

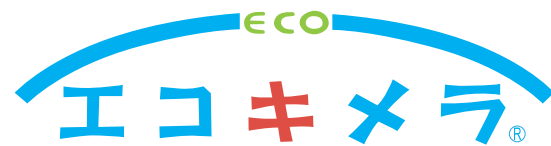


Even without *light*,  
we have *the power*  
*to protect* you.

未来ソリューション

# 未来ソリューション

## Solutions to Create Clean and Safety Living Environment



To overcome the disadvantages that photocatalysts faces as the times change, such as the spread of LED lights and UV-cut glass, we have developed リン酸チタニア<sub>YOO Co., Ltd.</sub> brand products by applying リン酸チタニア<sub>YOO Co., Ltd.</sub>, which was created from a patented technology we developed together with the Osaka Research Institute of Industrial Science and Technology, as the main ingredient.

We are also currently concluding joint research agreements with national research institutes and national universities (as of May 2023) to pursue clearer scientific proof and explore applications in new fields.



Titanium dioxide, which has dirt resistant and antibacterial properties, has been the focus of attention for some time.

Seeking further functionalization, we focused on titanium tetrachloride as a raw material and developed リン酸チタニア<sub>YOO Co., Ltd.</sub>, which is obtained by reacting it with phosphoric acid.

As a result of various tests conducted by an external inspection agency, it has been confirmed that this product has various effects and efficacies, including deodorizing, antibacterial, antiviral, dirt resistant, mold proof, and anti-allergenic, even indoors.

The main ingredient リン酸チタニア<sub>YOO Co., Ltd.</sub> of the functional coating agent Ecokimera manufactured and sold by YOO Corporation is limited to products using the above registered logo mark.



Ecokimera S Series

## Three Features

### Feature 1 High Quality

Yearly sustainability

High level of adhesion  
Activation mechanism

### Feature 2 Safety

High level of safety

Effects when swallowed  
Skin reaction  
Effects on DNA

### Feature 3 Functionality

Extensive data support

Third-party certification (SIAA/SEK)  
Deodorization  
Antibacterial  
Antiviral  
Other side effects



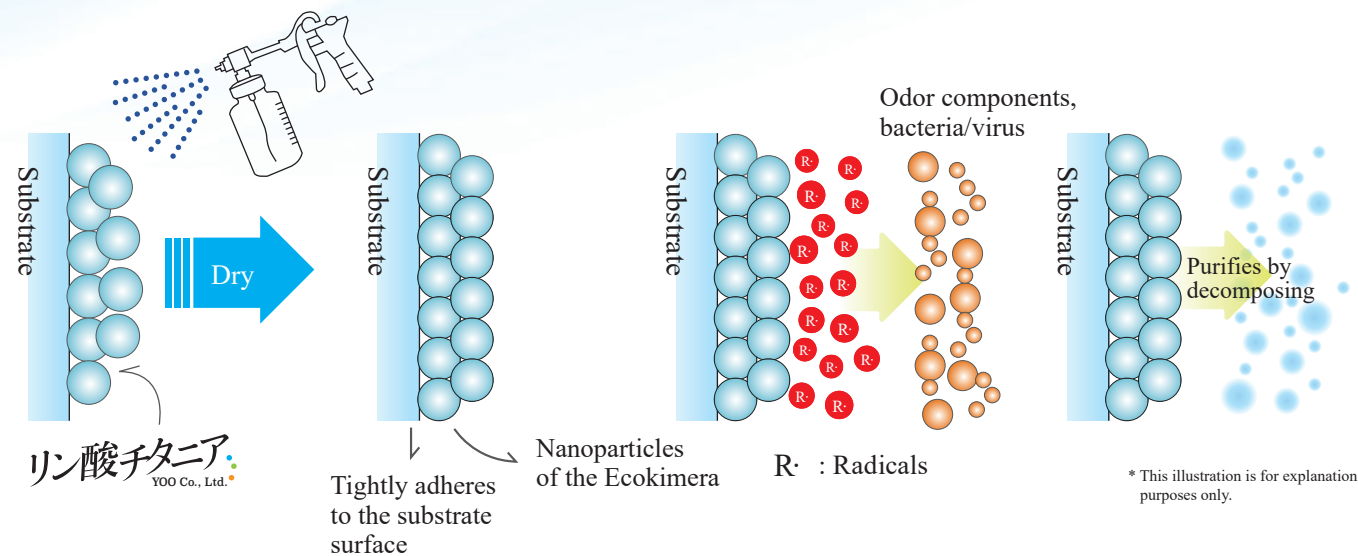
# S Series

Deodorization, antibacterial, antiviral

Feature 1

Yearly sustainability

## Ecokimera S Series Activation Mechanism



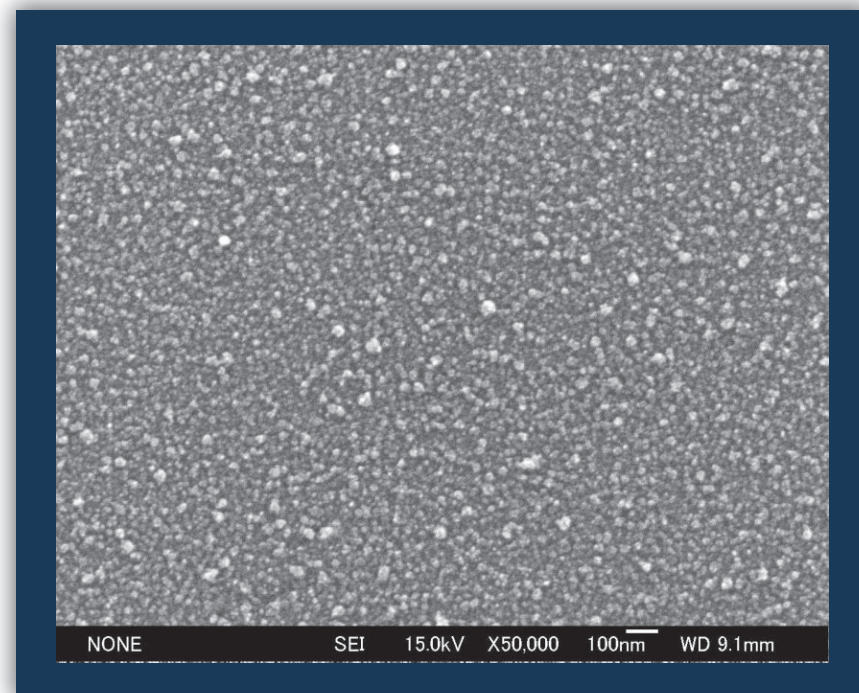
### Activation mechanism

By applying Ecokimera with a dedicated spray gun (spraying equipment and coating method using this equipment, Patent No. 6932410), nanoparticles derived from titanium phosphate-based compounds are deposited on the substrate surface.

It is believed to decompose odor components or physically destroy bacteria and viruses mainly by radical reactions on the surface of nanoparticles deposited during application. It is thought that the large number of nanoparticles on the applied surface increases the surface area, resulting in high activity.

### Observation of [SRW-30] coated surface using microscope

Magnified 50,000 times using a scanning electron microscope (SEM)



SEM photographs were taken by Dr. Takamichi Miyazaki, Tohoku University School of Engineering, using a JEOL JSM-6500F.

## Industry-Academia-Government Collaboration

We are establishing a research system to elucidate the adhesion and activation mechanism. (As of May 2023)

### National Institute of Advanced Industrial Science and Technology

We are conducting joint research with Dr. Hirokazu Masai (Engineering) and Dr. Hideaki Maseda (Agriculture) on the structure (mechanism analysis) of titanium phosphate-based compounds, the main ingredient of Ecokimera, and elucidation of their action based on microbiological (genetic) findings on the cause of material activity, and are working consistently to contribute to virus control in Japan and overseas. From September 2022, we also started Chronic Toxicity Evaluation Using Individual Fish with the cooperation of Dr. Takashi Kawasaki (Science) of the same institute to verify the presence or absence of chronic toxicity to aquatic organisms and its effects on microorganisms.

### Tohoku University Graduate School of Agricultural Science

Under the theme of Functional Verification and Application Development of the Ecokimera S Series, we are conducting joint research and development with Professor Hiroshi Yoneyama (M.D., Ph.D.) in the field of animal microbiology to evaluate the antimicrobial activity against bacteria causing infectious diseases in animals (livestock) and the applicability of deodorizing, antibacterial, and antiviral functions to the field of animal husbandry, etc. \* The research results about our product were presented at the 66th Annual Meeting of the Japanese Society for Staphylococcal Research. (October 29, 2022)

## S Series: Supportive Data for Adhesion

Spray application of Ecokimera to various materials deposits nano-sized particles on the surface. These particles adhere firmly to the surface of the material, so the stable effect lasts for years without the use of binders.

As empirical data on the adhesion between the surface and Ecokimera, the presence of titanium components derived from titanium phosphate-based compounds on a glass surface sample has been confirmed even after a cloth friction test of 10,000 rubs in an experiment conducted at the Kyushu Synchrotron Light Research Center in Saga Prefecture (results of joint research with the National Institute of Advanced Industrial Science and Technology). Third-party testing has also shown that the antibacterial activity of fiber material samples after 50 washings is comparable to that of untreated samples.

### Abrasion resistance test

Test name	Reciprocation count	Result
SRW-30	10,000	No abnormality (Swelling, cracking, peeling)

- ◎ Testing organization: AU Techno Services Co., Ltd.
- ◎ Test No.: P210458
- ◎ Testing method: JIS L0849
  - Friction material: broadcloth (JIS L0803)
  - Reciprocation speed: 30 round trips/min
  - Load: 200 g
- ◎ Substrate: glass

### Washing resistance and antibacterial test

Sample	Antibacterial activity value
SRW-30 (washed 0 times)	6.0
SRW-30 (washed 50 times)	6.0

- ◎ Testing organization: Boken Quality Evaluation Institute, general incorporated foundation
- ◎ Testing method: JIS L1902:2015 Bacterium liquid-absorbing method
- ◎ Washing method: Washing Methods for SEK Mark Textile Products - Standard washing method, Japan Textile Evaluation Technology Council, general incorporated association
- ◎ Substrate: felt

## S Series

Deodorization, antibacterial, antiviral

Feature 2

High level of safety

## Safety Test Results (Summary)

Testing organization: Drug Safety Testing Center Co., Ltd.

## Acute oral toxicity test\*

The test method was based on the acute toxic class method (OECD TG423), and the appropriate dose was administered. The results showed that there was no effect of the test substance on body weight and no death was observed. As a result, the LD50 of a single oral dose of Ecokimera SRW-30 is estimated to exceed 2000 mg/kg under the circumstances of this study, and the GHS classification is estimated to be Category 5 or Unclassified.

## Acute dermal irritation test\*

An acute dermal irritation test of Ecokimera SRW-30 was conducted. The test was conducted by judging the skin reaction after a period of time, referring to OECD TG404, and the results showed that there was no skin reaction at all in either the initial test or the confirmation test, and the P.I.I. was zero. From these results, it was inferred that Ecokimera SRW-30 is non-irritating to the skin.

## Skin sensitization test\*

As a result of the skin sensitization test of Ecokimera SRW-30 using the Guinea Pig Maximization Test method (OECD TG406), no skin reaction was observed in either the sensitized group or the control group even with the undiluted solution (100% concentration), and the sensitization rate was 0%. Based on these results, Ecokimera SRW-30 did not cause skin sensitization under the test conditions.

## Reverse mutation test\*

As a part of the safety evaluation of Ecokimera SRW-30, a preincubation method with the designated bacteria was used to examine the presence or absence of gene reverse mutagenesis, and the results showed that there was no increase in the number of reverse mutant colonies that was more than twice the negative target value in any of the strains, regardless of the presence or absence of metabolic activation. Based on the above results, Ecokimera SRW-30 was judged to have no mutagenic activity (negative) under the test conditions.

## Acute inhalation toxicity test

Using a special gun and compressor provided following the OECD TG403, spray for two seconds four times at 10-second intervals for exposure. Daily observation was conducted for 14 days after exposure, and at the end of the observation period, it was checked whether there were any abnormalities caused by the test substance (SRW-30). Pathological examination of the lungs was also conducted. The results showed that there was no effect of the test substance and no abnormality was observed in the pathological examination of the lungs.

In addition, the safety of the product has been confirmed in acute eye irritation tests and fish acute toxicity tests.

\* Conforms to the Certification Standards of SEK Mark Textile Products and the SIAA Voluntary Specifications for Quality and Safety.

## S Series

Deodorization, antibacterial, antiviral

Feature 3

Extensive data support

## Key Feature of Ecokimera S Series

## Certification marks obtained for the Ecokimera S series

## Deodorization

Certification acquired



Antibacterial  
Finished Product  
No: 324Z21W

## SIAA Certification Mark

Certification for application to non-porous surfaces

The Society of International sustaining growth for Antimicrobial Articles (SIAA) has granted Ecokimera SRW-30 (liquid product) an antibacterial and antiviral certification mark.

## SEK Certification Mark

Certification for textile products (porous products) only

Textile products processed with SRW-30 were found to conform to the standards set by the Japan Textile Evaluation Technology Council (general incorporated foundation), and have acquired three SEK Mark certifications.

## Antibacterial activity

Certification acquired



Antimicrobial  
Finished Product  
No: 142A21W

Certification acquired



## Antiviral activity

Certification acquired



Antiviral  
Finished Product  
No: UK41A21W

Certification acquired

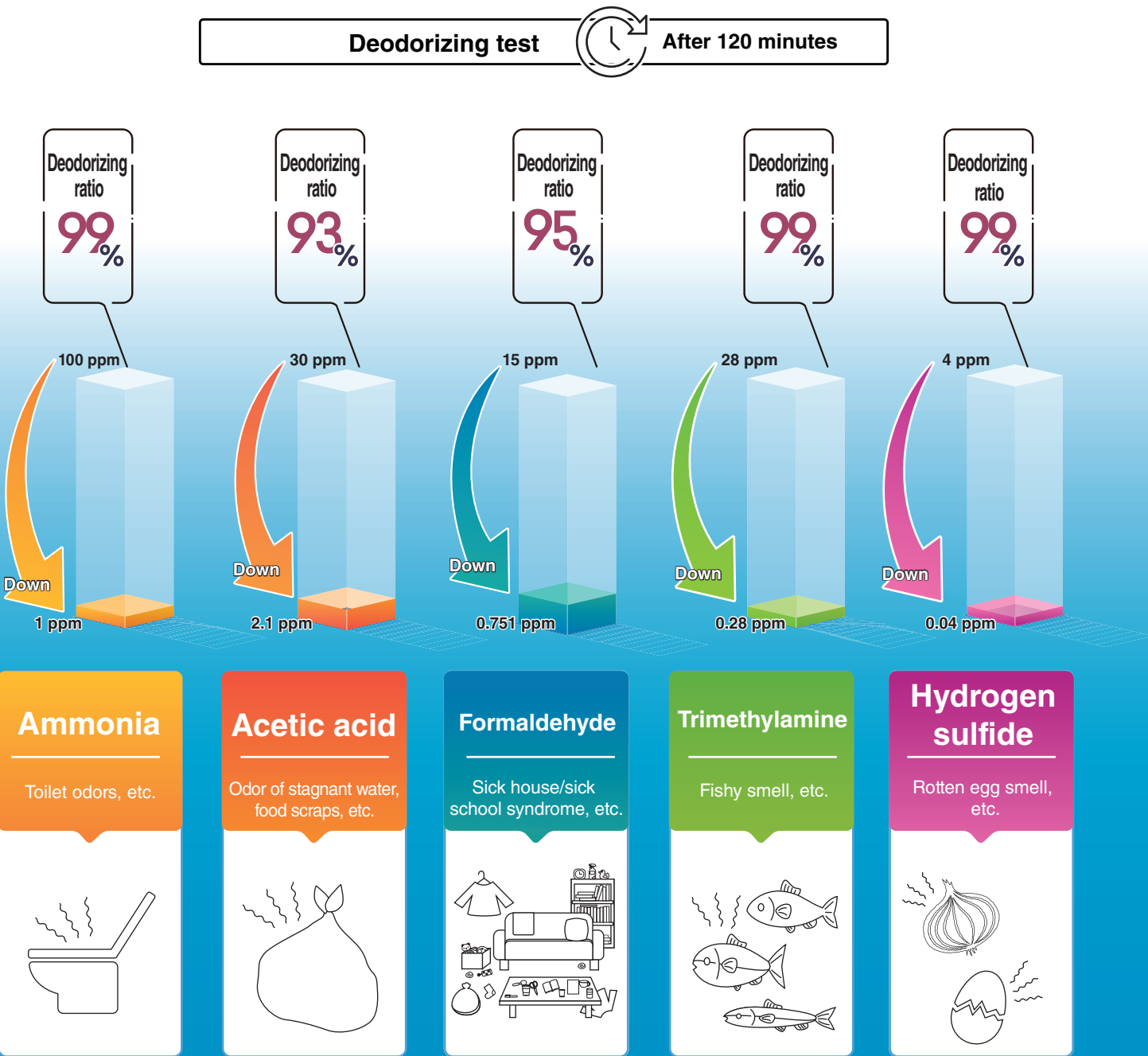




# S Series

## Deodorization

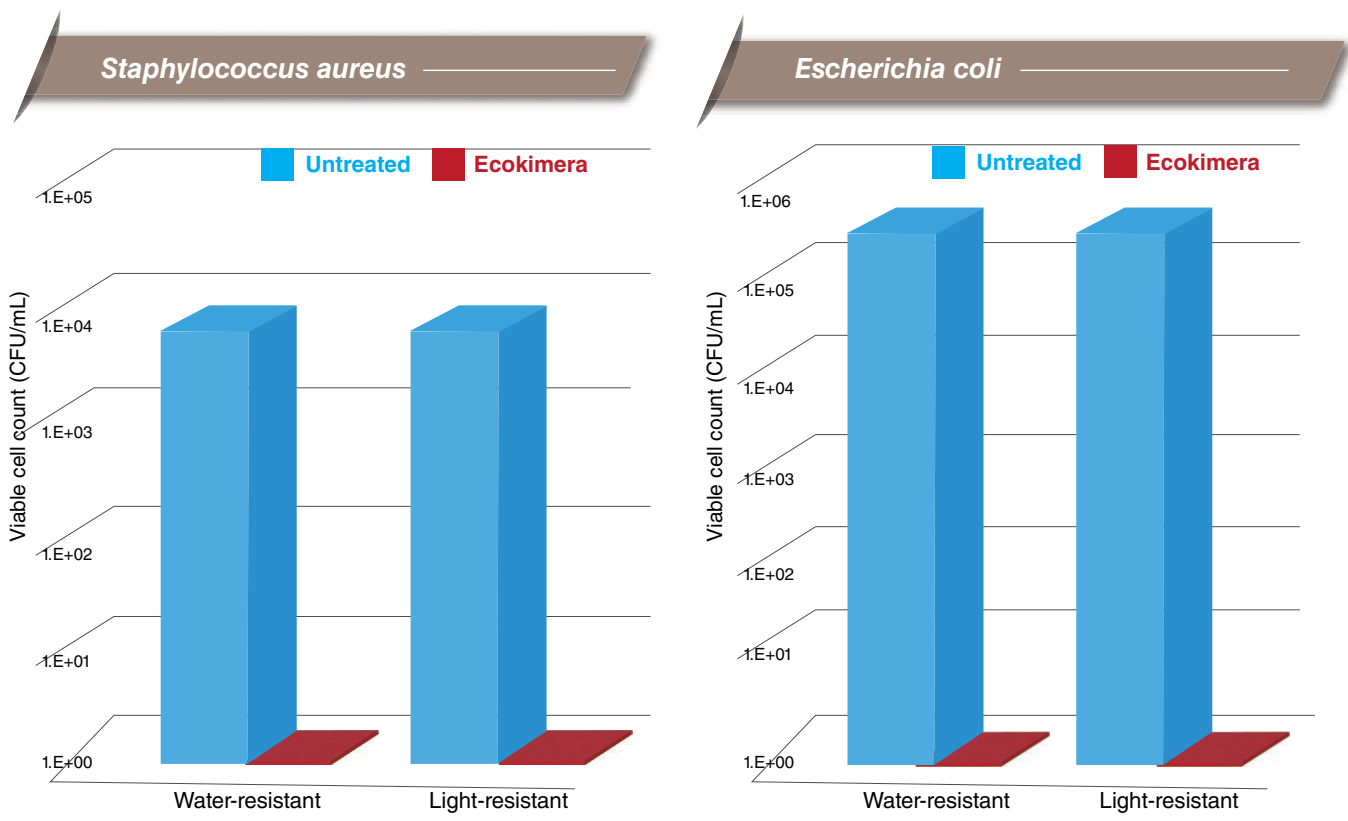
Ecokimera decomposes formaldehyde, ammonia, volatile organic compounds (VOC) that cause sick house and sick school syndrome, etc., and degrades unpleasant odors. In addition, it continues to work 24 hours a day, even in dark locations where light does not reach.



Applied the Certification Standards of SEK Mark Textile Products of the Japan Textile Evaluation Technology Council (general incorporated association).  
21. Deodorizing property test (detector tube method, gas chromatograph method)

# S Series

## Antibacterial



As a result of testing in accordance with the JIS Z 2801 standard after applying Ecokimera to glass surfaces using a dedicated gun, antibacterial activity values much higher than 2.0 were obtained under all conditions. Based on these results, the SIAA antibacterial certification mark was obtained.

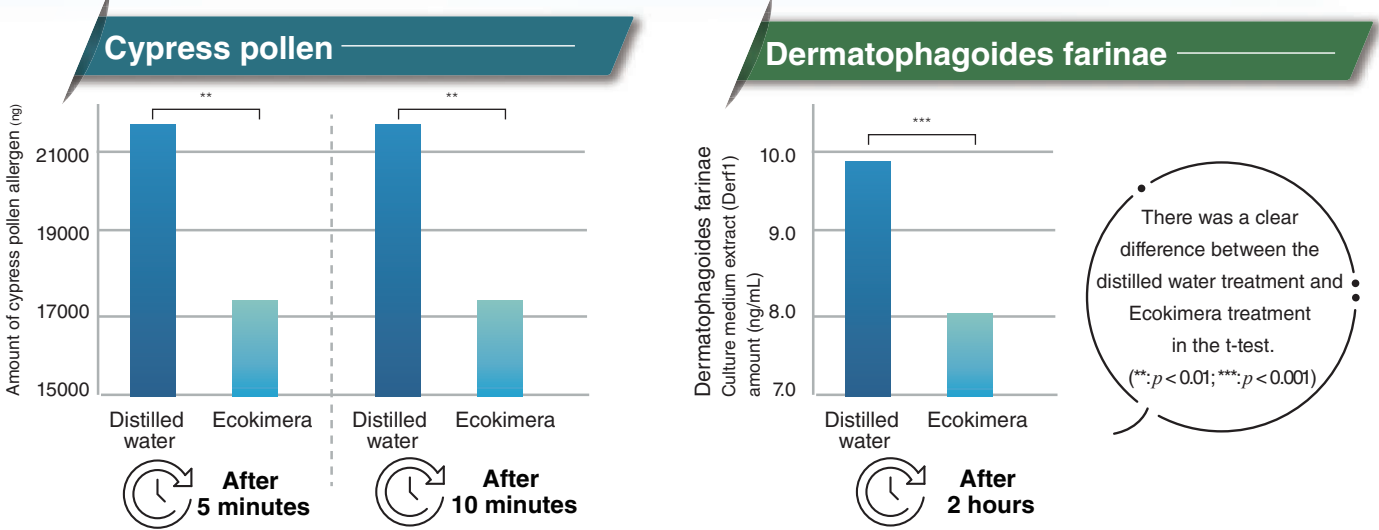
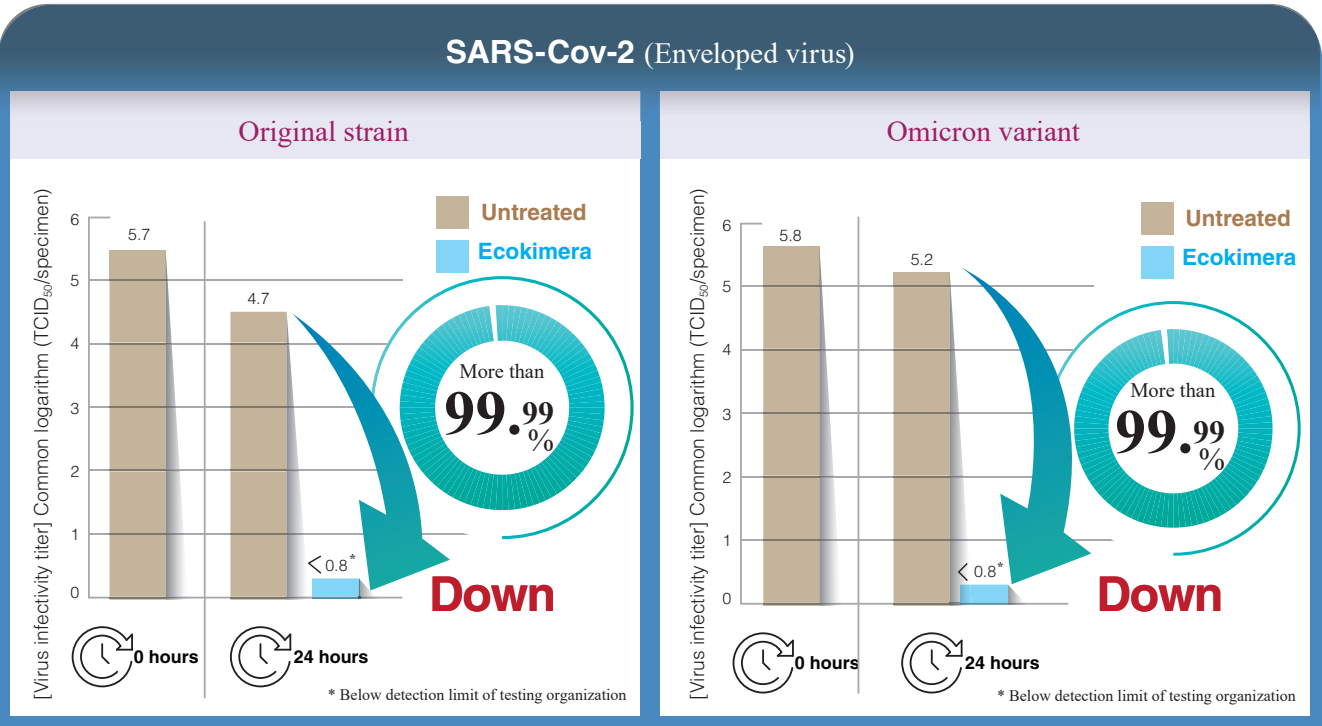
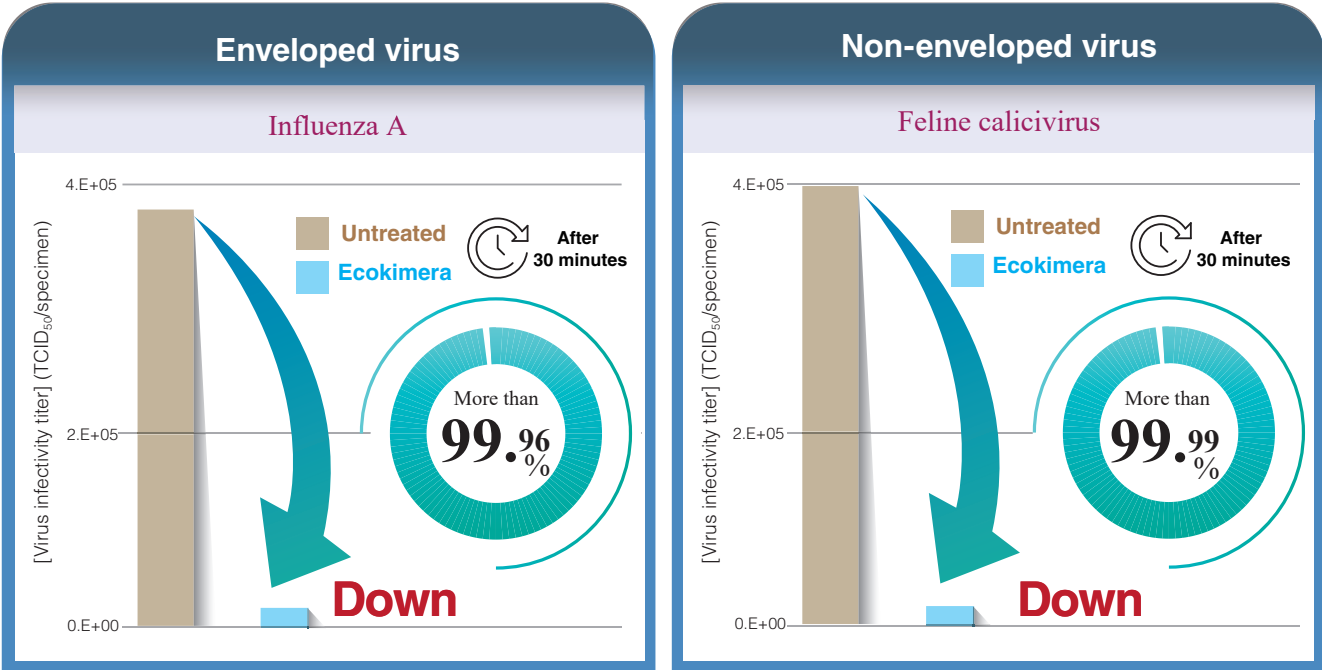
Distinction of bacteria		SRW-30 applied			Effective to resistant strain
Distinction by membrane structure	Bacteria species	Common processing	After washing (50 times)	After 2 years	
Gram-positive	MRSA	5.7			Antibacterial activity continues even after washing 50 times or two years later
	Staphylococcus aureus	6.0	6.0	6.0	
Gram-negative	Klebsiella pneumoniae	6.3	6.3		
	Pseudomonas aeruginosa	5.6			
	Salmonella	6.4			

Effective regardless of the membrane structure of the bacteria!

As a result of testing in accordance with the JIS L 1902:2015 standard after applying Ecokimera to standard cloth, antibacterial activity values much higher than 2.2 were obtained under all conditions. Based on these results, the SEK certification mark was obtained.

Antiviral test results

As the importance of anti-virus measures rises, there are two types of viruses that must be considered: enveloped viruses, which have protein shells for which alcohol disinfection is considered effective, and non-enveloped viruses, which have no shells. The evidence suggests that the S Series is effective against both types of viruses.



Mold proof test results

Test item	Testing method	Culture conditions /methods	Test strain	Mold proof activity value *
				$(\log C_t - \log C_0) - (\log T_t - \log T_0)$
Antimold test	JIS L 1921 Absorbing method	ATP level measured after incubation at 25°C for 42 hours	<i>Trichophyton mentagrophytes</i>	3.0
			<i>Cladosporium sphaerospermum</i>	2.9
			<i>Penicillium citrinum</i>	3.1

\* Mold resistant effect (JIS standard) shall have a mold proof activity value of 2.0 or higher.

Test item	Testing method	Culture conditions /methods	Test strain	Mold growth				Mold resistance value
				7 days	14 days	21 days	28 days	
Mold resistance test	JIS Z 2911 Dry method	Growth observation after incubation at 26°C for 28 days	<i>Aspergillus niger</i>	—	—	—	—	0 *2
			<i>Penicillium citrinum</i>	—	—	—	—	
			<i>Chaetomium globosum</i>	—	—	—	—	
			<i>Myrothecium verrucaria</i>	—	—	—	—	

\*1 (—): No mold growth observed \*2 (0): No mycelial growth observed

Anti-static test results

Test item	Measurement method	Test result	Test item	Measurement method	Test result
Half-life (seconds)	JIS L1094B method (half-life measurement method)	Less than 1.0	Friction-charged voltage (V)	JIS L1094B method (friction-charged voltage measurement method)	Cotton
					Vertical 140
	Test room temperature: 20°C, 40% RH			Friction cloth: 20°C, 40% RH	Horizontal 110
					Fur
	Washing: Untreated			Test room temperature: 20°C, 40% RH	Vertical 310
					Horizontal 330

Testing organization: Kaken Test Center, general incorporated foundation, Osaka Laboratory, Material Laboratory Report date: April 27, 2021 Approval No.: No. 21-0048 Expiration date: June 14, 2023





Antibacterial  
Finished Product  
No: 324Z21W



Antimicrobial  
Finished Product  
No: 142A21W

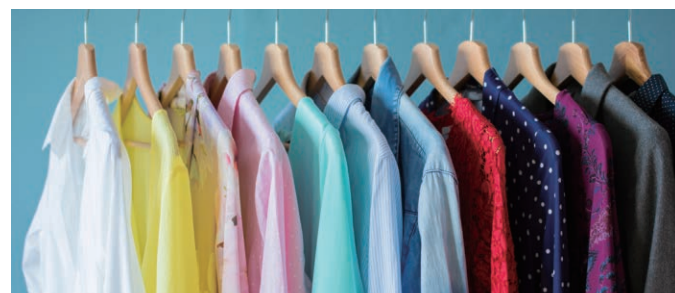


Antiviral  
Finished Product  
No: UK41A21W

Textile products processed with SRW-30 were found to conform to the standards set by the Japan Textile Evaluation Technology Council (general incorporated foundation), and have acquired three SEK Mark certifications.

Ecokimera promises peace of mind in important places in various facets of daily life, such as curtains, sofas, clothes, and towels.

## Application Examples



These images are for illustrative purposes only.



## S Series Example Uses



JAPAN NATIONAL STADIUM (Application: Seikadou Co., Ltd.)



Copyright: JAPAN SPORT COUNCIL

Yoyogi National Stadium 1st Gymnasium (Application: Seikadou Co., Ltd.)



Copyright: JAPAN SPORT COUNCIL



# Deodorizing, Antibacterial, and Antiviral Application Results

\* Permission is granted only for this catalog.

**Ferry Sunflower Kirishima**  
(Application: Reborn Technos, Inc.)



**Hankyu Railway (Kobe Line)**



**National Theatre of Japan**  
(Application: Ares Co., Ltd.)



**Takarazuka Revue Theater**  
(Application: CleanTech Kanazawa, Co., Ltd.)



**Kanto Bus**  
(Application: Kanto Motor Maintenance, Co., Ltd.)



**Ambulance**  
(Application: Eco Maintenance Co., Ltd.)



**Junior High School, Nara University of Education**  
(Application: Fujishiroko Construction Co., Ltd.)



**Aoyama Music Foundation Memorial Hall Barocksaal**  
(Application: Fujishiroko Construction Co., Ltd.)



**Coca-Cola commercial vehicle**  
(Application: Hokkaido Service Co., Ltd.)



**Nishinomiya Country Club**  
(Application: Armored Products Co., Ltd.)



**Himeji City Zoo**  
(Application: Funamo Corporation)



**Izumo Grand Shrine**  
(Application: Daimaru Co., Ltd.)



## Dirt Resistant

Hydrophilic dirt resistant coating can be applied to exterior concrete, painted surfaces, and window glass to reduce daily maintenance.

## Mold Proof

When applied to bathrooms and other areas exposed to water, it prevents mold spores from attaching and inhibits the growth of mold.

## Application Method

Before application, prior cleaning is necessary, such as by steam cleaning or wiping with water to remove dirt and oil. After that, please follow the application method and apply with a dedicated spray gun. The effects will last longer if dirt and dust is removed from the surface after application.



Application by dedicated spray gun

### Clear liquid

The Ecolimera is transparent, does not require organic binders, adheres to materials such as fibers, does not cause coloring, discoloration, or fading, and does not damage the texture of fabrics.



### Ecolimera application sticker

The Ecolimera Deodorizing, Antibacterial, Antiviral sticker is attached to areas where Ecolimera has been applied.



\* The appearance may differ from the actual one.

## Patents

## Patents / Trademarks Registration

### ◆ Exclusive patent

Deodorant manufacturing method Patent No. 4119963	Amorphous film and antifogging amorphous film Patent No. 4542322	Antiviral agent * Patent No. 6973835
Deodorant manufacturing method Patent No. 4119964	Coating method Patent No. 5237674	Spraying equipment and coating method using this equipment Patent No. 6932410
Reduction agent for volatile organic compounds, etc. Patent No. 4235741	Composition Patent No. 6012345	Anti-allergen agent and method for imparting anti-allergen performance Patent No. 7039081
Antibacterial/deodorant Patent No. 4430877	Solution coating method and apparatus for hanging strap Patent No. 6976608	* Overseas patent pending

### ◆ Osaka City University Joint Patent

Coating composition and coating method for vehicle body  
Patent No. 6161671

### ◆ Tokushima University Joint Patent

Coating composition  
Patent No. 6388888

### ◆ Tokushima University Joint Patent

Plant growth regulator coating composition  
Patent No. 6370859

## Trademarks registration

エコキメラ® Registration No. 4775031 (Ecolimera)	Registration No. 5303121	リン酸チタニア® Registration No. 6443882 YOO Co., Ltd.
リン酸チタニアエコキメラ® Registration No. 5331541 (Titanium phosphate Ecolimera)	ド親水® Registration No. 5853367 (Super Hydrophilic Liquid)	リン酸チタニア® Registration No. 6443883 YOO Co., Ltd.
無光触媒エコキメラ® Registration No. 5331542 (Non-photocatalytic Ecolimera)	e- シャルル® Registration No. 5982450 (e-Sharuru)	未来ソリューション® Registration No. 6400898 (Future Solutions)
エコキメラ® Registration No. 5211718	ECOKIMERA® Registration No. 6368828	



# リン酸チタニア

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