

SHINAGAWA GENERAL

Chemical Div.



Products Catalog

Features



Allophane

Adsorbent



Deodorizing Agent



Ozone Decomposing Agent



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Chemical Division of Shinagawa General CO., LTD.

Allophane is clay mineraloid, and **allophane mined only in Japan** is used as the raw material of products provided by the Chemical Division of Shinagawa General CO., LTD. Shinagawa General CO., LTD. is a company that refines allophane using its unique and proprietary technology and formulation, and manufactures and sells products as adsorbents.

Allophane is a substance that is generated from volcanic holohyaline minerals or feldspar through age-long weathering or hydrothermal action, and is also called **silica-alumina gel**. It is **harmless and odorless**.

The properties of **allophane**, which is optimal as an adsorbent, include **an enormous adsorption area, pH neutralization performance, high ion exchange capacity, adsorption performance capable of treating various VOCs, and heat resistance**. Taking advantage of these features of allophane, Shinagawa General has worked on the research and development of various products such as adsorbents, deodorizing agents, catalysts, drying agents, VOC removers, ozone decomposing agents, and cleaning solvent cleaners, through day-to-day efforts.

Our products are used in a wide range of fields such as various industrial uses, deodorizing agents, precision equipment, petroleum refining, coatings, construction materials, pharmaceutical products, healthcare and nursing care practices, purification plants, restaurants, and laundries.

In an endless quest to deliver **adsorbency comparable to silica gel, and VOC adsorbing and deodorizing performances superior to ordinary activated charcoal products**, to our customers, we have worked on product development for **60 years**.

Fortunately, we have won the favor and support of a large number of customers.

We will continue to strive to meet diversified needs of our customers.



Company Profile

Company name

Shinagawa General CO., LTD.

(SHINAGAWA REFRACTORIES Group)

Company name in English:

Shinagawa General CO., LTD.

Company name in Chinese: 品川通用株式会社

Established

1938

President

Tetsuro Uchida

Headquarters

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705-0022, Japan TEL + 81-(869)-64-3701

FAX + 81-(869)-64-3320

Capital

36 million yen

Shareholder

SHINAGAWA REFRACTORIES CO., LTD.

(with full ownership)

Businesses

Manufacture and sale of adsorbents,
deodorizing agents, ozone decomposing agents,
drying agents, and detergents for cleaning

Chemical Division offices

Tokyo Office

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Moka Factory

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The Features of Our Products and the Characteristics of Allophane (i)

Allophane is amorphous **clay mineraloid** that is composed of an amorphous or poorly crystalline **hydrous aluminum silicate**, and was first described in 1816 in Germany. It is a substance that is altered, generated from volcanic glass or feldspar through age-long weathering or hydrothermal action. Much of allophane occurring in Japan is contained in the andosol (which has been formed since 10,000 years ago) at the superficial layer of volcanic ash soil.

Allophane used as the raw material of our products is **natural material that is all mined in Japan**. To be more precise, it is **mined in Moka, Tochigi Prefecture**, which is on a volcanic ash soil layer created by volcanic activity of Mt. Akagi in Gunma Prefecture, which is adjacent to Tochigi Prefecture.

Its molecular structure consists of sheet-form layers of **aluminum** (alumina) and **silicon** (silica), and has **a hollow spherical shape with size 3.5 to 5.0 nm**. Each sphere has approximately 10 pores for adsorption. It has a larger surface area (**700-900 m²/g**) than molecules of other raw materials of adsorbents.

Having both **a moisture absorption performance comparable to silica gel** and deodorization and adsorption performances superior to ordinary **activated charcoal products (mineral, woody and coconut shell)** (see the data on the Deodorizing Performance Test with Allophane), allophane is a highly excellent material as an adsorbent.

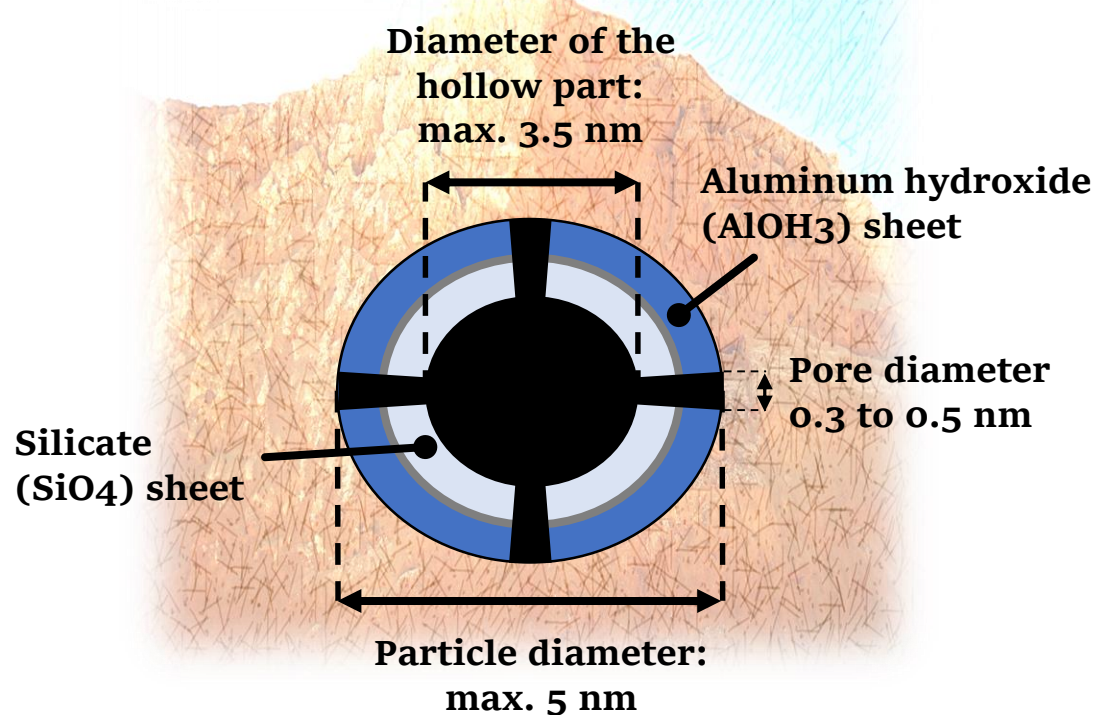
In addition, it has **a high ion exchange capacity** and **organic-acid adsorbing capacity**. Therefore, it is capable of adsorbing and retaining various substances such as organic acids (e.g., phosphoric acid), bases, moisture and radioactive cesium.

With the pH level between mildly acidic and neutral (5 to 7), it is characterized by: **(i) having a buffer action against change in pH, (ii) being resistant to acidification, and (iii) being capable of adsorbing both acidic and alkaline substances.**

“Data on VOC Adsorbing and Deodorizing Performance Test with Allophane (Chapter 07)”

Odorless and harmless, our allophane-based products are resistant to water and heat (recommended durable temperature is 400°C or less; the products do not ignite even at high temperature thanks to the effect of aluminum hydroxide, which is one of the components), and used in various industrial fields such as deodorizing agents, industrial VOC adsorbents, ozone decomposing agents, cleaning solvent control, research experiments, cosmetics and pharmaceuticals.

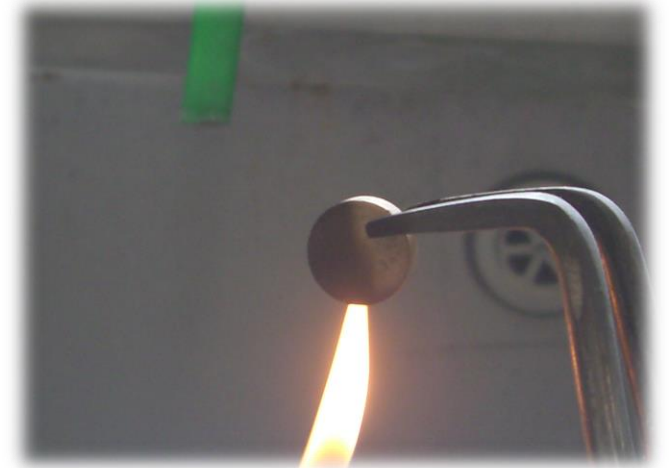
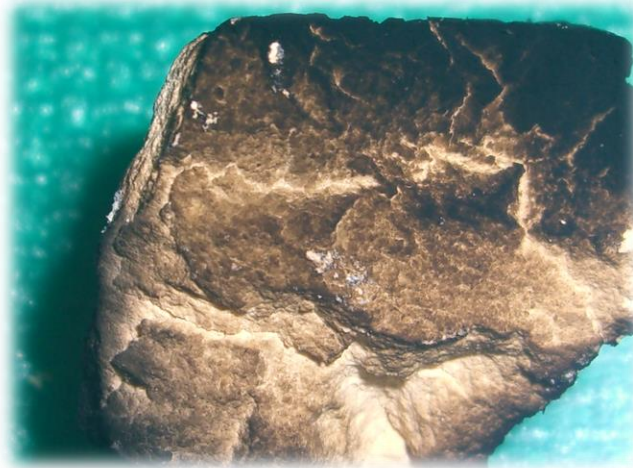
Allophane particle structure



Allophane composition analysis (%)	Al ₂ O ₃	SiO ₂	Fe ₂ O ₃	CaO	Other
	43.2	50	3.6	1.1	2.1

Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (Wt%)	10% or more	15% or more	20% or more	25% or more

The Features of Our Products and the Characteristics of Allophane (ii)



Heat Resistance

In an ignition and combustion test conducted at our company, it was confirmed that **the product does not ignite even at 1,000°C.**

Due to the effect of aluminum hydroxide (used in fireproof paper, etc.), which is one of the components, the product does not ignite even at high temperature.

Adsorption performance

Although the adsorption performance by substances is inferior to materials that are dedicated to the adsorption of specific substances using the chemical adsorption action, such as impregnated charcoal, SEKADO is capable of simultaneously adsorbing both **an acidic gas** (hydrogen sulfide, acetic acid, phosphoric acid, formaldehyde, methylmercaptan, hydrofluoric acid, sulfur oxide(SO_x), chlorine) and **an alkaline gas** (ammonia, trimethylamine) **without requiring any impregnation of a chemical.** Therefore, the product is very useful and safe.

Dehumidifying performance

The product has a moisture absorption performance equivalent to ordinary silica gel products, and characteristically, it demonstrates a high level of moisture absorption in a medium-to-high humidity range. If the product is intended to serve only as a dehumidifying agent (drying agent), it is used as the raw material for precision equipment or humidity controlling construction material.

By also having a dehumidifying performance, which is a key factor of deodorization (because the odor component is carried in moisture in the air), the product has a high deodorizing performance.

All-Japanese products

Allophane used as the raw material of the products is all mined in Japan, and the products are manufactured only in Japan (at our Moka Factory).

As a result, the product prices are less susceptible to exchange rate fluctuations or overseas situations.

Basic specifications

Each allophane particle has many fine pores, and inter-particle pores (pores formed between particles: defect pore spaces) play a major role in adsorption.

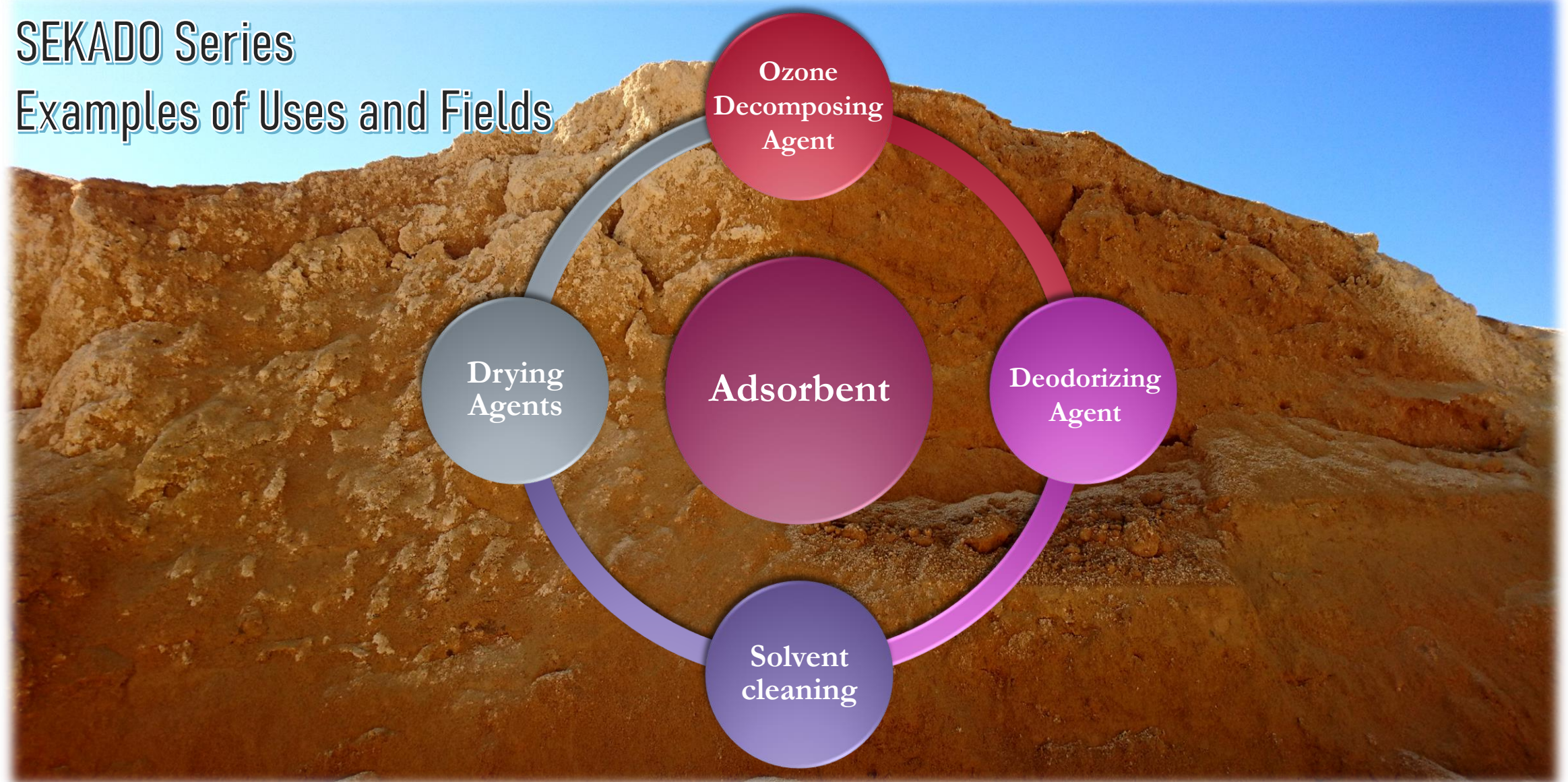
* Due to characteristics of an amorphous substance, defect pore spaces are not converted or quantified as a specific surface area in the test data with the product version of allophane.

Although the average pore size of the product version (SEKADO) is 40 to 45Å of mesopores (2 to 50 nm), the allophane particle has a wide range of pores from micropores (< 2 nm) to macropores (50 nm <).

The Features of Our Products and the Characteristics of Allophane (iii)

SEKADO Series

Examples of Uses and Fields



Adsorbent

As adsorbents treating various gases, VOCs and contaminants (organic matter), these products demonstrate their effect especially at sites where it is necessary to adsorb substances such as chlorine-based gases, fluorine (hydrogen fluoride), hydrogen sulfide, formaldehyde, and phosphoric acid. The products are resistant to combined gases, and at the same time, capable of adsorbing them. They can also dehumidify materials.

→ **Chemicals, pharmaceuticals, corrosion prevention for precision equipment, fluororesin coating, paintings, exhaust gas treatment, radioactivity adsorption, construction materials, etc.**

Deodorizing Agent

Resistant to complex odors, these products demonstrate a deodorizing effect for odors such as foul odor that is generated when both hydrogen sulfide and ammonium are present, and for trimethylamine.

They also cover humidity, which may cause foul odor (preventing odor molecules from floating or spreading together with moisture in the air).

→ **Deodorization filters, nursing care industry, food industry, grease traps, human excreta treatment plants, containers, etc.**

Drying Agents

These products are used as air dryers intended for dehumidification or as drying agents. They cover a wide range of humidity from low to high humidity. They also support water vapor absorption at high temperature. They are helpful in applications such as preventing condensation inside precision equipment or controlling humidity.

→ **Industrial air dryers, pharmaceuticals, humidity controlling material, power stations (use for the phase separation bus), precision equipment, refreshing candies, etc.**

Solvent cleaning

These products adsorb and remove substances such as certain harmful substances, fatty acids (oil/fats such as linoleic acid), surfactants (excluding non-ion surfactants), phosphoric acid, as cleaners (deoxidizing agents, dehydrating agents) for organic solvents (e.g., acetone) and hydrocarbon-based (petroleum-based) washing agents.

→ **Discharged water treatment, non-ion surfactant cleaning, surfactant removal, petroleum refining, dry-cleaning, etc.**

Ozone Decomposing Agent

An ozone decomposing agent we have developed in cooperation with the former Japan Atomic Energy Research Institute (present Japan Atomic Energy Agency) by blending allophane with special activated charcoal.

Since it is highly heat-resistant and hard to ignite, it supports high concentrations more safely than a single-component activated charcoal.

→ **Advanced water purification plants, electron beam irradiation industry, wafer cleaning (atmospheric pressure plasma), beverage manufacturers, aquariums, etc.**

Product Catalog I

Adsorbent

The SEKADO Series products are adsorbents that combined with a VOC adsorbing effect, dehumidifying performance and deodorizing performance.

Allophane, which naturally occurs and is harmless, is refined without using a binder (excluding some of the products), and processed into a product while maintaining allophane's original performances as much as possible. This group of products is used in various fields such as industrial air dryers, adsorption of various VOCs, deodorization, air filters, medical practices, pharmaceuticals, petroleum refining, paintings, nursing care practices, soil improvement, recycling of industrial washing agents, and discharged water treatment.

* For the adsorption performance for various VOCs, see the following test data.

"Data on VOC Adsorbing/Deodorizing Performance Test with Allophane (Chapter 07)"

SEKADO K-1 / K-3

The SEKADO K Series products are our core products in the form of molded adsorbents. These molded products do not require a binder thanks to our unique molding technology. Having high hardness, each of them is less susceptible to loss of shape due to its own weight and the pressure loss is constant, Even if it is used in a large quantity for applications such as an adsorption tower, air dryer or discharged water treatment. As adsorbent fillers in filters, they are optimal products for cases where pressure loss or crumbling need to be prevented in every way possible, or a large amount of fillers need to be placed in the filter.



Product specifications	SEKADO K-1	SEKADO K-3
Weight (g)	0.45 ± 0.05	0.150 ± 0.015
Diameter (mm)	8.60 ± 0.15	5.75 ± 0.10
Height (mm)	7.00 ± 0.30	5.25 ± 0.15
Bulk Density	720 kg/m ³	780 kg/m ³
Packing Style	Metallic can (13.5 kg)	Metallic can (15 kg) / cardboard case (20 kg)

Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (Wt%)	10% or more	15% or more	20% or more	25% or more

SEKADO P-1

SEKADO P-1 is a powdery product made of allophane alone. It is used mainly for VOC adsorption, dehumidification, catalyst, or deodorization under conditions where powdery matter can be used.

This product was created as a result of joint research and development between our company and Dr. Satoshi Omura (Prof. Emeritus at Kitasato University), who won the Nobel Prize in Physiology or Medicine.

For research experiment purposes, SEKADO P-1 is an additive intended to adsorb surplus substances such as nutrients and water during antibiotic culture to improve the cultivation environment. Its uses are wide-ranging, from petroleum refining, catalysts, deodorizing agents, pharmaceuticals, cosmetics, fermentation media, painting additives to coagulating sedimentation.

Because SEKADO P-1 is powdery, it can be blended into products of various forms such as non-woven fabric, paper media, sheets, nursing care products and catalysts.



Product specifications	SEKADO P-1
Standard size	200 mesh or less (95% or more)
Bulk Density	430 kg / m ³
Packing Style	Kraft bag (20 kg)

SEKADO P-1 particle size distribution	Approx. 2 to 130 μm (particle size range)
75 μm or more	2% or less
75 to 40 μm	5 to 6%
40 to 20 μm	20 to 35%
20 μm or less	60 to 70%

Product Catalog I - 2

Adsorbent

SEKADO KW

SEKADO KW is a granular product made of allophane alone, and has no corrosiveness, deliquescency or toxicity. Superior in adsorbing performance due to a large contact surface, the product is optimal for deodorization of gaseous phases with air filters or individual packages, and adsorption of various VOCs. For liquid phases, the product demonstrates a superior effect also in the cleaning and recycling of hydrocarbon-based washing agents. With large deoxidizing and dehydrating capacities, SEKADO KW is used for the removal of a minute amount of water, acids or Impurities contained in organic, inorganic or petroleum-based solvents.



Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (Wt%)	10% or more	15% or more	20% or more	25% or more

Product specifications	Bulk article	Individually packed article							
	SEKADO KW	SEKADO KW 5G	SEKADO KW 10G	SEKADO KW 20G	SEKADO KW 50G	SEKADO KW 100G	SEKADO KW 200G	SEKADO KW 300G	SEKADO KW 500G
Length (mm)	Approx. 0.5 to 5 mm	90 mm × 50 mm	120 mm × 50 mm	110 mm × 90 mm	145 mm × 100 mm	155 mm × 120 mm	200 mm × 140 mm	220 mm × 160 mm	270 mm × 160 mm
Filler content	-	5 g	10 g	20 g	50 g	100 g	200 g	300 g	500 g
Bulk Density	480 kg / m ³	-	-	-	-	-	-	-	-
Packing Style	Kraft bag (20 kg)	1,000 pcs in a cardboard case	500 pcs in a cardboard case	400 pcs in a cardboard case	200 pcs in a cardboard case	100 pcs in a cardboard case	50 pcs in a cardboard case	35 pcs in a cardboard case	15 pcs in a cardboard case

SEKADO OW

SEKADO OW is a pelletized product made of allophane alone. This product is fabricated by pelletizing SEKADO KW, and less susceptible to shape loss or crumbling than KW. It is used for dehumidification of precision equipment and Chemical products and adsorption of various VOCs mainly in an Individually packed article. SEKADO OW is suitable for cases where the product with higher filling density (bulk density) than the density of SEKADO KW is required, or cases where a pellet-type adsorbent is needed.



Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (Wt%)	10% or more	15% or more	20% or more	25% or more

Product specifications	Bulk article	Individually packed article							
	SEKADO OW	SEKADO OW 5G	SEKADO OW 10G	SEKADO OW 20G	SEKADO OW 50G	SEKADO OW 100G	SEKADO OW 200G	SEKADO OW 300G	SEKADO OW 500G
Length (mm)	Approx. 1 to 3 mm	80 mm × 50 mm	135 mm × 50 mm	110 mm × 90 mm	130 mm × 100 mm	150 mm × 120 mm	180 mm × 140 mm	200 mm × 160 mm	260 mm × 160 mm
Filler content	-	5 g	10 g	20 g	50 g	100 g	200 g	300 g	500 g
Bulk Density	540 kg/m ³	-	-	-	-	-	-	-	-
Packing Style	Kraft bag (20 kg)	1,000 pcs in a cardboard case	500 pcs in a cardboard case	400 pcs in a cardboard case	200 pcs in a cardboard case	100 pcs in a cardboard case	50 pcs in a cardboard case	35 pcs in a cardboard case	15 pcs in a cardboard case

Product Catalog I - 3

Adsorbent

SEKADO D

The SEKADO D Series products are tablets made of allophane alone.

These adsorbents are available in various sizes including a small one, and no binder is required, while a certain level of hardness is secured.

They can be used even in small spaces such as pharmaceuticals, precision equipment or in the cap of adhesives.

Since an individually packed type is also offered, the customer can use it without worrying about crumbling.

In an environment where dehumidification and VOC adsorption (deodorization) are required at the same time, the product will contribute to space saving.



Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (Wt%)	10% or more	15% or more	20% or more	25% or more

Product specifications	Bulk product					Individually packed article		
	SEKADO D 6.6 × 4	SEKADO D 8 × 4	SEKADO D 15 × 1	SEKADO D 20 × 2	SEKADO D 25 × 3	SEKADO D 15 × 1 (H)	SEKADO D 20 × 2 (H)	SEKADO D 25 × 3 (H)
Standard size	6.65 mm φ × 4.1 mm (H)	8.1 mm φ × 4 mm (H)	15 mm φ × 5 mm (H)	20 mm φ × 6 mm (H)	25 mm φ × 6 mm (H)	45 mm φ × 28 mm	45 mm φ × 28 mm	54 mm φ × 38 mm
Weight	0.16 g	0.24 g	1 g	2 g	3 g	1 g	2 g	3 g
Quantity packed (per can)	80,000 pcs packed	20,000 pcs packed	12,000 pcs packed	6,000 pcs packed	3,500 pcs packed	4,000 pcs packed	2,500 pcs packed	1,300 pcs packed
Packing Style	18-1 metallic can	9-1 metallic can	18-1 metallic can	18-1 metallic can	18-1 metallic can	18-1 metallic can	18-1 metallic can	18-1 metallic can

SEKADO DPT

SEKADO DPT is a crumbling-free tablet-type adsorbent

Fabricated by blending SEKADO D with a binder.

Being the only product using a binder, SEKADO DPT has the highest hardness among all SEKADO Series products.

Since it is very hard, it is free from crumbling.

SEKADO DPT also supports small spaces such as use in Precision equipment, pharmaceuticals or storage containers.

It is also optimal for use in an environment where crumbling should be avoided.

In an environment where dehumidification and VOC adsorption (deodorization) are required at the same time, the product will contribute to space saving.



Product specifications	Bulk product		
	SEKADO 15DPT	SEKADO 20DPT	SEKADO 25DPT
Standard size	15 mm φ × 5 mm (H)	20 mm φ × 6 mm (H)	25 mm φ × 6 mm (H)
Weight	1 g	2 g	3 g
Quantity packed (per can)	12,000 pcs packed	6,000 pcs packed	3,500 pcs packed
Packing Style	18-1 metallic can	18-1 metallic can	18-1 metallic can

Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (wt%)	-	8% or more	13% or more	17% or more

Adsorbent

ALLO-SHEET

ALLO-SHEET is a sheet-form adsorbent (blended with pulp) made of allophane.

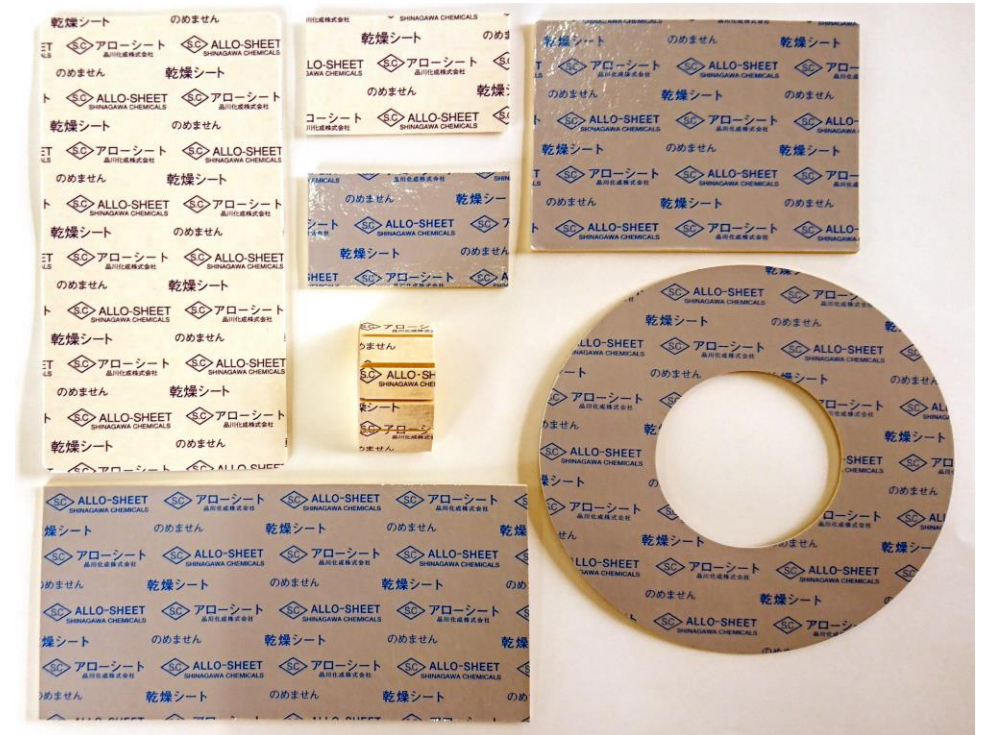
This product is available in free sizes on a custom basis, and it is used for precision equipment, chemicals, refreshing candies, health food, pet goods, humidity controlling agents, etc.

Despite being in sheet form, it is useful because it can achieve VOC adsorption, deodorization and moisture absorption simultaneously.

Its surface supports specifications as lamination, no cover, a double-faced seal, etc.

In addition, we accept orders for original logo printing or the like.

* Only for ALLO-SHEET with a thickness of 1 mm.



Relative humidity (25°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (wt%)	5%	6.50%	10.50%	16%

* Reference value

ZEO-SHEET

ZEO-SHEET is a sheet-form adsorbent using zeolite as the raw material (blended with pulp and a binder).

As compared to allophane, zeolite has a higher moisture absorbing performance mainly in a low-humidity range, and is used in various products such as precision equipment, cameras and pharmaceuticals.

Taking advantage of the strong dehumidification performance of synthetic zeolite, ZEO-SHEET is almost dedicated for dehumidification.

Its surface supports specifications as lamination, no cover, a double-faced seal, etc.

In addition, we accept orders for original logo printing or the like.

* Only for ZEO-SHEET with a thickness of 1 mm.



Relative humidity (40°C)	RH20%	RH40%	RH60%	RH80%
Moisture absorption rate (wt%)	12%	13%	14.5%	15.5%

* Reference value

Product Catalog II

Ozone Decomposing Agent

SEKADO KR / MR-4

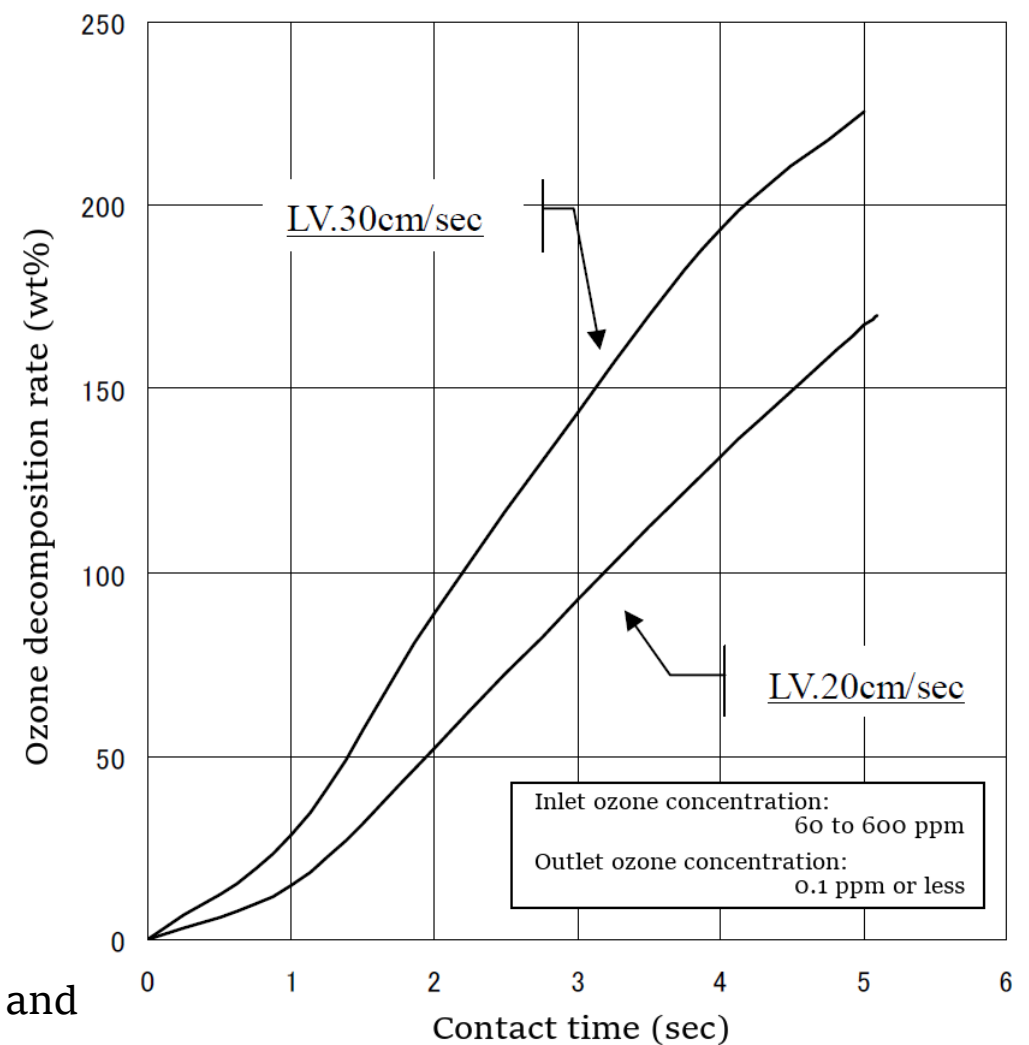
SEKADO KR and MR-4 are ozone decomposing agents based on allophane blended with special activated charcoal. SEKADO KR is a tablet-form agent that is mechanically molded, while SEKADO MR-4 is pelletized. They are designed not to cause rapid heat generation or explosion during ozone decomposition. With a relatively large scale, this agent is used for decomposition at medium to high concentration of approximately 5,000 ppm or less. In terms of the decomposition capacity, the agent is effective with contact time of three seconds and linear velocity of 30 cm/sec or more, and is capable of decomposing ozone one to 1.5 times heavier than its weight (assuming that the concentration of the discharged ozone is 0.1 ppm or less).

Features of SEKADO KR

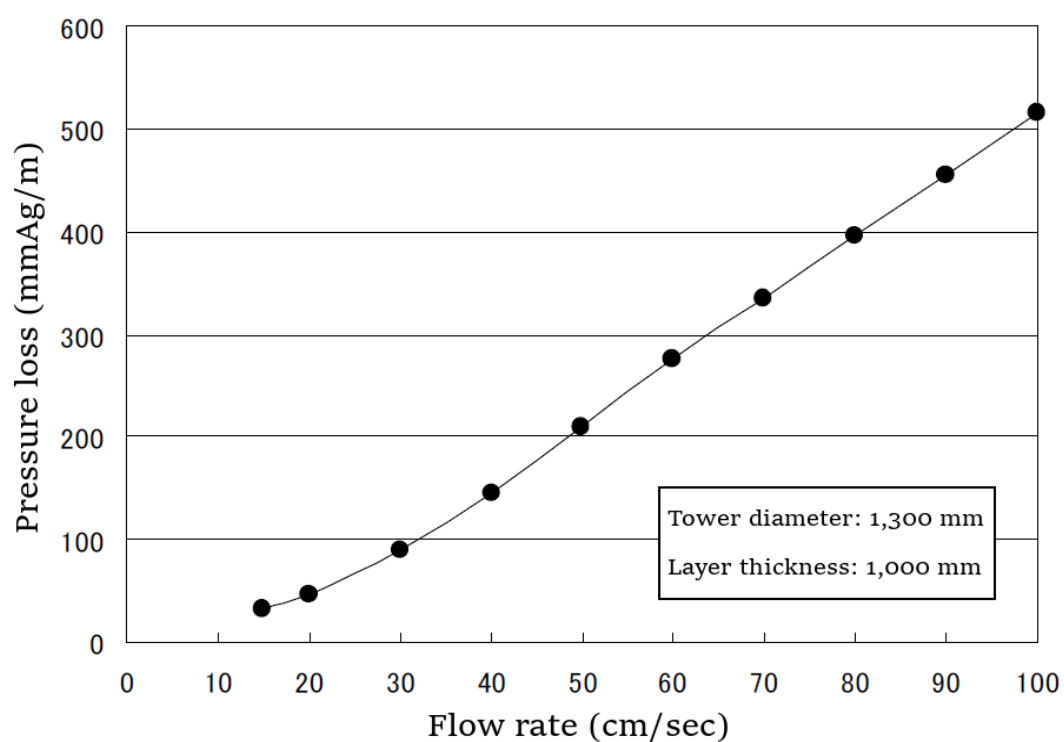
1. Because it is molded, the filling density is constant.
2. Since the compressive strength is large, it will rarely be crushed or pulverized.
3. As it changes its color, the reaction state can be observed.
4. Even if the ozone concentration at the inlet is high, pretreatment is unnecessary.
5. Since it is free of pulverization and the pressure loss is constant, the pressure rise is controlled.

SEKADO KR and MR-4 are used by customers such as service water and sewerage treatment plants and purification plants, beverage manufacturers, and electron beam irradiation equipment manufacturers.

Ozone gas decomposition efficiency



Pressure loss (actual measurement value)



SEKADO KR / MR-4 composition analysis (%)	Al ₂ O ₃	SiO ₂	Activated Carbon
	35 to 40%	39 to 42%	17 to 22%

SEKADO KR (molded)



SEKADO MR-4 (pelletized)



Product specifications	SEKADO KR	SEKADO MR-4
Weight (g)	0.15 ± 0.02	-
Diameter (mm)	5.85 ± 0.15	Particle diameter: 2 to 5 mm (70% or more)
Height (mm)	6.00 ± 0.5	-
Bulk Density	650 kg / m ³	530 kg / m ³
Packing Style	Cardboard case (20 kg)	Cardboard case (15 kg)

Performance Comparison

Comparative Table for Product Specifications

Product name	Form	Standard size	Weight	Bulk Density	Adsorbing performance (comparison at our company), on a scale of one to ten *	Hardness	Littleness of crumbling	Remarks
SEKADO K-1	Molded	8.6 mm ϕ \times 7.0 mm (H)	0.45 g	720 kg / m ³	7	Hard	⊙	Can: 13.5 kg
SEKADO K-3	Molded	5.75 mm ϕ \times 5.25 mm (H)	0.15 g	780 kg / m ³	7.5	Hard	⊙	Can: 15 kg. Box: 20 kg
SEKADO KW	Granular	Approx. 0.5 to 4.0 mm	-	480 kg / m ³	10	Soft	×	20 kg cardboard case
SEKADO KW (Individually packed article)	Individually packed article	Depending on the filling quantity	Depending on the filling quantity	-	9	-	⊙	Available in different sizes Cardboard case
SEKADO OW	Pelletized	Approx. 1 to 3 mm	-	540 kg / m ³	8.5	Soft	×	Kraft bag: 20 kg
SEKADO OW (Individually packed article)	Individually packed article	Depending on the filling quantity	Depending on the filling quantity	-	8	-	⊙	Available in different sizes Cardboard case
SEKADO BW	Granular	Approx. 1 to 6 mm	Depending on the filling quantity	450 kg / m ³	8	Soft	×	Blended with activated charcoal Box: 15 kg. Kraft bag: 20 kg
SEKADO BWM	Pelletized	Approx. 1 to 3 mm	Depending on the filling quantity	640 kg / m ³	7.5	Soft	×	Blended with activated charcoal Box: 15 kg. Kraft bag: 20 kg
SEKADO BWM (Individually packed article)	Individually packed article	Depending on the filling quantity	Depending on the filling quantity	-	7	-	⊙	Available in different sizes Cardboard case
SEKADO D	Tablet	By sizes	By sizes	-	7.5	Hard	○	Available in different sizes
SEKADO DPT	Tablet	By sizes	By sizes	-	6	Very hard	⊙	Available in different sizes
SEKADO KR (Ozone Decomposing Agent)	Molded	5.85 mm ϕ \times 6.0 mm (H)	0.15 g	650 kg / m ³	Ozone decomposition	Hard	△	For medium-to-large device Box: 20 kg
SEKADO MR-4 (Ozone Decomposing Agent)	Pelletized	2 to 5 mm (70% or more)	-	530 kg / m ³	Ozone decomposition	Slightly hard	×	For small-to-medium device Box: 15 kg
SEKADO P-1	Powdery	200 mesh or less, 95%	-	430 kg / m ³	6.5	-	-	20 kg
ALLO-SHEET	Sheet-form	Available in different sizes	667 g / m ²	-	4	-	○	Blended with pulp
ZEO-SHEET	Sheet-form	Available in different sizes	830 g / m ²	-	5	-	○	Blended with zeolite and pulp

Data on VOC Adsorbing/Deodorizing Performance Test with Allophane

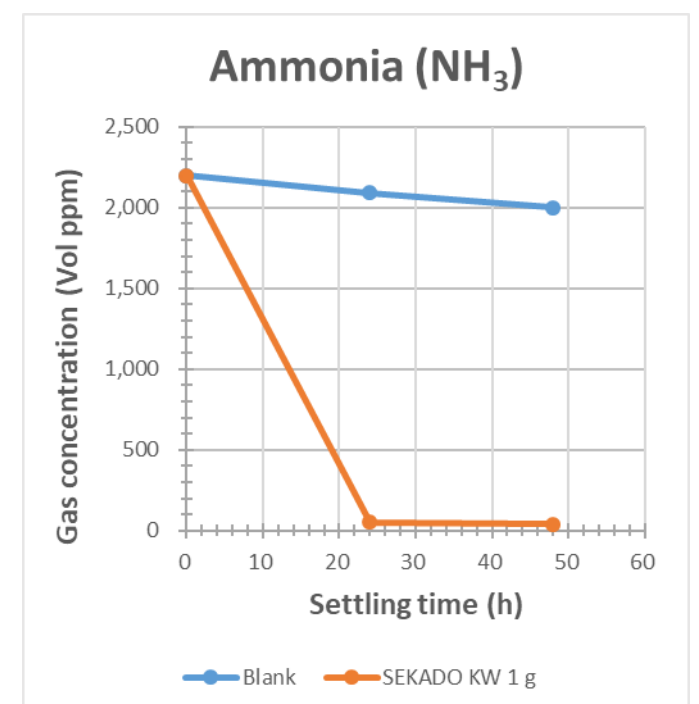
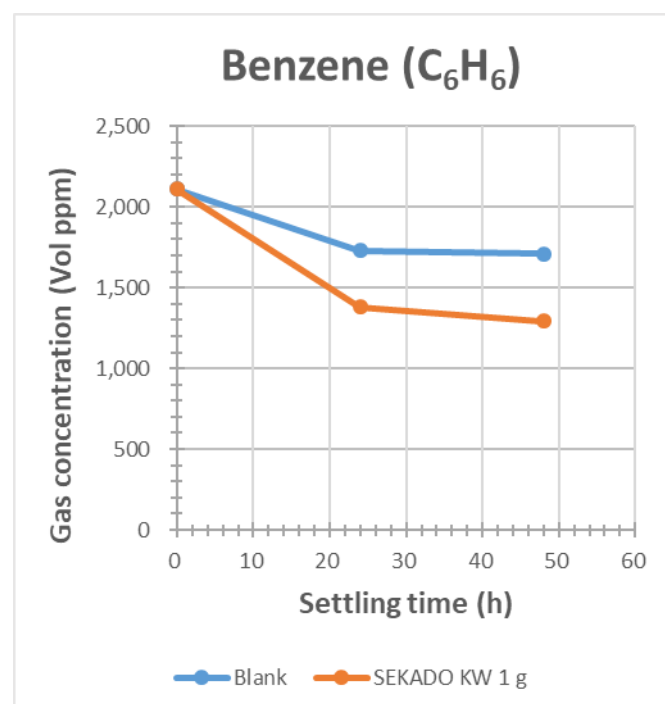
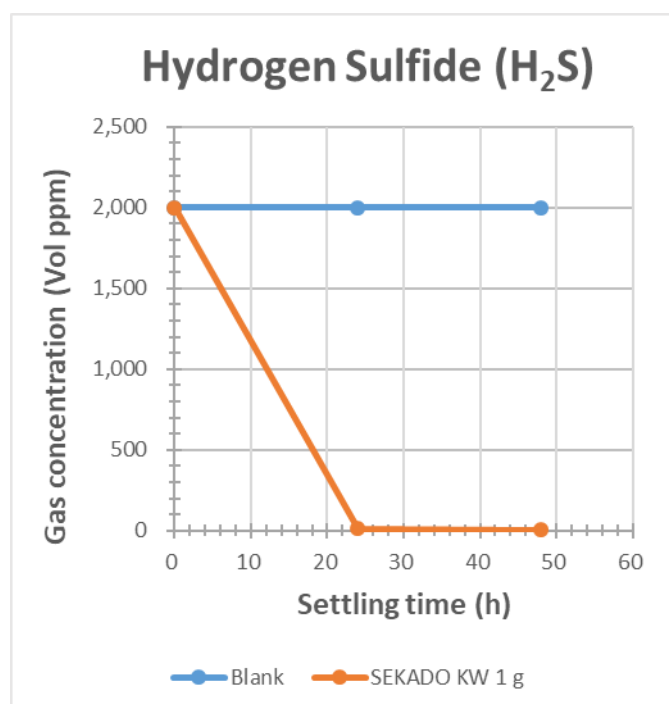
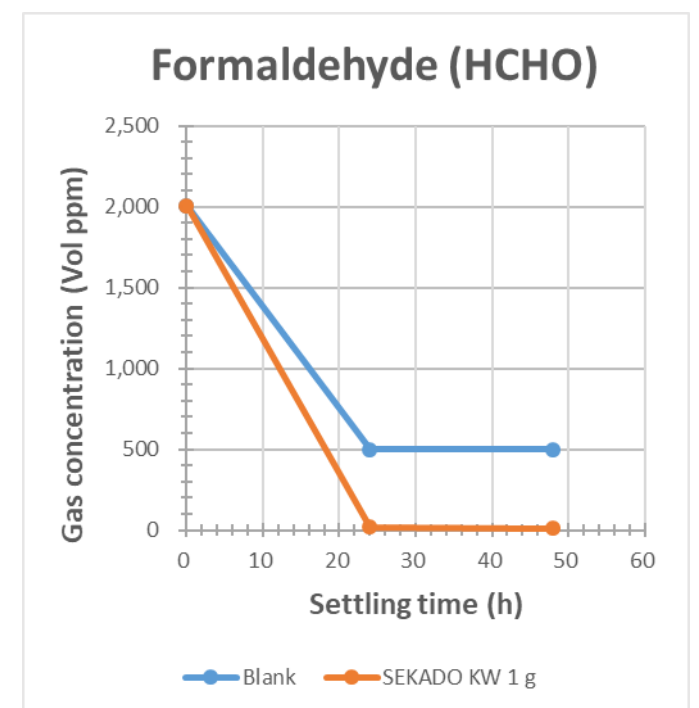
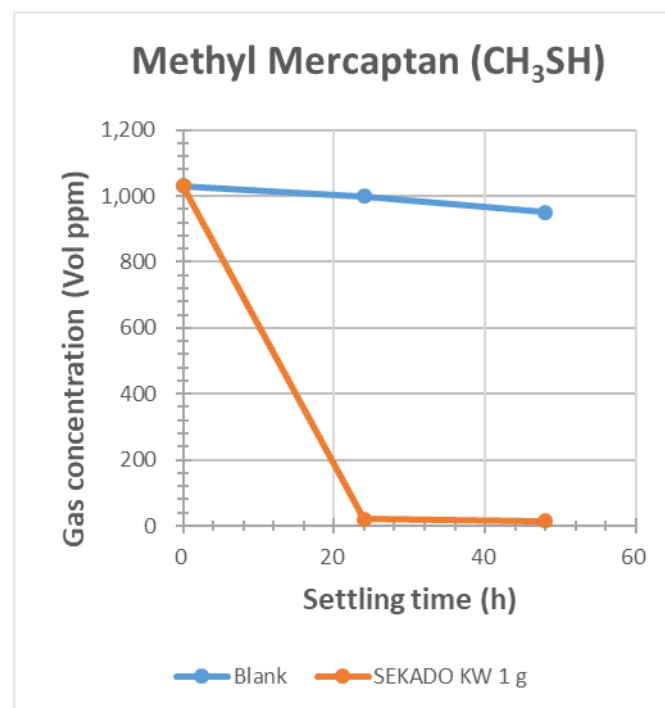
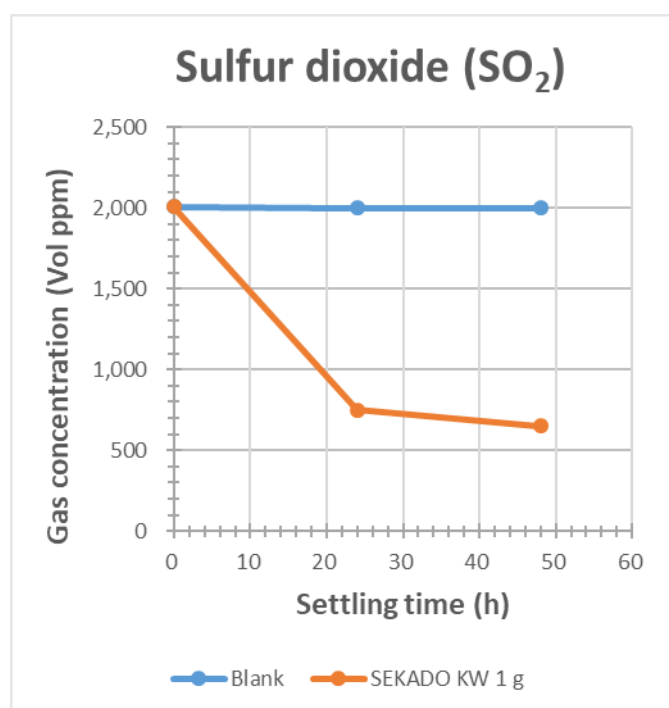
Adsorbing Performance Test Data - Performance of adsorbing VOC gases

【Decay curve test】

Data obtained by testing the basic adsorption effect after filling a 9 l container with various VOC gases (foul odor substances). As the specimen, measurements with granular SEKADO KW (1 g) were taken, and the following results were obtained.

Foul odor substance (initial concentration)	Amount of deodorization for each elapsed duration (ppm)			
	10 min	1h	3h	6h
Ammonia (500 ppm)	380	495 <	Not detected	Not detected
Acetic Acid (100 ppm)	70	99	99 <	Not detected
Hydrogen Sulfide (100 ppm)	40	86	98	99 <
Trimethylamine (70 ppm)	55	69 <	Not detected	Not detected
Methyl Mercaptan (100 ppm)	20	71	97	99 <
Formaldehyde (100 ppm)	30	90	90.4	89
Isovaleric Acid (40 ppm)	16	38.6	39 <	Not detected

* Measurement test performed at the Japan Food Research Laboratories



* Measurement test performed at MC Evolve Technologies Corporation

Data on VOC Adsorbing/Deodorizing Performance Test with Allophane

【VOC gas adsorption isotherm measurement】

The products are capable of adsorbing **combined gases** (both an acidic gas and an alkaline gas), without requiring **any impregnation of a chemical**.

* The adsorption amount steeply increases when hydrogen sulfide and ammonium (ammonium hydrogen sulfide) and moisture coexist. However, this is the result of **individual measurement**, and the actual adsorption performance is more than ten times that of ordinary coconut shell activated charcoal (excluding impregnated charcoal).

* Our company's test data are not data from measurement conducted at our company, and **we commission all tests to an external test laboratory to ensure credibility of performance.**

Foul odor substance

Hydrogen Sulfide :	8.3 % (at 5 ppm)	11 % (at 10 ppm)	14 % (at 20 ppm)	20 % (at 50 ppm)	* <u>Ammonium and moisture not coexisting</u>
Ammonia :	1 % (at 10 ppm)	1.3 % (at 100 ppm)	* <u>Hydrogen sulfide and moisture not coexisting</u>		
Methyl Mercaptan :	2 % (at 15 ppm)	3.5 % (at 30 ppm)	5 % (at 100 ppm)	10 % (at 130 ppm)	

* Measurement test performed at MC Evolve Technologies Corporation

Other

Acetone :	24.4 %	(* Specimen: SEKADO KW; test method: JISK-1474)
Fluorine / hydrogen fluoride :	1.3 mg / g	(* Specimen: SEKADO P-1; test with standard fluorine solution)
* Fluorine adsorbing performance of an ordinary magnesium oxide-based insolubilizing agent: 0.03 mg / g		

Methyl alcohol :	30 to 35%	(* Specimen: SEKADO KW)
Benzene :	35 to 40%	(* Specimen: SEKADO KW)

* Measurement test performed by Nagoya Municipal Industrial Research Institute

Anthracene :	11 mg / g	(* Specimen: SEKADO KW: precursor material of dioxin / alternative gas)
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* Measurement test performed at MC Evolve Technologies Corporation

【Record of other adsorption uses】

Adsorption of tetrachloroethylene (perchloroethylene).
Removal of acidic odors/amine odors of ink dye intermediates.
Removal of irritating odors of acrylic acid series, removal of fatty acids (e.g., linoleic acid) (solvent cleaning).
Adsorption of chlorine-based gas, cleaning of exhaust gas.
Crude oil/petroleum refining, radioactive material adsorption, fluorine/ hydrofluoric acid/ hydrogen fluoride adsorption.
Ozone gas decomposition, etc.

* Examples of past uses by our customers

Allophane's Adsorption/Moisture Absorption Isotherm Data

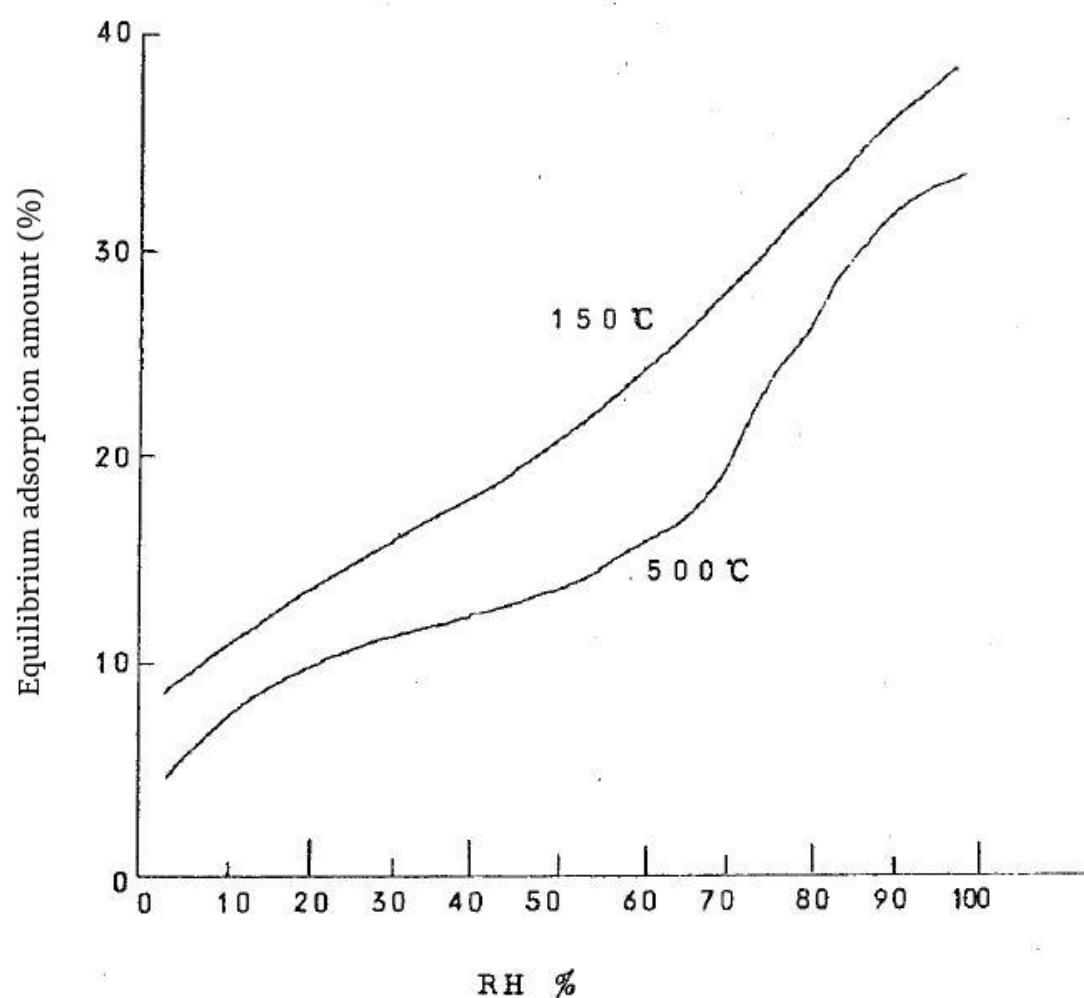
Adsorption Isotherm

The following figure shows isotherm data representing the relationship between the adsorption amount and the equilibrium amount (equilibrium concentration) at constant temperature of 150°C or higher.

After processing SEKADO at 150°C for four hours, and at 300°C, 500°C, 700°C, 800°C and 900°C for one hour each, the moisture absorption amount with water vapor was measured at temperature of 27.5°C, and the results shown in the following figure were obtained.

* Measurement test performed by Mr. Motoi Nishimura of Nagoya Municipal Industrial Research Institute

Equilibrium moisture absorption rate (%) at 27.5°C						
RH (%)	150°C	300°C	500°C	700°C	800°C	900°C
5	9	6.1	5.2	4.1	2.9	1.4
10	10.4	8.5	7	5.8	4.3	1.6
15	12.1	9.7	8.3	6.7	4.5	1.6
20	13.3	10.6	9.2	7.4	4.9	1.6
25	14.4	11.5	10.2	7.9	5	1.6
30	15.6	12.4	11	8.5	5.4	1.6
35	16.5	13.8	11.7	8.8	5.9	1.6
40	17.6	14.9	12.1	9	6.7	1.6
45	18.9	16.2	12.8	9.4	6.8	1.6
50	20.1	17.3	13.5	9.5	7.2	1.6
55	21.9	18.3	14.4	9.9	7.4	1.6
60	23.8	19.8	15.3	10.4	8.1	1.6
65	25.7	21.2	18.6	11.9	10.1	1.8
70	27.5	23.4	18.9	13.5	12.4	2
75	29.3	27	22.9	15.7	15.7	2.3
80	31.4	30.2	26.1	18.2	18.2	2.7
85	33.6	32.8	28.8	21.1	21.1	3.2
90	35.4	34.7	31	24.2	24.3	4
95	37.1	36	32.6	27.9	27	5
100	38.2	37.8	33.5	31.7	31	7.9



Equilibrium adsorption amount of SEKADO

The figure on the left shows a curve of the equilibrium adsorption amount of SEKADO heated at 150°C and 500°C is plotted for each RH%.

The curve of the specimen heated at 150°C is almost linear and of Henry type, while that of the specimen heated at 500°C is of BET type and shows S form. This is because multiple layers with irregular thickness were generated.

* Measurement test performed by Mr. Motoi Nishimura of Nagoya Municipal Industrial Research Institute

Various Test Data (Passing Water Test Data)

Water quality test with the passing water

Outline of the test

A container was filled with the specimen (allophane - SEKADO K-3), tap water (Tama City, Tokyo) was run at a flow rate of 1.5 l/min for ten minutes, and the passing water was measured on 51 items specified by a ministerial ordinance on water quality standard (Ordinance of the Ministry of Health, Labour and Welfare in 2003, No. 101).

* Water temperature during water running: 20°C

Test result

The measurements were below the reference values on all the specified 51 items.

* Test performed at Japan Food Research Laboratories

Item of analysis test	Reference	Result	Lower limit of quantitation	Measuring method	Item of analysis test	Reference	Result	Lower limit of quantitation	Measuring method
General bacteria	Number of colonies: 100/mL or less	30/mL or less	-	Standard agar medium method	Total trihalomethane	0.1 mg/L or less	0.014 mg/L	-	-
Escherichia coli	Not detected	Not detected	-	Specific enzyme substrate medium method	Trichloroacetic acid	0.03 mg/L or less	Not detected	0.003 mg/L	Solvent extraction - derivatization - gas chromatograph - mass spectrometry
Cadmium and its compounds	0.003 mg/L or less	Not detected	0.0003 mg/L	Inductively coupled plasma mass spectrometry	Bromodichloromethane	0.03 mg/L or less	0.005 mg/L	-	Purge/trap - gas chromatograph - mass spectrometry
Mercury and its compounds	0.0005 mg/L or less	Not detected	0.00005 mg/L	Hydride generation - atomic absorption spectrophotometry	Bromoform	0.09 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry
Selenium and its compounds	0.01 mg/L or less	Not detected	0.001 mg/L	Inductively coupled plasma mass spectrometry	Formaldehyde	0.08 mg/L or less	Not detected	0.008 mg/L	Solvent extraction - derivatization - gas chromatograph - mass spectrometry
Lead and its compounds	0.01 mg/L or less	Not detected	0.001 mg/L	Inductively coupled plasma mass spectrometry	Zinc and its compounds	1.0 mg/L or less	Not detected	0.01 mg/L	Inductively coupled plasma mass spectrometry
Arsenic and its compounds	0.01 mg/L or less	Not detected	0.001 mg/L	Inductively coupled plasma mass spectrometry	Aluminum and its compounds	0.2 mg/L or less	Not detected	0.02 mg/L	Inductively coupled plasma mass spectrometry
Hexavalent chromium compounds	0.05 mg/L or less	Not detected	0.005 mg/L	Inductively coupled plasma emission spectroscopy	Iron and its compounds	0.3 mg/L or less	Not detected	0.03 mg/L	Inductively coupled plasma mass spectrometry
Nitrite nitrogen	0.01 mg/L or less	Not detected	0.004 mg/L	Ion chromatography	Copper and its compounds	1.0 mg/L or less	Not detected	0.01 mg/L	Inductively coupled plasma mass spectrometry
Cyanide ion and cyanogen chloride	0.04 mg/L or less	Not detected	0.001 mg/L	Ion chromatograph - post-column absorption photometry	Sodium and its compounds	200 mg/L or less	9.0 mg/L	-	Inductively coupled plasma mass spectrometry
Nitrite nitrogen and nitrite nitrogen	10 mg/L or less	0.8 mg/L	-	Ion chromatography	Manganese and its compounds	0.05 mg/L or less	Not detected	0.005 mg/L	Inductively coupled plasma mass spectrometry
Fluorine and its compounds	0.8 mg/L or less	0.09 mg/L	-	Ion chromatography	Chloride ion	200 mg/L or less	9.0 mg/L	-	Ion chromatography
Boron and its compounds	1.0 mg/L or less	Not detected	0.1 mg/L	Inductively coupled plasma emission spectroscopy	Calcium, magnesium, etc. (hardness)	300 mg/L or less	54 mg/L	-	Titration method
Carbon tetrachloride	0.002 mg/L or less	Not detected	0.0002 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Evaporation residue	500 mg/L or less	110 mg/L	-	Gravimetric method
1,4-dioxane	0.05 mg/L or less	Not detected	0.005 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Anionic surfactant	0.2 mg/L or less	Not detected	0.02 mg/L	Solid-phase extraction - high-speed liquid chromatography
Cis-1,2-dichloroethylene and trans-1,2-dichloroethylene	0.04 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Geosmin	0.00001 mg/L or less	Not detected	0.000001 mg/L	Purge/trap - gas chromatograph - mass spectrometry
Dichloromethane	0.02 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry	2-methylisoborneol	0.00001 mg/L or less	Not detected	0.000001 mg/L	Purge/trap - gas chromatograph - mass spectrometry
Tetrachloroethylene	0.01 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Non-ionic surfactant	0.02 mg/L or less	Not detected	0.005 mg/L	Solid-phase extraction - absorption photometry
Trichloroethylene	0.01 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Phenol	0.005 mg/L or less	Not detected	0.0005 mg/L	Solid-phase extraction - derivatization - gas chromatograph - mass spectrometry
Benzene	0.01 mg/L or less	Not detected	0.001 mg/L	Purge/trap - gas chromatograph - mass spectrometry	Phenolic organic matter (amount of total organic carbon [TOC])	3 mg/L or less	0.7 mg/L	-	Total organic carbon measuring method
Chloric acid	0.6 mg/L or less	Not detected	0.6 mg/L	Ion chromatography	pH value	5.8 or more to 8.6 or less	7.4 (23°C)	-	Glass electrode method
Chloroacetic acid	0.02 mg/L or less	Not detected	0.002 mg/L	Solvent extraction - derivatization - gas chromatograph - mass spectrometry	Taste	Not abnormal	No anomaly	-	Sensory method
Chloroform	0.06 mg/L or less	0.006 mg/L	-	Purge/trap - gas chromatograph - mass spectrometry	Odor	Not abnormal	No anomaly	-	Sensory method
Dichloroacetic acid	0.03 mg/L or less	Not detected	0.003 mg/L	Solvent extraction - derivatization - gas chromatograph - mass spectrometry	Chromaticity	Five or less	One or less	-	Colorimetric method
Dibromochloromethane	0.1 mg/L or less	0.003 mg/L	-	Purge/trap - gas chromatograph - mass spectrometry	Turbidity	Two or less	One or less	-	Turbidimetric method
Bromic acid	0.01 mg/L or less	Not detected	0.001 mg/L	Ion chromatograph - post-column absorption photometry					

List of Main Business Partners

Main Business Partners

【Japan】

Astellas Pharma Tech Co., Ltd.
Azbil Trading Co., Ltd
AIR WATER Co., Ltd.
NHV Corporation
EBARA JITSUGYO CO., LTD.
Ebisu Yakuhin Kako Corporate
Kanamorisangyo Co., Ltd.
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Mitsubishi Electric Plant Engineering Corporation
Mitsubishi Heavy Industries, Ltd.
Mihama Corporation
RICOH LOGISTICS Co., Ltd.

National Council for Cleaning Equipment Business
Cleaning Cooperatives, etc.
(titles omitted, in Japanese syllabary order)

List of Main Customers

Main Customers

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Asahi Kasei Corporation

BML, INC. Bosch GmbH

Chiba Nogikunosato Water Purification Plant Clarion Co., Ltd.

DAIICHI SANKYO PROPCHARMA CO., LTD. Daito Purification Center Denka Seiken Co., Ltd.

EBARA JITSUGYO CO., LTD.

Furano Water Treatment Center

Hanshin Water Supply Authority Higashi-Murayama Purification Plant Hino Motors, Ltd. Honda Motor Co., Ltd.

Isuzu Motors Limited Itami city Waterworks Bureau

JFE Chemical Corporation JFE SHOJI ELECTRONICS CORPORATION JFE Steel Corporation

KEYENCE CORPORATION KURABE INDUSTRIAL CO.,LTD Kuraray Co., Ltd. Kurita Water Industries Ltd.

Metropolitan Police Department MITSUBISHI GAS CHEMICAL COMPANY, INC. Mitsubishi Heavy Industries, Ltd.

National Care Taxi Kyokai Co., Ltd. Nipro Pharma Corporation Nissan Chemical Corporation
NISSAN SHATAI KYUSHU CO., LTD.

Ohara Pharmaceutical Co., Ltd. Otsuka Pharmaceutical Co., Ltd.

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SEIKO EPSON CORPORATION SHI-ATEX Co., Ltd.
Shinko Chemical Co.,Ltd. Sumitomo Wiring Systems, Ltd.

TAIHO PHARMACEUTICAL CO., LTD. TERUMO CORPORATION TOAGOSEI CO., LTD.
TOTOKU ELECTRIC CO., LTD. Toyono Water Purification Plant TOYOTA MOTOR CORPORATION

Uji Water Purification Plant

Wako System Control Co.,Ltd. Watakyu Seimoa Corporation

Yamazaki Union Co., Ltd.

【Other】

Cleaning Cooperatives National Council for Cleaning Equipment Business

【Overseas】

United States, Austria, China, South Korea, Taiwan, Thailand state-operated, Indonesia, Malaysia, Saudi Arabia, Kuwait state-operated, etc.



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