

**Coating material
for breaking down
bacteria, odors, and
harmful substances:
just spray it on!**



 A totally new type
of photocatalyst
minacoat®

Apatite coating for visible light

**An antiviral, antibacterial,
deodorizing, antifouling coating**

What is a Photocatalyst?

Upon exposure to daylight or fluorescent light, a photocatalyst decomposes and removes harmful substances such as organic compounds and bacteria by generating strong oxidation on its surface. Its incredible power degrades harmful substances such as formaldehyde, which causes sick-house syndrome, carcinogenic dioxin, and even bacteria and viruses such as O-157, which causes food poisoning.

The use of photocatalytic technology is attracting world attention as a promising solution to environmental pollution and energy problems.

The photocatalytic coating reacts to **light,
and decomposes and removes harmful materials.**



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Apatite coating for visible light

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Creates safety
Inspires confidence
Fosters trust



That is the mission of “Environmental OPETH”

This quest led to minacoat®: friendly to people and materials.

The photocatalytic coating

The light that bathes us
is constantly decomposing dirt and viruses.

● Antibacterial and antiviral

In-hospital infection is a serious problem in the medical field. Photocatalysts prevent the breeding of bacteria more effectively than normal antibacterial agents.

● Antifouling

Dirt on the walls or ceilings degrades through the work of photocatalysts which have absorbed light energy. As a result, they prevent dirt buildup and reduce cleaning costs.

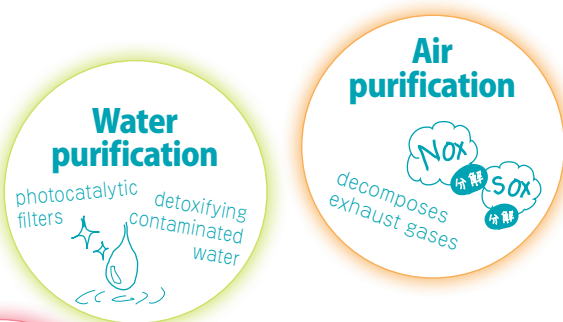
● Odor elimination

Acetaldehyde, the source of cigarette smells, is decomposed and deodorized through the operation of photocatalysts. The better the air circulation is, the more efficient the deodorizing will be. Photocatalysts are widely utilized in public spaces or smoking areas.

● Removal of harmful substances

Photocatalysts decompose formaldehyde, a cause of sick-house syndrome. It is highly regarded by those suffering from sick-house disease.

In safe, clean rooms with people you care about.



A totally new type of photocatalyst
minacoat®
Apatite coating for visible light
An antiviral, antibacterial, deodorizing, antifouling coating

minacoat® is a hybrid product --- a new type photocatalyst that reacts to visible light--- and an internationally patented technology. This new type of photocatalyst was developed in Japan by an independent organization known as the National Institute of Advanced Industrial Science and Technology. Reacting to the light from the sun or artificial lighting, it absorbs organic compounds and decomposes harmful substances that would cause contamination and viruses.

Low-cost minacoat® can be applied to textiles or plastics, and it will prevent yellowing. It greatly improves acetaldehyde decomposition performance and antibacterial effects.

A totally new type of photocatalyst

minacoat®

Apatite coating for visible light

An antiviral, antibacterial, deodorizing, antifouling coating

Coating material to break down bacteria, odors, and harmful substances: just spray it on!

When exposed to daylight or fluorescent light, minacoat® , a totally new type photocatalyst decomposes and removes harmful substances such as organic compounds and bacteria by generating powerful oxidation on its surface. It decomposes harmful substances such as formaldehyde that causes sick-house syndrome, carcinogenic dioxin, and even bacteria and viruses such as O-157 which causes food poisoning.

The use of photocatalytic technology is attracting world attention as a promising solution to environmental pollution and energy problems.

Photocatalytic Coating

Reacts with light, Eliminates harmful substances!

By using only light energy, it provides efficient and reliable deodorizing, anti-bacterial and anti-mold action, exhaust gas decomposition, antifouling, and water purification without any running costs.

A photocatalyst is a kind of catalyst that operates on light energy. Upon absorbing light, it attains high energy status, and the energy enables responding substances to generate chemical reactions. By making use of the strong oxidizing power of titanium oxide when exposed to light, almost every organic compound, including deadly poisonous dioxin, can be decomposed into harmless water and carbon dioxide. The effective use of this photocatalytic reaction brings about efficient results in deodorizing, anti-bacterial and anti-mold action, exhaust gas decomposition, antifouling, self-cleaning, and water purification.

Once apatite absorbs bacteria and organic chemicals, the absorbed substances will be decomposed by the photocatalytic operation of titanium oxide and light radiation.



A photocatalyst that reacts to visible light

A visible light compatible photocatalyst, minacoat® operates even in an indoor environment without daylight's ultraviolet rays. Indoor lighting generates a full photocatalytic reaction.

What is visible light?

It is a light that people can see with the naked eye (with a wavelength of about 380-770 nm). It includes both daylight and illumination from light bulbs or LED lamp. Unlike previous types, minacoat® can provide a full photocatalytic reaction with indoor lighting.

The application of photocatalytic coatings

The application of minacoat® will be done through the use of micro-spraying that does not require any special training. It can be applied to various places including elevators, smoking areas, and bathrooms. The main photocatalyst material, titanium oxide apatite, is used as a food additive in chewing gum and lipstick. It is safe to spray it indoors.



It will take approximately three hours for a total floor area of 300m² (ceiling height of 2.5m and floor area of 100m²), one hour for a floor area of 25 m² and a total area of 100 m², or half an hour for a floor area of 10 m². As for an elevator, after spraying for twenty minutes inside the elevator, the coating will be perfectly fixed in twenty-four hours.

※ Total areas given only as a guide. The spray time will vary according to temperature, humidity, and other conditions.

Low cost of single layer application; no masking is necessary

Application by spraying 2.5 micron particles with a special sprayer enables the stable fixing of photocatalysts even in small areas. Since minacoat® includes no binder (adhesive), curing for materials such as glass is not necessary. **minacoat® enables a speedy application.**



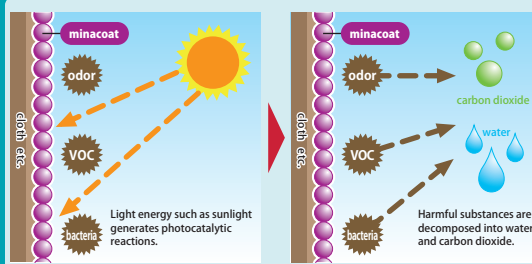
※ Curing is necessary for fire alarms, detectors, electronic devices, painting, or furniture.



Organic compounds will be absorbed and decomposed powerfully, using any kind of light.

minacoat® absorbs organic compounds powerfully through the effects of apatite. They are decomposed by the photocatalytic reaction of titanium dioxide.

	minacoat®	Existing photocatalyst
Binder <small>(fixing agent for photocatalysts)</small>	Not necessary	Organic binders Inorganic binders
Reacts to visible ray	Yes	No
Reacts in dark places	Absorbs organic compounds & decomposes with visible light	No
Application method	Simple and easy	Skills required
Application cost	Inexpensive	Expensive



The photocatalyst reacts with light on the coated surface, then decomposes and removes viruses.

【 The mechanism of the new photocatalyst 】

Upon exposure to light from the sun or a fluorescent lamp, our photocatalyst generates powerful oxidation on its surface, removing harmful substances such as organic compounds and bacteria that are on the surface. Its primary component, titanium oxide, is used as a food additive, which means it is safe.

Cyclic effects with any light

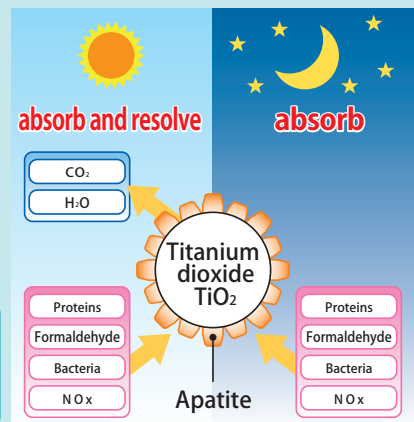
One of the few weak points of titanium oxide as a photocatalyst is that its reaction is caused by ultraviolet rays, only a few percent of which exist in daylight. In order to solve this problem, a photocatalyst that reacts with any light was developed by utilizing plasma processing techniques based on titanium oxide. minacoat®, the totally new type of photocatalyst, exhibits high performance not only in indoor situations but also outdoors.



A contact reaction of organic substances on a minacoat® surface triggers decomposition.

- **The absorbing function of apatite**
Absorbs bacteria and odor factors
- **The resolving function of titanium dioxide**
Decomposes absorbed organic substances upon exposure to light

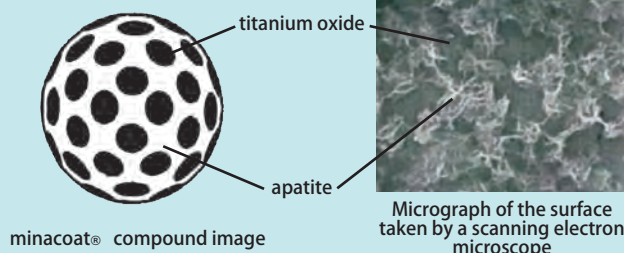
Function of "absorption" and "resolution" Operates 24 hours a day.



Expanding applications with apatite film titanium oxide

When titanium oxide contacts fiber or resin directly, degradation will occur through a photocatalytic reaction. However, with the intermediary of apatite, titanium oxide is able to directly mix with, or coat high-polymer materials. These materials can be utilized for the purification of air and water, antifouling, bleaching, and washing. It enables the application of titanium oxide to organic base materials such as fiber, resin, plastic, wood, and paper.

- It isolates organic substances from titanium dioxide.
 - Degradation of the organic medium base material rarely occurs.
- ※ Organic medium: plastic, fiber, etc.



The Indoor Environment

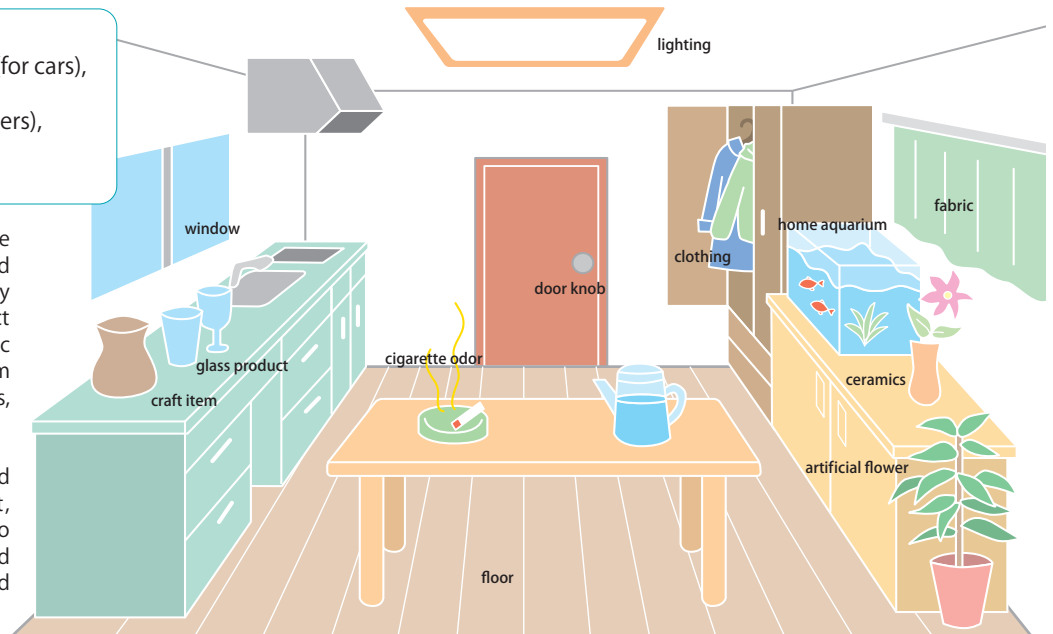
Antifouling, antibacterial, antiviral, deodorizing, removal of harmful substances in a room

[minacoat® product]

minacoat® DC (for indoors), HF (for cars), FB/FB-PE (for bathrooms), CD (for hospitals), TX/TX-P (for fibers), ZK (for artificial flowers), KABK (for wallpaper)

A tightly closed house encourages the breeding of mold and bacteria, and indoor air is easily contaminated by various chemical substances like insect repellents, tick repellents, organic solvents, and formalin emitted from building materials, furniture, floor mats, or carpeting.

Through the contact reaction of emitted chemicals and the photocatalyst, harmful chemicals will be resolved into harmless substances such as water and carbon dioxide, thus detoxifying and purifying the indoor environment.



Deodorizing and antifouling

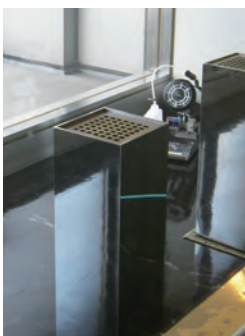
removal of bad smells

Light reaches inside the extremely light porous ceramic material with fine 10-80 μm pores coated with titanium oxide. By using a deodorizing photocatalyst module with this material inserted, smells in restaurants, hotels, and food-processing plants will be completely resolved and removed through exposure to ultraviolet rays.

In order to neutralize bad odors, only a small amount of substance needs to be treated, which means just a small quantity of light makes for efficient deodorizing. The full deodorant effect in the lavatory can be attained with indoor lighting, since the primary odor components present in small quantities.



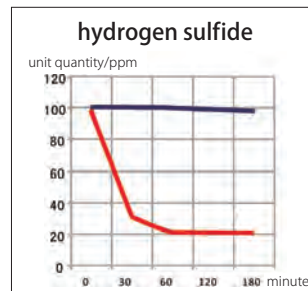
antifouling



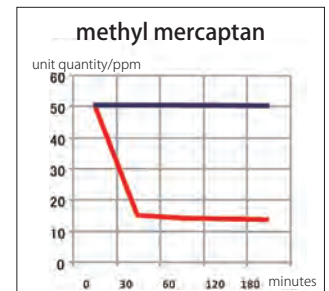
Although dirt made from inorganic substances such as sand or dust will not be resolved, minacoat® enables outdoor dirt to be washed off by rain because it decomposes organic oil smears which act as adhesives. It also enables indoor materials to be stain-resistant and easily cleaned. minacoat® is especially effective at preventing yellowing by cigarette tar that gradually accumulates on a surface.

Deodorizing test

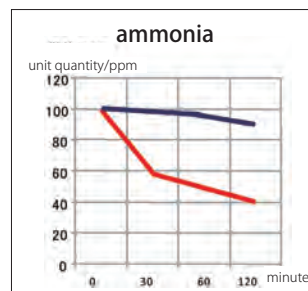
— purified water — minacoat CD



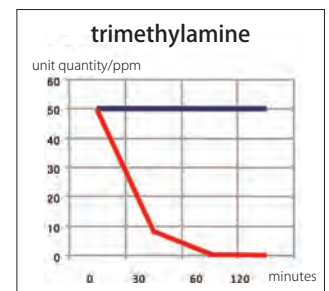
the smell of rotten eggs



the smell of rotten onions or radishes



a suffocating odor, like urine



the smell of rotten fish

Test: performed by Japan Food Research Laboratories. (Material: provided by the manufacturer)

[Protection of craft works]

Applying a liquid type photocatalytic coating can prevent traditional Japanese crafts (cultural treasures) from being stained. It protects cultural treasures from discoloration and dust.



Antibacterial & Anti viral

preventing bacteria

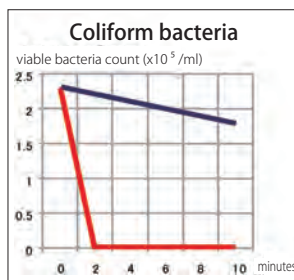
Due to its high affinity with mold and bacteria, apatite attracts germs and mold floating in the air and sterilizes them through the photocatalytic operation. It will prevent bacteria and mold from developing on food. The application of apatite film titanium oxide on its surface is effective at preventing slime caused by bacteria in a swimming pool or hot spring bath. Putting a bath agent mixed with powdered apatite film titanium oxide into water and exposing it to ultraviolet rays enables it to sterilize coliform bacteria; only 33 ppm added to water can eliminate almost all coliform bacteria within an hour.

Destroying bacteria (anti-bacterial, bacteria reducing, antiviral)

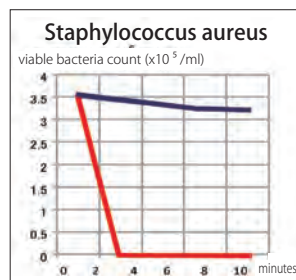
- In-hospital infections and in-house infections
- O-157, coliform bacteria, staphylococcus aureus
- Bird flu
- Mold

Bacteria eradication effect testing

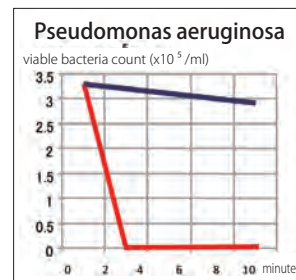
Test: performed by Japan Food Research Laboratories.
(Material: provided by the manufacturer)



causes food poisoning (O-157 etc.)



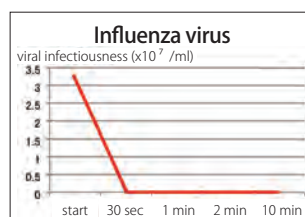
food poisoning, MRSA, in-hospital infections



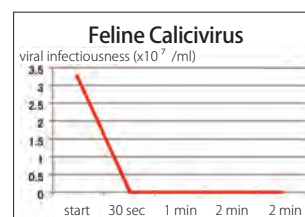
causes in-hospital infections

Virus inactivation testing

It has been proved that minacoat CD makes influenza virus and feline calicivirus (used as an alternative for norovirus) inactive within 30 seconds.



changes in a short period, liable to an outbreak



used as an alternative for norovirus, causes respiratory infection in cats

Removal of harmful substances

Various chemicals in insect repellents, tick repellents, organic solvents, and formalin are emitted from tatami mats, carpets, and building materials. By using a photocatalyst, harmful chemicals can be decomposed into harmless substances such as water and carbon dioxide, thus purifying the indoor environment.



Lamps and shades with photocatalyst coatings will effectively generate photocatalytic reactions through the light from the lamp. Photocatalyst-applied artificial plants, artificial flowers, sliding paper doors, wallpaper, window shades, and room partitions will purify the air just using the light coming from windows or indoor lights without using any other energy! In order to attain efficient photocatalytic effects, it is vital that harmful chemicals have good contact with the photocatalyst.

air purification

Main indoor harmful substances that contaminate the environment

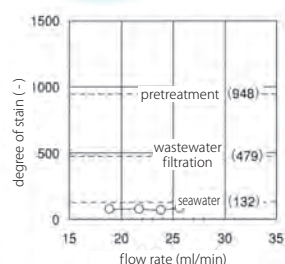
Source of generation	Contaminant
Plywood (closets, ceilings, walls, furniture, floors, etc.)	Adhesives (formaldehyde), insecticides (fenitrothion, phoxim), preservatives (CCA: copper chromated arsenate)
Wallpaper, coating materials	Plasticizers (phthalate ester, DOP, DBP etc.) solvents (toluene, acetic ether), flame retardants (TCEP), adhesives (unreacted formaldehyde)
Tatami mats, flooring	Insecticides for tatami mats (fenitrothion, fenthion, diazinon, naphthalene), vinyl chloride resinated plasticizers for floors (phthalate ester, DOP, DBP), adhesives for composite wood (formaldehyde)

An airtight house with low air circulation encourages the breeding of mold and bacteria, which can cause allergy, sick-house syndrome, or chemical sensitivity to harmful chemicals from building materials. minacoat® purifies the indoor air by rendering harmful factors harmless.

Purification of water

purifying contaminated water

With a density of 0.92g/cm³, a fine hollow glass ball coated with titanium oxide floats on water and enables contaminated substances to be efficiently decomposed. When purifying laver during processing and drainage, minacoat® purified water into a cleaner state than normal seawater. minacoat® can be used for decomposition of heavy oil that comes from tanker accidents.



The development of slime or algae growth is a problem not only for aquarium or watery areas such as sluices, quay walls, and water-parks, but also for outdoor areas where rain often hits: building walls, roads, stairs, and windows. Versatile photocatalysts can be applied to various places such as kitchen sinks to prevent slime or algae.

Everyone is happy with the minacoat® photocatalyst.

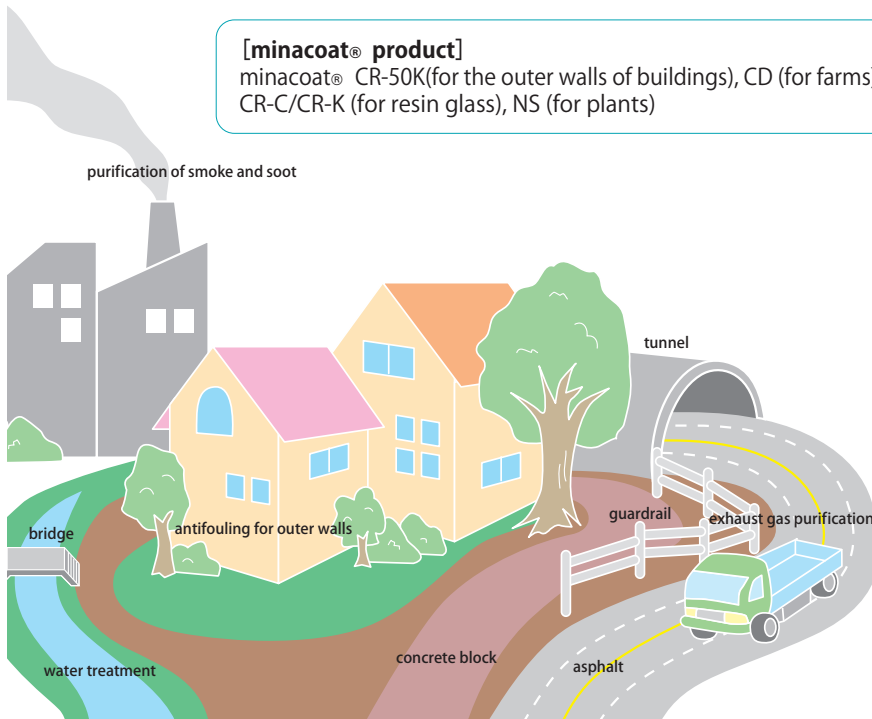


The Outdoor Environment

Purification of air and water, self-cleaning

[minacoat® product]

minacoat® CR-50K (for the outer walls of buildings), CD (for farms), CR-C/CR-K (for resin glass), NS (for plants)



Photocatalysts give excellent results with daylight (ultraviolet rays). They are utilized in various places such as outer walls, roads, stairs, bridges, parabolic antennas, solar panels, and power lines to take advantage of their hydrophilic nature.

Street lights and security lights in the OPETH LED light SQ-RAYS® series have photocatalytic coatings for anti-fouling, which effectively prevents luminance reduction.

As for water-parks, pools, irrigation canals, aquariums, or goldfish bowls, the hydroxyl radical, produced through light falling on photocatalysts prevents fouling very powerfully via the double effect of decomposing slime and algae and preventing the breeding of organic microbes.

Removal of harmful substances

In order to purify air pollution caused by nitrogen oxides (NOx) and sulfur oxides (SOx) emitted from automobile exhausts, a trial has been made by applying photocatalytic coatings to acoustic boards along the sidewalls of roads. It will trigger complete oxidization of NOx and SOx. They will be decomposed into nitric acid and sulfuric acid by reacting with absorbed water, which will then be washed off by rain.

With the application of apatite film titanium oxide on the surface, the function of absorbing harmful chemicals will be added regardless of the existence of light, and it will exercise decomposition through light exposure.



detoxifying auto exhausts

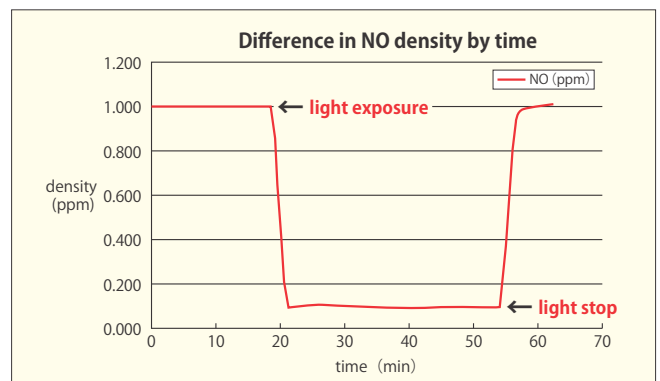
● The performance of photocatalysts for NOx removal

Sample	Density after chemical reaction (ppm)			NOx removal rate (%)
	NO	NO ₂	NOx	
Blank	4.6	0.3	4.9	—
No catalyst light exposure	4.6	0.3	4.9	0
one time dip coat	0.2	0.1	0.3	94
three time dip coat	0.1	0.0	0.1	98

● The effect of NOx removal with the totally new type photocatalyst

【 Apatite film 】

The base component of mineral apatite film is phosphorus and calcium. Coated with apatite film, minacoat® absorbs harmful substances and enables efficient photocatalytic reactions.



Antifouling

the prevention of dirt on outside walls

By applying apatite film titanium oxide on outside walls, organic substances which cause dirt will be differentiated through photocatalytic operation. The outer walls of a building are normally cleaned once every five years, so the application of this type of photocatalyst permits a significant cost reduction in maintenance fees.

Example of minacoat® application



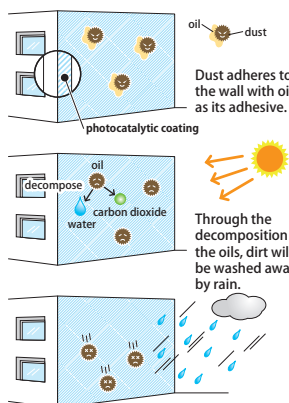
before application

after application

When the titanium oxide photocatalyst is used as a coating for the outer walls of a building, even if it does not decompose all of the dirt, rain will wash off the dirt as long as the area in contact with the coating has been decomposed. This is due to the superhydrophilic quality of titanium oxide.

Not only organic dirt such as smears, but inorganic substances such as sand or dust tend to adhere to the outer walls of a building. Organic smear oil acting as an adhesive attracts inorganic dirt such as sand or dust. A photocatalyst does not decompose inorganic dirt, but it does decompose organic smears, and makes them easy to wash off with rain, which takes away the dirt with them. This process enables self-cleaning.

The antifouling via photocatalysts



By utilizing these operations, the self-cleaning function has been applied in various products such as building materials, outdoor walls, window glass, stove hoods, guardrails, and washing machine tubs. Materials such as film or paint with this function are already on the market.

Other Environments

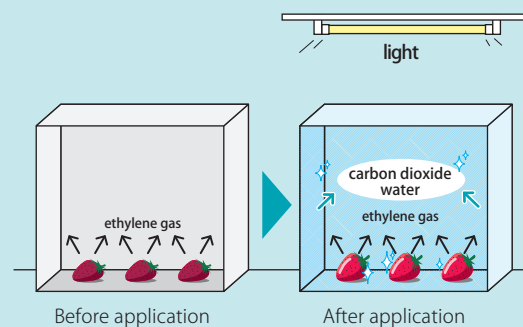
It can be used in this way

To maintain freshness by decomposing ethylene

Fruit, grains, and flowers are refrigerated to prevent over-ripening by ethylene gas, which they emit in order to ripen, but it only limits the ethylene emission and does not eliminate the gas itself, so it is not highly effective.

A photocatalyst, which decomposes the ethylene gas into carbon dioxide and water, is effective, as it enables crops such as fruit, grains, flowers, seedlings and plant bulbs to last. It can also prevent the breeding of bacteria and mold, and eliminate odors, thus stabilizing the quality of the product.

Commodity values will increase through the combined applications of coating the containers/ storehouses/ transportation trucks and using LED lighting SQ-RAYs® series to further promote photocatalytic reactions.

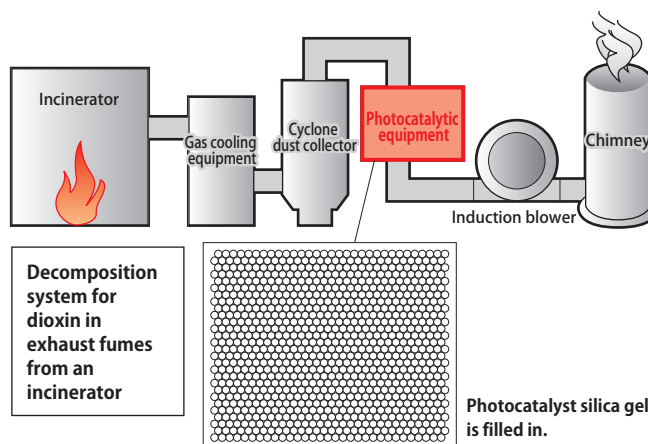


Removal of harmful substances

decomposition of dioxin in the exhaust fumes of incinerators

Deadly-poisonous dioxin in exhaust fumes from incinerators for industrial waste can be efficiently decomposed by photocatalysts. Equipment for photocatalytic decomposition is installed in a place after the dust collector, where industrial waste passes through. Inside the equipment, transparent silica gel (about 3 mm in diameter) is filled in with titanium dioxide coating as a photocatalyst film. Through exposure to ultraviolet rays, more than 95 percent of dioxin and other substances can be decomposed and removed.

Coplanar PCB, which used to be difficult to treat, can be completely decomposed and disposed of.



minacoat® products at a glance

minacoat HF

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide
Form	Water + Alcohol
Uses	For automobiles
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Combating sick-car syndrome



minacoat DC

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide
Form	Water solution
Uses	For indoors
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Combating sick-house syndrome



minacoat CR-50K

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide/ ethyl silicate
Form	Water + Alcohol
Uses	For outer walls of buildings
Primary applications	Antifouling of exteriors



minacoat FB

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide/ ethyl silicate
Form	Water + Alcohol
Uses	For bathrooms
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Antivirus

minacoat TX-PE

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide/ polyester emulsion
Form	Water solution
Uses	For cloth/ fibers
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Antivirus

minacoat CD

Main composition	Light-activated titanium oxide/ titanium hydroxide/ cyclic oligosaccharide/ iodide/ natural organic acids/ alcohol
Form	Water + Alcohol
Uses	For hospitals
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Antivirus

minacoat FB-PE

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ polyester/ titanium hydroxide/ ethyl silicate
Form	Water + Alcohol
Uses	For film/resin
Primary applications	Antibacterial/ Antifouling

minacoat CR-C

Main composition	Hydroxyapatite-coated titanium oxide/ ethyl silicate
Form	Alcohol solution
Uses	For glass/resin
Primary applications	Antifouling/ Anti-fogging (glazing at 130°C)/ Solar panels/ Acryl/ Polycarbonate

minacoat CR-K

Main composition	Hydroxyapatite-coated titanium oxide/ ethyl silicate
Form	Alcohol solution
Uses	For glass/ resin
Primary applications	Antifouling/ Anti-fogging (glazing at 130°C)/ Solar panels

minacoat TX-P

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide/ cereal extract
Form	Water solution
Uses	For cloth/ fibers
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Antivirus

minacoat KAB-K

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide/ ethyl silicate
Form	Water solution
Uses	For cloth/ fibers/ wallpaper
Primary applications	Deodorizing/ Antibacterial

minacoat Spray-type

Main composition	Light-activated titanium oxide
Form	Water + Alcohol
Uses	For indoors (S1)/ car interiors (G1)
Primary applications	Deodorizing/ Antibacterial/ Antimold/ Antivirus

minacoat ZK

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ polyester/ titanium hydroxide/ ethyl silicate
Form	Water + Alcohol
Uses	For artificial flowers
Primary applications	Deodorizing/ Antibacterial

minacoat NS

Main composition	Light-activated titanium oxide-coated hydroxyapatite/ titanium hydroxide
Form	Water + Alcohol
Uses	For plants
Primary applications	Deodorizing/ Antibacterial/ Organic produce/ High-grade charcoal



■ Mini Sprayer SLV-05F

Sprays ultra-fine particles (2.5 micron)

This sprayer creates ultra-fine particles by inflating compressed air in a vortex at the speed of the sound. (340 m/sec) The patented air-atomizing nozzle allows the 2.5 micron particles to float onto surfaces.



■ Tornado 2

Ultra-fine spray gun

This atomizer produces a 1 to 5 micron particle mist.



※ For application on glass

Visible-light-driven apatite coated

minaPower[®] Photocatalytic cleaner

Thorough cleaning with power of photocatalysis

Powerful cleaning and deodorant & disinfectant



Hikari power P400

For norovirus measures

Antibacterial and antiviral agents that utilize the photocatalytic function to remove organic substances

Deodorant & Disinfectant

Minature[®]

Minature is a deodorant and disinfectant by simply adding it to water.

Air conditioner, air purifier, ventilation fan

minacoat Filter

Thorough cleaning with power of photocatalysis

Block the dirt on the filter inside the air conditioner just by pasting it on the intake port!



Advanced photocatalyst Coating type LED lighting

SQ-RAYS[®]

Simple Quality Rays

Thorough cleaning with power of photocatalysis

LED lighting with excellent stain resistance



Antistatic agent
minaRex
Advanced photocatalyst
minacoat[®]
ミナコート

Application procedure

[Normal coating (except outer walls)]

1 ATP (adenosine triphosphate) wiping test before inspection

- measure the surface with ATP inspecting device
- take photos of the inspected areas

2 Cleaning before the application

- cleanse with cleaning liquid, then wipe with a damp sponge
- ※ Ohmi SG-1 (alkali cleanser)

3 Dry curing

- use air blower/fan as needed

4 Photocatalytic coating

- use a special sprayer to coat the surface
- ※ Mini Sprayer SLV-05F

5 Confirming the coating after dry curing

- dry and cure for about an hour
- check the coated surface

6 ATP wiping test after application

- measure the result during the same period of time with the same conditions as in the first test
- approximately one month after the first inspection

7 Evaluation

- reconfirm the measured number, if it is lower than before
- standard target: 400-500 RLU
- ※ RLU (relative light units)



An example of minacoat[®] application

[Coating inside a car]

1 Clean the inside of a car and place a sprayer inside it.



2 Seal the cracks along the window frames, and pull the sprayer's electric cord out of the car.



3 Place the spray hose into the minacoat[®] solution.



4 Close the windows tightly and start spraying

- ※ It will usually take about 15 minutes to finish, but keep spraying until the liquid is used up.



5 Turn off the compressor, and turn on the fan for about 5 minutes until the mist disappears. Wash off the minacoat[®] solution that is left inside the sprayer.



Certified specialists are in charge of making the application, and they guarantee its enduring effects and quality.



(Certification of photocatalytic application)



(A sticker to certify the photocatalytic application)



(A tag to certify the photocatalytic application for a car)



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Inquiries

Distributor  **OPETH.co.,Ltd.**

3-9-17, Hashimoto, Midori-ku, Sagami-hara, Kanagawa 252-0143
Phone. 042-770-7005 FAX. 042-770-7710 E-mail: info@opeth.co.jp

<https://www.opeth.co.jp/>



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