and put to the layer of Porous Alpha where microbe inhabit

The odorous air is the nutrition for microbe

The odorous gas has the air also

Watering by sprinkler is installed

Digestion of nutrition by microbe generates heat

Compared to the competing solution based on rock wool, we have advantages in durability & cost

Comparison of deodorizing between rock wool-base solution and Porous Alpha for livestock farmers

		Rock wool	Porous Alpha
	Mechanism	Air treatment: Biofiltration	Air treatment: Biofiltration
	Durability	8 ≈ 13 years	More than 15 years
	Cost	Large scale system needs high initial investment Expensive Rockwool	Simple system with low initial investment Less expensive Porous Alpha
Model case (30.000 pigs)	Initial invest	7 : 1	
	Running	3,5 : 1	

Utilisation of **Porous Alpha** for H_2S removal process can reduce the cost of gas treatment

	Activated carbon Only	Bio-filtration Only	Bio-filtration & Activated carbon
Performance	Stable As far as the saturation level is monitored, the performance is stable	Fluctuating With sudden environment change for microbe, there's risk of performance decrease	Stable The potential risk of performance deterioration of microbe can be covered by activated carbon
Cost	High Frequent change of activated carbon is quite expensive	Low As there's no need to change media for long term, the cost is low.	Low ≈ Middle As the activated carbon is used only as buffer and back-up, the required amount and frequency to change are comparably low. Existing activated carbon equipment can be used as backup

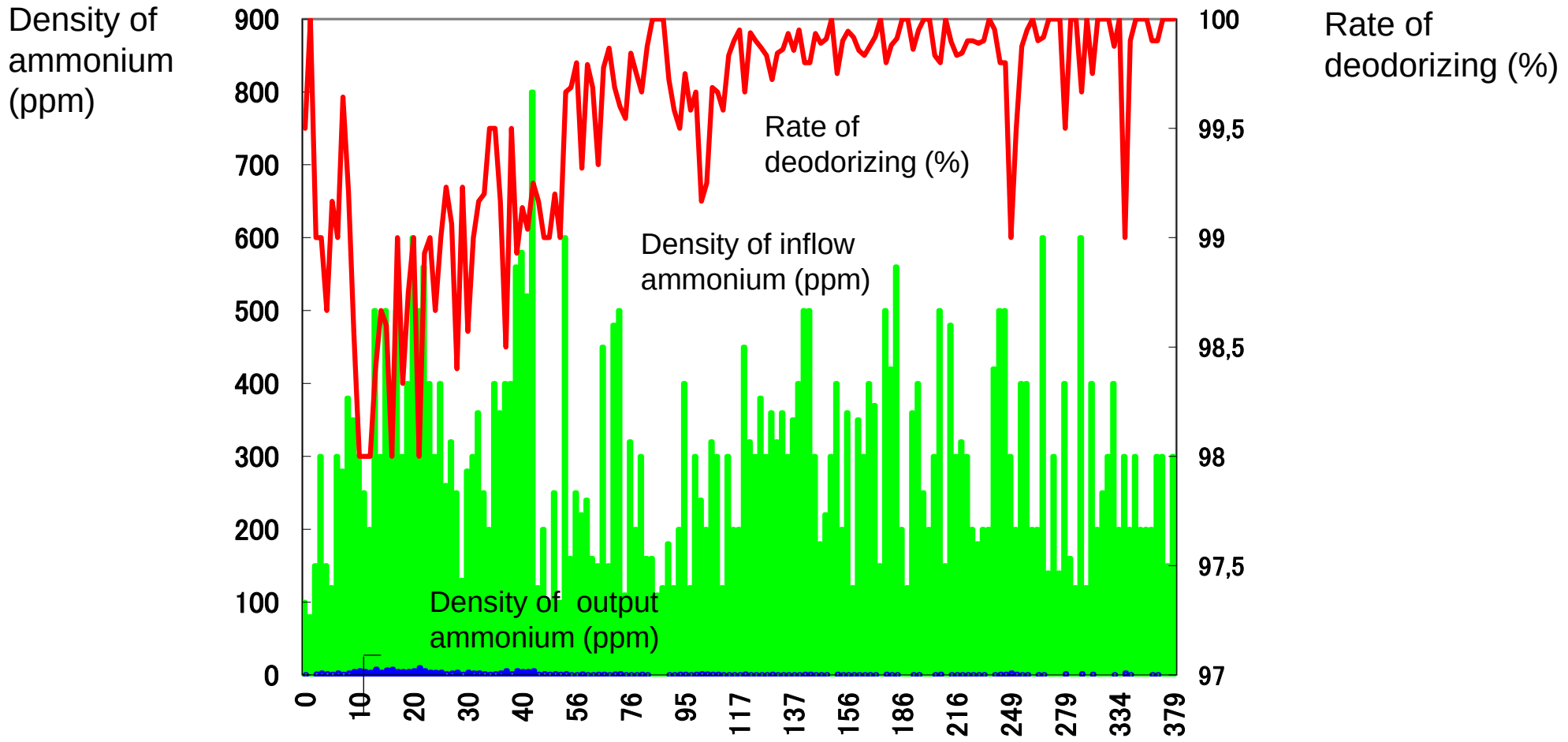
We have various experience in deodorizing

Summary of case studies for Air treatment: Biofiltration

No.	Customer	Scale of odor source	Density of source odorous air	Quantity of Porous Alpha	Rate of deodorizing (output density)	Cost of Porous Alpha system (JPY)	Cost of rock wool-based system (JPY)
1	Poultry house	30K birds	Ammonium 100≈800ppm	1,82 m^3	99% (0.1 ppm)	1 + 1/month	3,5 + 3/month
2	Poultry abattoir	3t/day	Ammonium 2,81ppm Methylmercaptan 0,33ppm Hydrogen sulfide 0.32ppm	7 m^3	Ammonium 99,7% (0,01 ppm) Methylmercaptan 98,9 (0,004 ppm) hydrogen sulfide 100% (0,00 ppm)	1 + 1/month	5 + 3/month
3	Pig house	15 pigs	Ammonium 11,3ppm	5 m^3	Ammonium 100% (0ppm)	1 + 1/month	3,5 + 3/month
4	Poultry house	300K birds	Ammonium 2091ppm Methylmercaptan 6,7ppm	70 m^3	Ammonium98,2% (37,9 ppm) Methylmercaptan 100% (0 ppm)	1 + 1/month	6,5 + 2/month
5	Poultry abattoir	50t/day	Trimethylamine 250ppm	1 m^3	Trimethylamine 100% (0ppm)	1 + 1/month	5 + 3/month
6	Pig house	30K pigs	Ammonium 2000ppm Methylmercaptan 4ppm	135 m^3	Ammonium 95% (100 ppm) Methylmercaptan 100% (0 ppm)	1 + 1/month	7,5 + 3,5/month
7	Slaughter	NA	Hydrogen sulphide < 100ppm	21 L	Hydrogen sulphide 35ppm	NA	NA

Case No.1 & 2 are explained in the following pages in detail

Case 1：Deodorizing performance increases as time proceeds, more than 99% after 50 days of installation



Density of ammonium and rate of deodorizing

Case1: Odorous gas emission in manure fermenter

Case1: Poultry house (30K birds)

Composting unit → Blowing the odorous gas → Deodorizing → Odor-free air

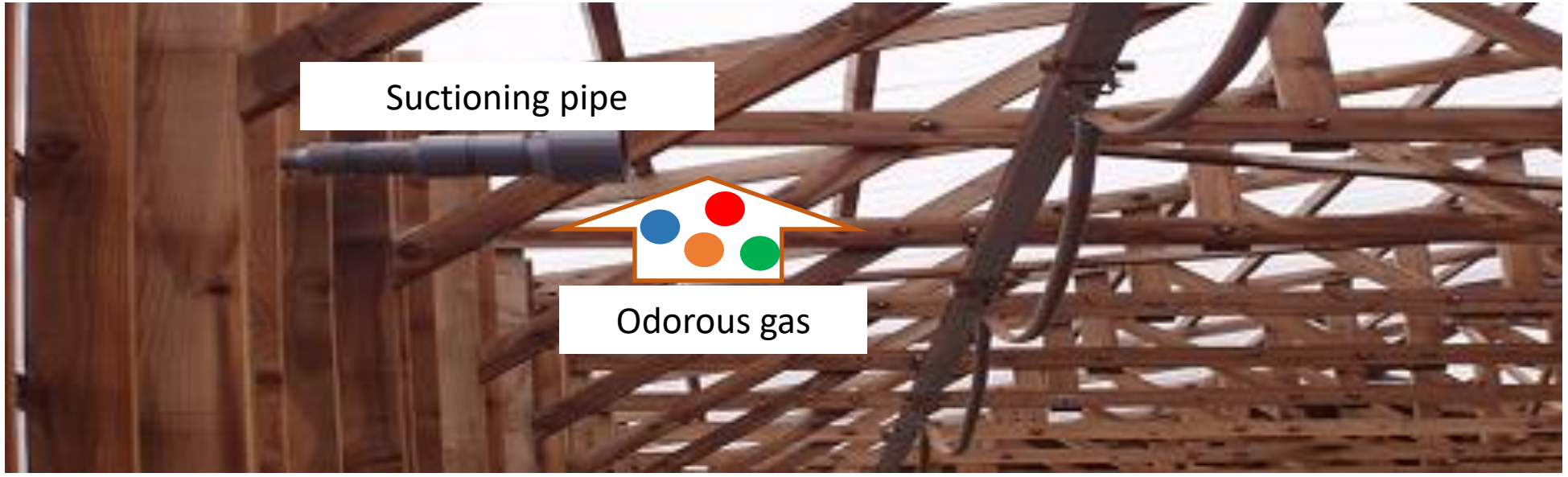
Composting unit

Case 1: Vacuuming odorous gas in by blower at composting unit

Case1: Poultry house (30K birds)

Composting unit → Blowing the odorous gas → Deodorizing → Odor-free air

Suctioning odorous gas from upper side of composting unit

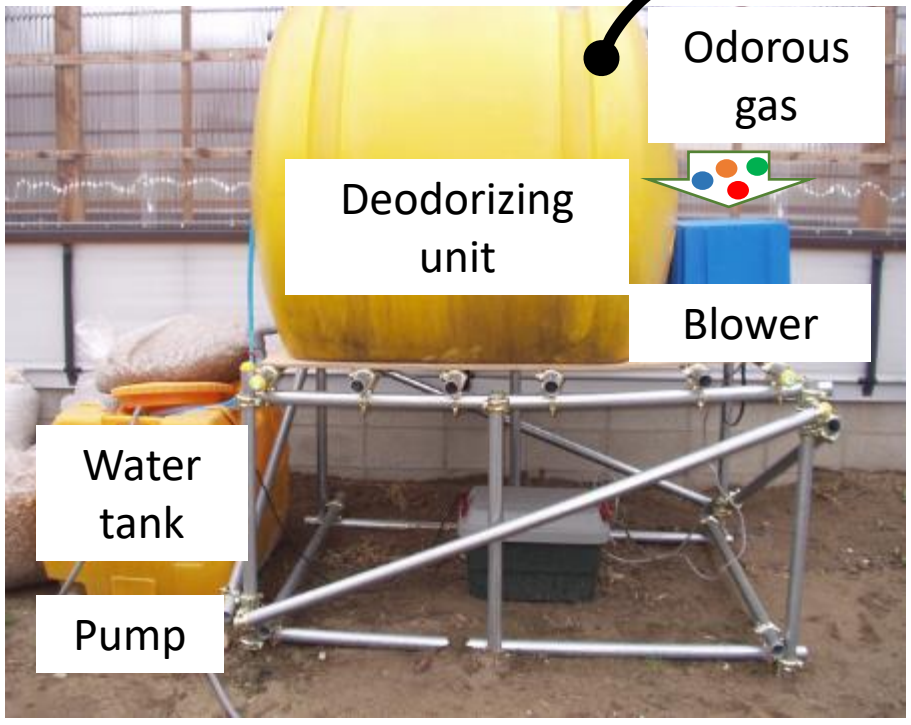


Case1: Blower and deodorizing unit

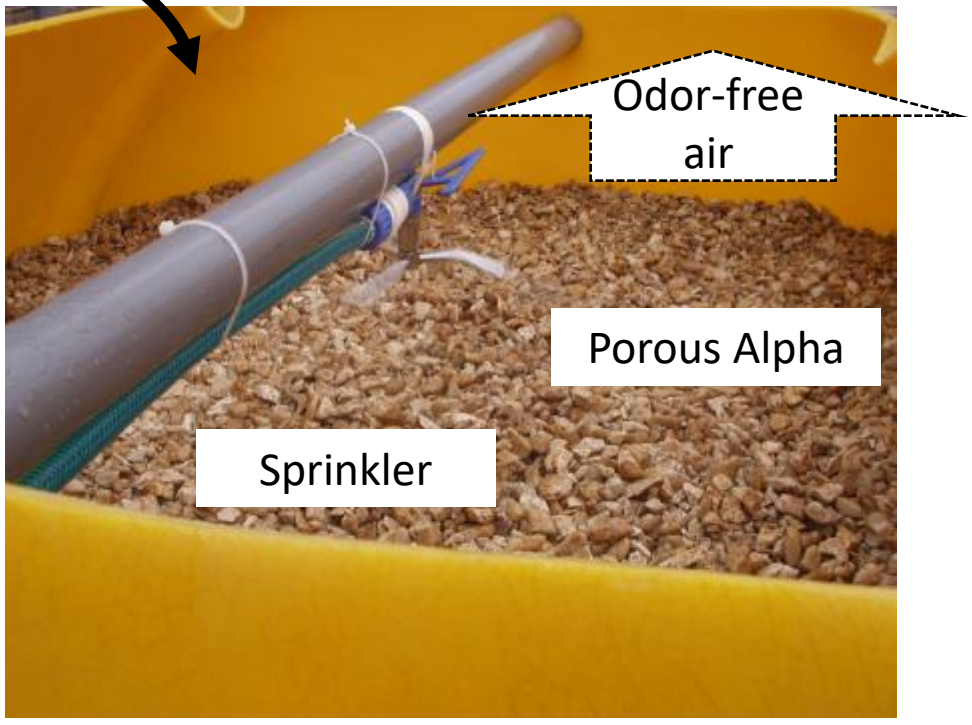
Case1: Poultry house (30K birds)

Composting unit → Blowing the odorous gas → Deodorizing → Odor-free air

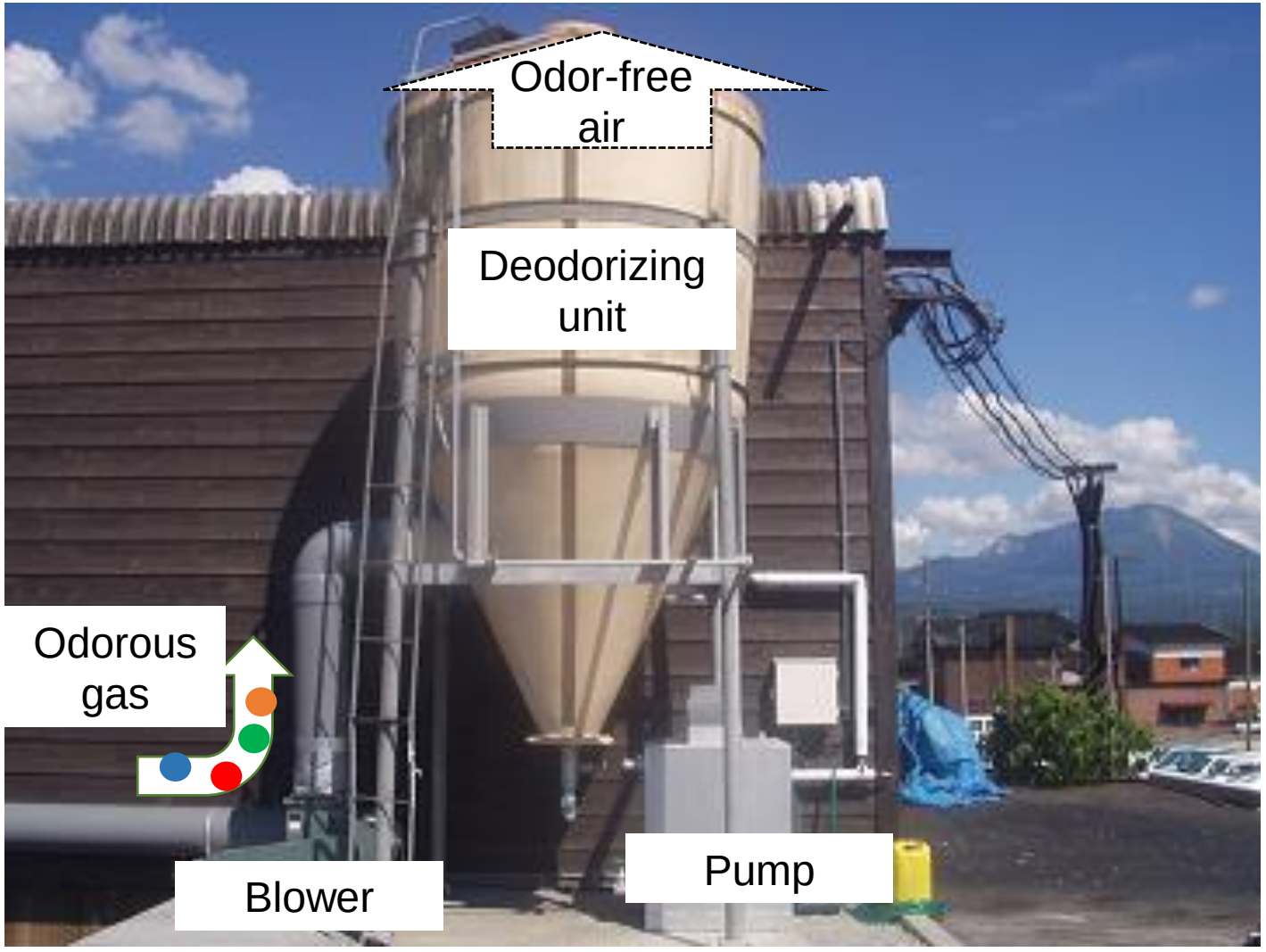
Exterior of deodorizing unit



Interior of deodorizing unit



Case 2: Exterior view of deodorizing plant with **Porous Alpha** for poultry abattoir



Specification and applied conditions for deodorizing by **Porous Alpha**

- Watering
  - Moisture of support (Porous Alpha) should be more than 50%
    - In summer season, Porous Alpha becomes dried. Watering should be more frequent than other seasons. Water for watering should be maintained
  - If there is risk of frost, measures to prevent it is required
  - Salt concentration of water should be less than 5,000 ppm
- Blower and its power source is required to transfer the odorous gas
- Source of odor should be enclosed so that the blower can suction the gas
- A filter at the end of the pipe for blower should be installed and changed periodically

- Required period of habituation for microbe: About 1 month
- Temperature for active performance of microbe: 10 – 40 ℃
  (There is experience of working less than 10℃)
- Track record of odorous gas source
  - Pig house compost
  - Poultry house compost
  - Food waste compost
  - Hotel restaurant compost
- Track record of odorous gas
  - Ammonium
  - Methylmercaptan
  - Hydrogen sulphide
  - Trimethylamine

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