



Presenter
2019-08-01 20:55:45

Welcome to our course "Every Breath
You Take: Innovative Air Quality Design".

Every Breath You Take: Innovative Air Quality Design



**EDUCATION
PARTNER**





An American Institute of Architects (AIA) Continuing Education Program

Credit(s) earned upon completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

You must complete the quiz upon completion of this course with an 80% or higher to receive credit.

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This course has been registered with the
AIA Institute of Architects for continuing
professional education.





Objectives

Upon completion of this course, the design professional will be able to:

- **Discuss** the LEED v4 Indoor Environmental Quality (EQ) category and common indoor air quality issues that affect the health of building occupants.
- **Describe** how FN[®] NANO photocatalytic coatings can help protect the health and comfort of building occupants.
- **Review** how FN[®] NANO Titanium dioxide (TiO₂) helps eliminate VOCs, allergies, odors, mold, bacteria, and viruses in buildings indoors and outdoors.
- **Explain** how TiO₂ photocatalytic coatings can clean interior and exterior building surfaces and help combat air pollution.

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- Describe how photocatalytic coatings can help protect the health and comfort of building occupants.



Air Pollution Kills 6 Million People Annually

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According to the United Nations, air pollution is the most important environmental risk in the world and causes one in nine deaths. Air pollution kills more than six million people every year. Air pollution causes strokes, chronic respiratory disease, and lung cancer, as well as one quarter of deaths from heart attack. Air pollution is also



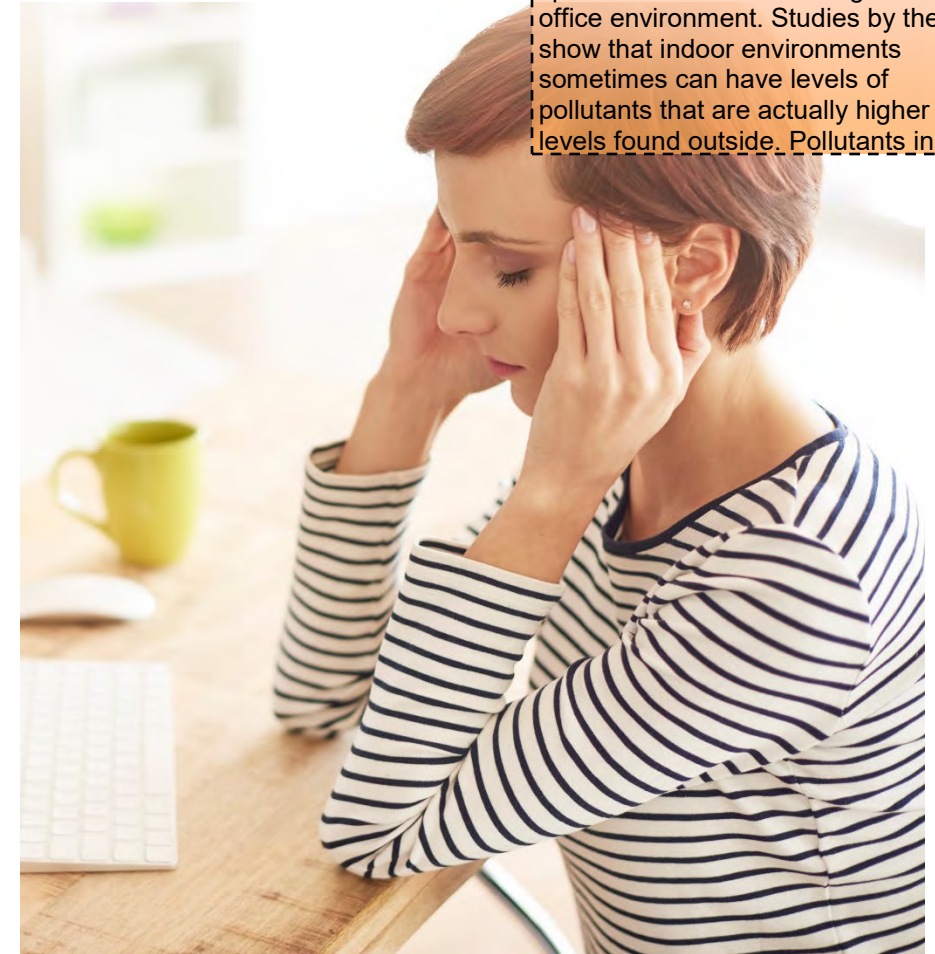


Indoor Air Quality Problems

- Americans spend 90% of their time indoors
- EPA studies indicate indoor environments can have higher level of pollution than outdoor environment
- Poor indoor air quality may cost the U.S. several billion dollars annually

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According to the Environmental Protection Agency, most Americans spend up to 90% of their time indoors and many spend most of their working hours in an office environment. Studies by the EPA show that indoor environments sometimes can have levels of pollutants that are actually higher than levels found outside. Pollutants in our



The sun is a star in the middle of our solar system. It is a sphere of hot plasma that is the most crucial source of energy for life on earth. Plants need sunlight to grow. Animals need plants for food and the oxygen they produce. Without heat from the sun, the Earth would freeze. Without the sun, there would be no winds, ocean currents, clouds, plants,





Sunlight is the best disinfectant

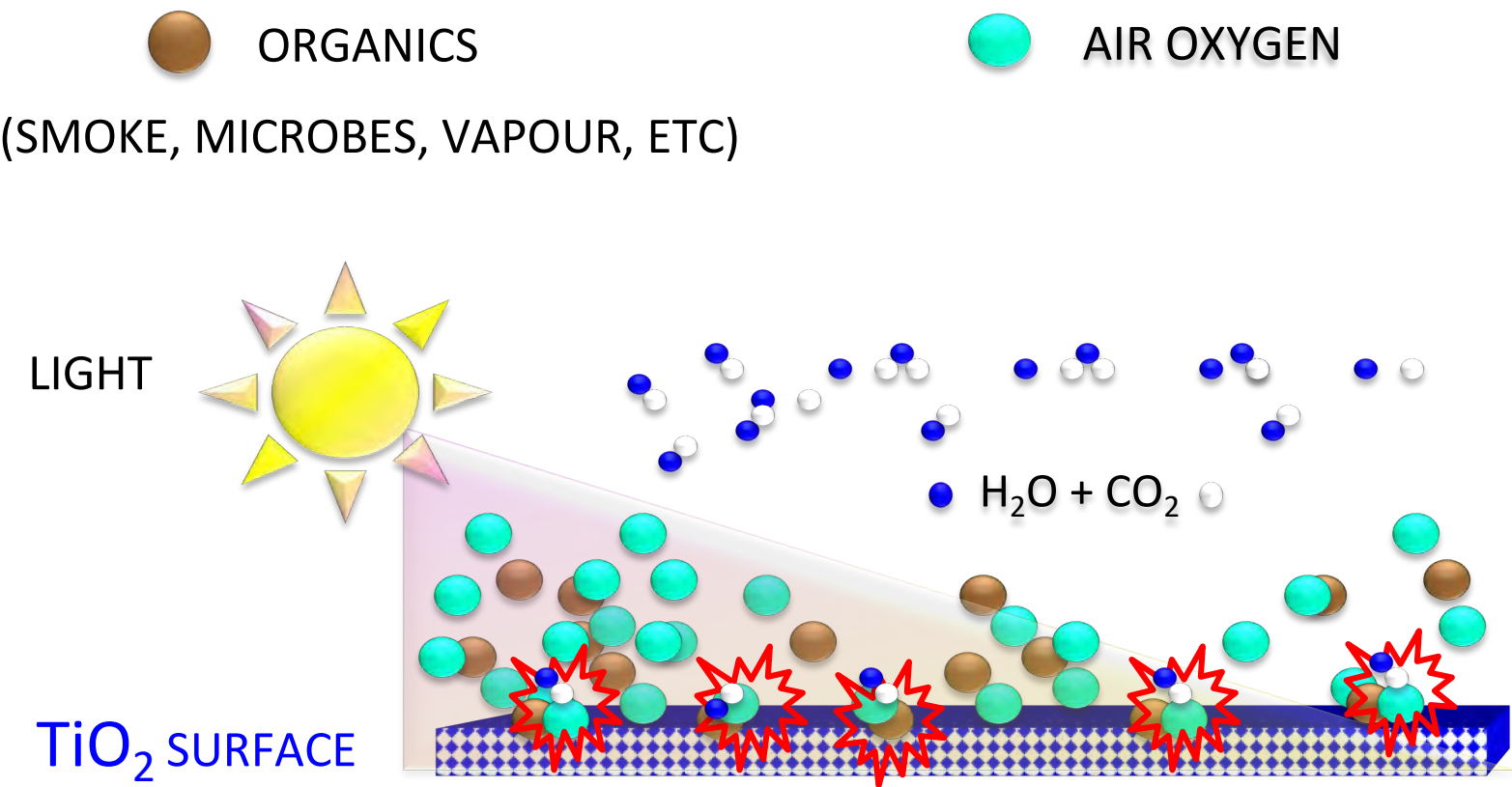
Sunlight is said to be the best disinfectant. Ultraviolet radiation or UV, is present in sunlight constituting about 10% of the total light output of the Sun. Ultraviolet radiation in sunlight works as a natural disinfectant and is used regularly to disinfect drinking water in countries such as India, Kenya, and Peru, where more complex forms





Photocatalysis and Building Materials

Photocatalysis can be defined as the ~~aid~~ of a chemical reaction by light. The photocatalytic process and how it can help self-clean objects such as glass has been known for decades. Research on the benefits of photocatalysis started in Japan in the 1960s. By the 1990's research had shifted into the area of environmental





Titanium dioxide

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Titanium dioxide is the main ingredient in many materials designed to take advantage of this self-cleaning photocatalytic process. Titanium dioxide is a naturally occurring oxide of titanium. Titanium dioxide has a wide range of applications including paint, sunscreen, food coloring, candies, toothpaste.

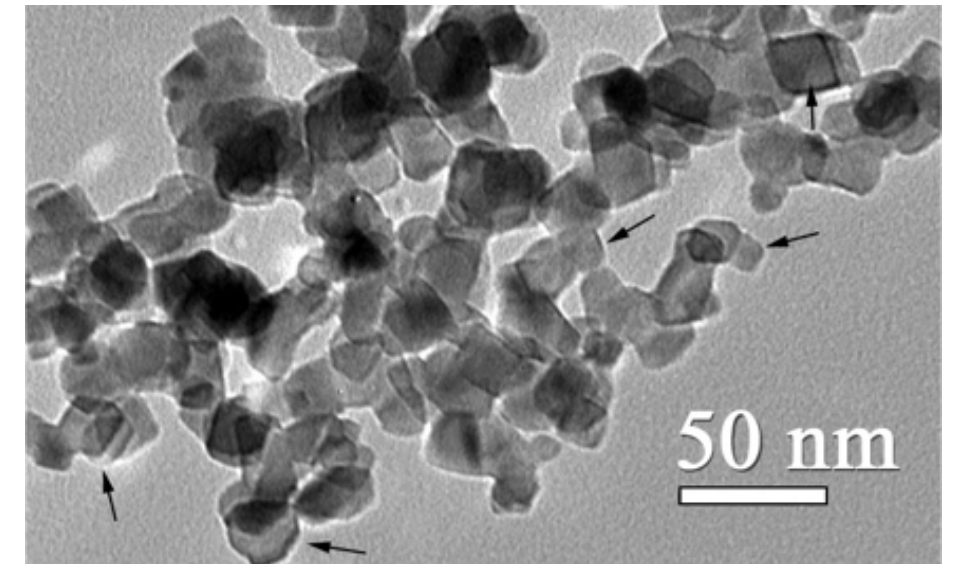




Titanium dioxide nanoparticles

The most effective building materials which properties use Titanium dioxide nanoparticles, also called ultrafine titanium dioxide. These are particles of titanium dioxide with diameters less than 100 nm. Ultrafine Titanium dioxide is used in sunscreens due to its ability to block UV radiation while remaining transparent on the skin, and its

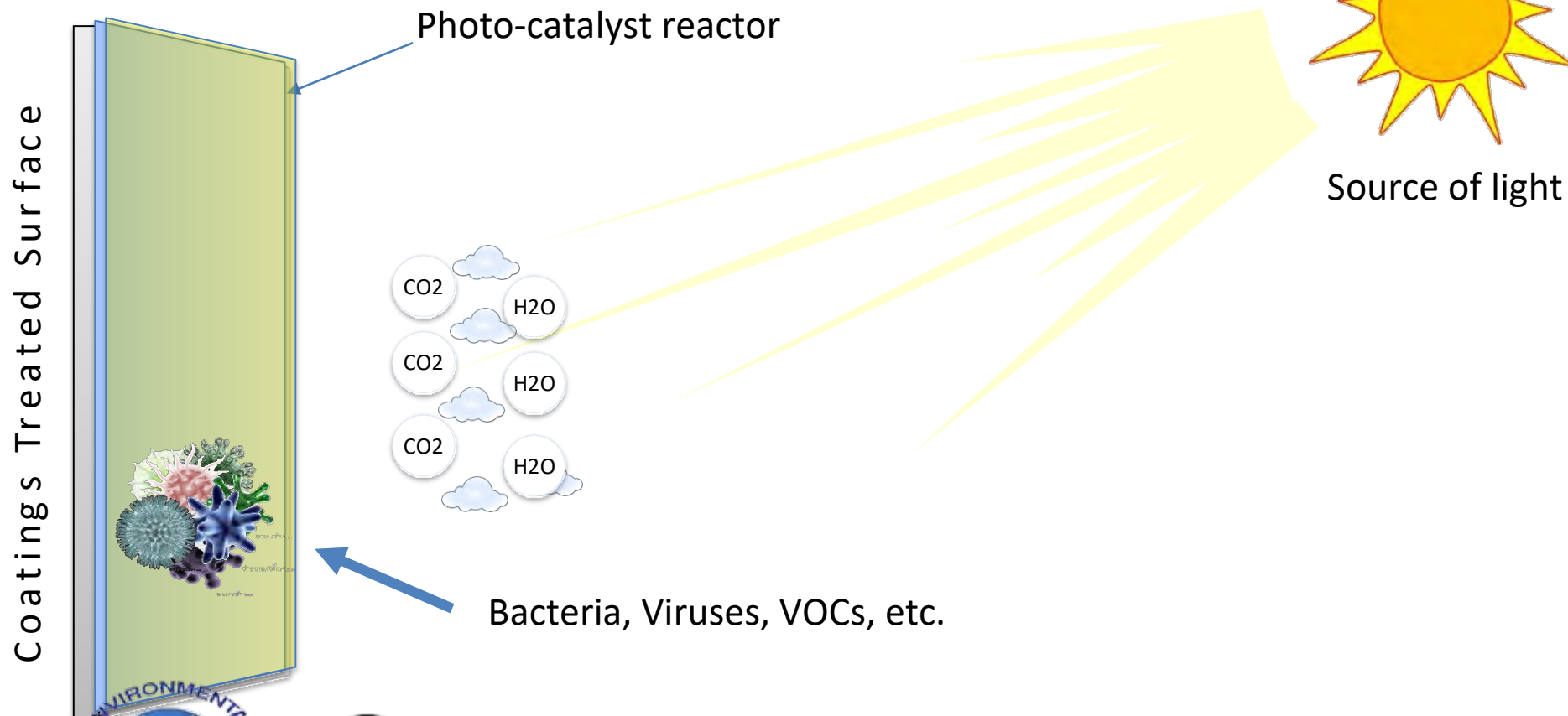
- Titanium dioxide nanoparticles have diameter less than 100 nm
- Titanium dioxide and its photocatalyticsterilizing properties also make it useful as an additive in construction materials
- Titanium dioxide can be considered a "legacy" nanomaterial





Photocatalysis Coatings Process

In this diagram we can see a surface that has been treated with a photocatalytic titanium dioxide nanoparticle coating. For example, this surface could be an exterior wall panel on a 50 story building in New York City. When the wall panel is exposed to sunlight, the coated surface is activated. Titanium dioxide nanoparticles absorb the



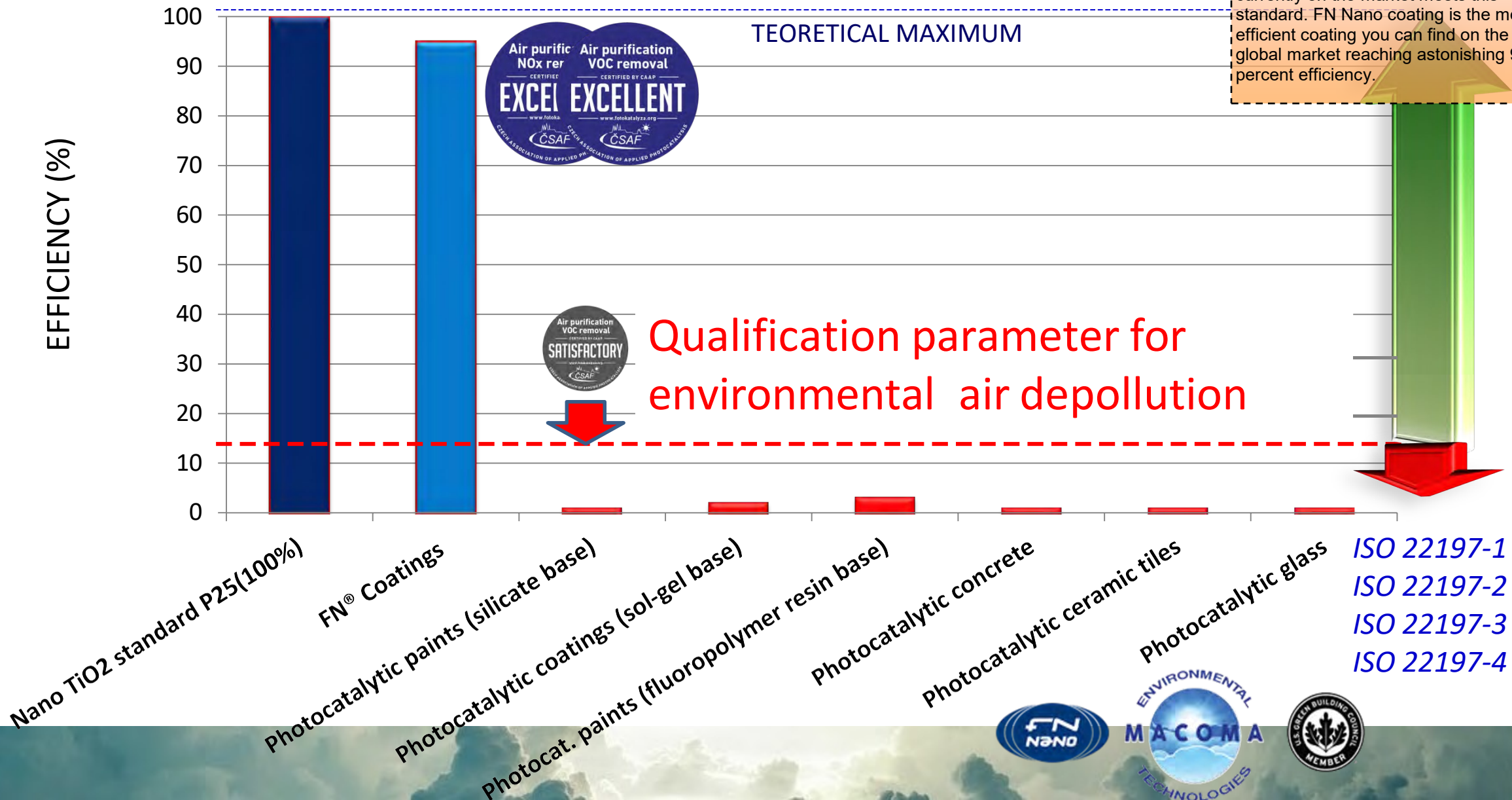


Comparison – efficiency of photocatalytic products

FN[®] efficiency – almost as high as a pure photocatalyst

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For truly effective air cleaning function technology must have at least 10 percent efficiency. Not very many products currently on the market meets this standard. FN Nano coating is the most efficient coating you can find on the global market reaching astonishing 95 percent efficiency.





Effects of weathering photocatalytic perform

To obtain reliable data about the effects of weathering, the photocatalytic performance of two-year-old samples taken from a noise barrier located along one of the busiest thoroughfares in Prague. It was demonstrated that the commercial photocatalytic coating Protectam FN2 maintains high efficiency in removing nitrogen oxides



The benefits of photocatalytic coatings
backed up by extensive research. In
August of 2007, the Lawrence Berkeley
National Laboratory released a report
for the California Energy Commission.
Researchers investigated the potential
for passive cleaning of outdoor air
using photocatalytic titanium dioxide
particles. The state of California





For the Lawrence Berkley Lab report, ~~day~~ of photocatalytic materials was summarized and tabulated in terms of catalytic activity. Each square meter of high-performance photocatalytic material, exposed to outdoor sunlight, can remove nitrogen oxides from about 200 cubic meters of air per day. The removal rate for volatile organic

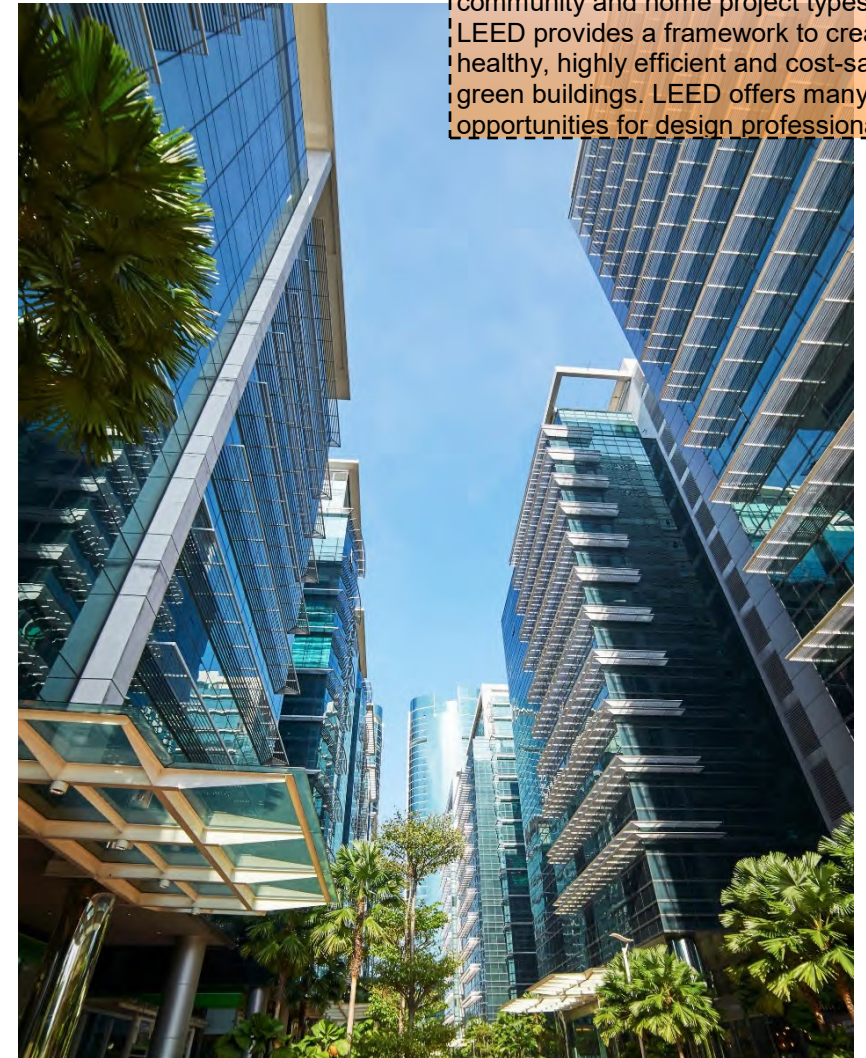




LEED v4 Building Design + Construction

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LEED, or Leadership in Energy and Environmental Design, is the most widely used green building rating system in the world. Available for virtually all building, community and home project types, LEED provides a framework to create healthy, highly efficient and cost-saving green buildings. LEED offers many opportunities for design professionals





Indoor Environmental Quality (EQ) Category

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The Indoor Environmental Quality (EQ) in LEED v4 rewards decisions made by project teams about indoor air quality and thermal, visual, and acoustic comfort. Green buildings with good indoor environmental quality protect the health and comfort of building occupants. High-quality indoor environments also enhance

Buildings with good EQ:

- Protect building occupants
- Enhances productivity
- Decreases absenteeism
- Increases building's value
- Reduces liability

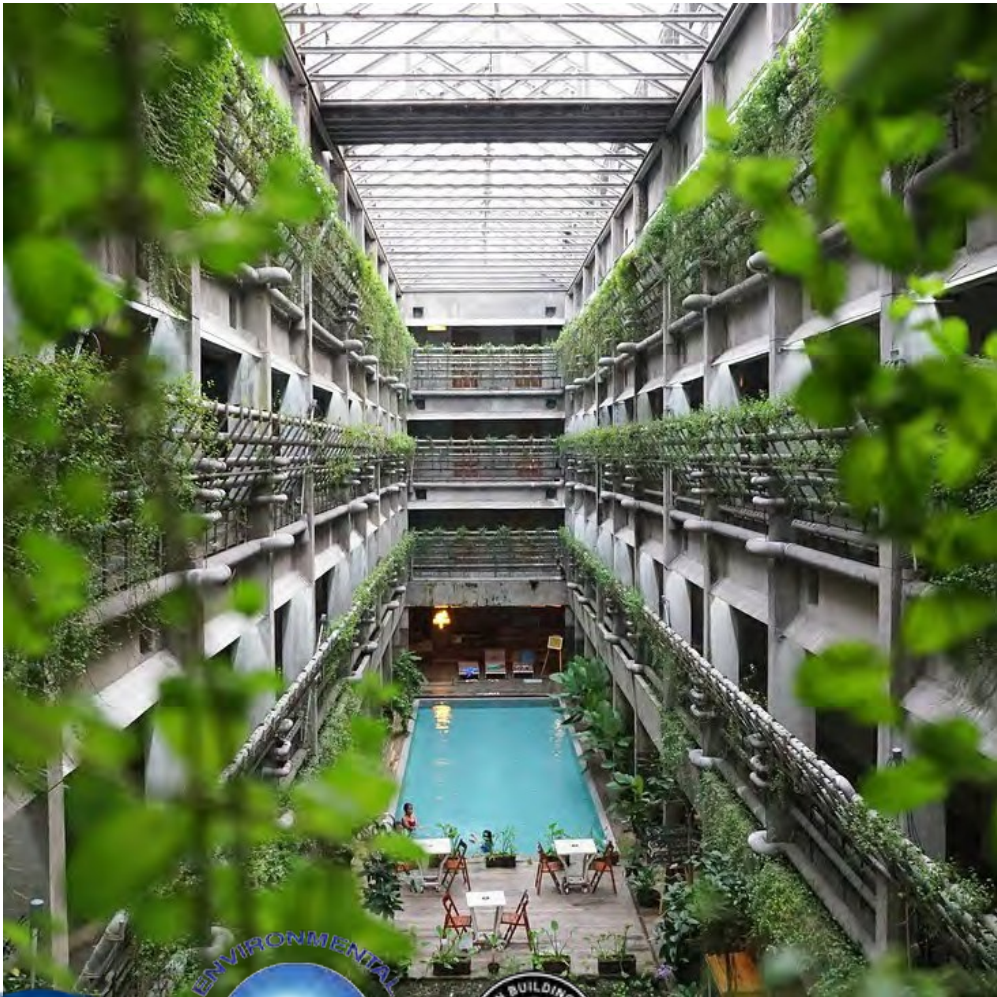




Indoor Environmental Quality (EQ) Category

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The EQ category combines traditional such as ventilation and thermal control, with emerging design strategies, including a holistic, emissions-based approach (the Low-Emitting Materials credit), source control and monitoring for user-determined contaminants (the Enhanced Indoor Air Quality Strategies



MACOMA

TECHNOLOGIES





Low-Emitting Materials Credit

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Photocatalytic coatings can contribute to the Low-Emitting Materials credit in LEED v4. The intent of the credit is "To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment." The Low-Emitting Materials credit applies to:

- New Construction

Credit Intent:

"To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment."

Credit Applies To:

New Construction
Core and Shell
Schools
Retail
Data Centers
Hospitality
Healthcare
Warehouses
Distribution Centers





Low-Emitting Materials Credit

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Volatile organic compounds (VOCs) are ~~not~~ that are released into the air from numerous materials—some of them natural, human-made, plant-based, and from animals, including people. Prolonged exposure to high concentrations of some VOCs has been linked to a wide range of chronic health problems such as asthma.





Low-Emitting Materials Credit

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This credit includes requirements for ~~materials~~ as well as project teams. It covers volatile organic compound (VOC) emissions into indoor air and the VOC content of materials, as well as the testing methods by which indoor VOC emissions are determined. Different materials must meet different requirements to be considered

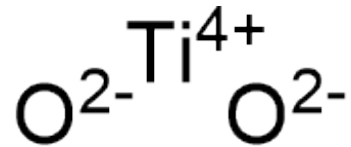
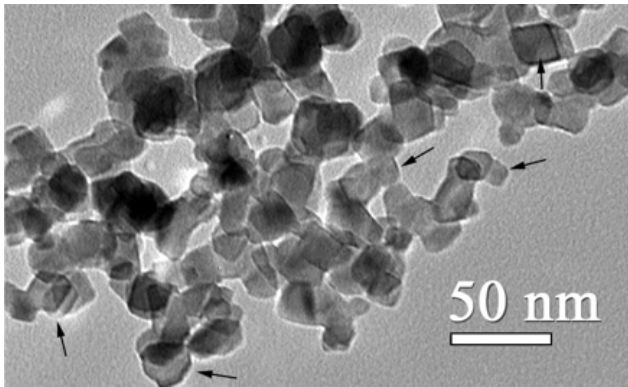
TABLE 1. Thresholds of compliance with emissions and content standards for 7 categories of materials

Category	Threshold	Emissions and content requirements
Interior paints and coatings applied on site	At least 90%, by volume, for emissions; 100% for VOC content	<ul style="list-style-type: none">General Emissions Evaluation for paints and coatings applied to walls, floors, and ceilingsVOC content requirements for wet applied products
Interior adhesives and sealants applied on site (including flooring adhesive)	At least 90%, by volume, for emissions; 100% for VOC content	<ul style="list-style-type: none">General Emissions EvaluationVOC content requirements for wet applied products
Flooring	100%	General Emissions Evaluation
Composite wood	100% not covered by other categories	Composite Wood Evaluation
Ceilings, walls, thermal, and acoustic insulation	100%	<ul style="list-style-type: none">General Emissions EvaluationHealthcare, Schools only Additional insulation requirements
Furniture (include in calculations if part of scope of work)	At least 90%, by cost	Furniture Evaluation
Healthcare and Schools Projects only: Exterior applied products	At least 90%, by volume	Exterior Applied Products

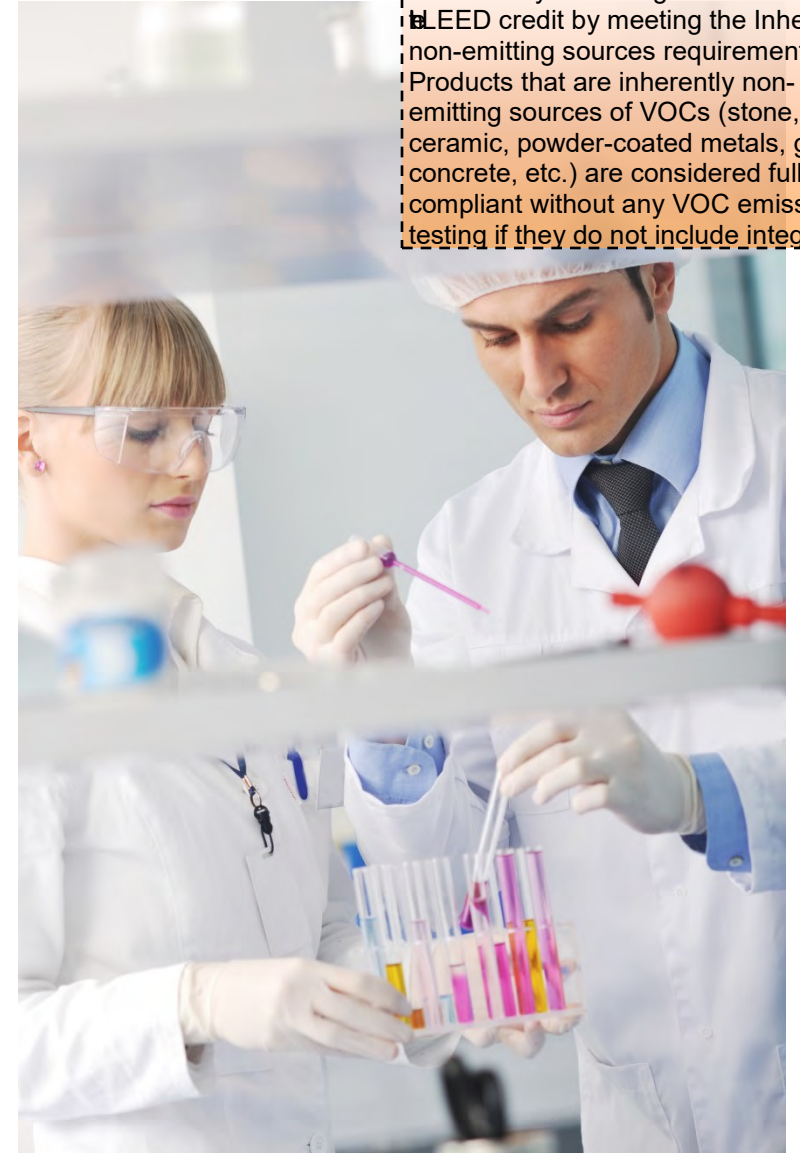




Low-Emitting Materials Credit



titanium dioxide



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Photocatalytic coatings can contribute to LEED credit by meeting the Inherently non-emitting sources requirements. Products that are inherently non-emitting sources of VOCs (stone, ceramic, powder-coated metals, glass, concrete, etc.) are considered fully compliant without any VOC emissions testing if they do not include integral





Low-Emitting Materials Credit



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In addition to meeting the general requirements for VOC emissions, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable.



MACOMA





Low-Emitting Materials Credit

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The photocatalytic coatings have also passed a series of tests including the ISO 16000-10, ISO 16000-11 methods, which are a part of the CDPH standard method. ISO 16000-10:2006 specifies a general laboratory test method for determination of the area specific emission rate of volatile organic compounds (VOCs) from newly



Photocatalytic Coatings Passed:

- ISO 16000-10
- ISO 16000-11





California's Proposition 65 Label



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Labels warning that a product contains what may cause cancer, birth defects, or reproductive harm are now required on many household items sold in California. California's Proposition 65, also called the Safe Drinking Water and Toxic Enforcement Act, was enacted in 1986. It is intended to help Californians make informed decisions





California's Proposition 65 Label

Prop. 65 Warning for California Residents



WARNING: This product may contain chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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Photocatalytic coatings are in compliance with California Proposition 65 requirements. The highly breathable and vapor permeable coatings offer "no significant risk". The law defines "no significant risk" as a level of exposure that would cause no more than 1 extra case of cancer in 100,000 people over a 70-year lifetime.





Biological Pollutants

According to the EPA, infectious illnesses, ~~has~~ influenza, measles and chicken pox are transmitted through the air. Molds and mildews release disease-causing toxins. Children, elderly people and people with breathing problems, allergies, and lung diseases are particularly susceptible to disease-causing biological agents in





Photocatalytic Coatings Benefits

Photocatalytic coatings are an excellent ~~sub~~for project teams to consider when designing healthy buildings or renovating older structures. Photocatalytic coatings solve multiple problems for both the interior space of a building and the exterior façade. Photocatalytic coatings can:





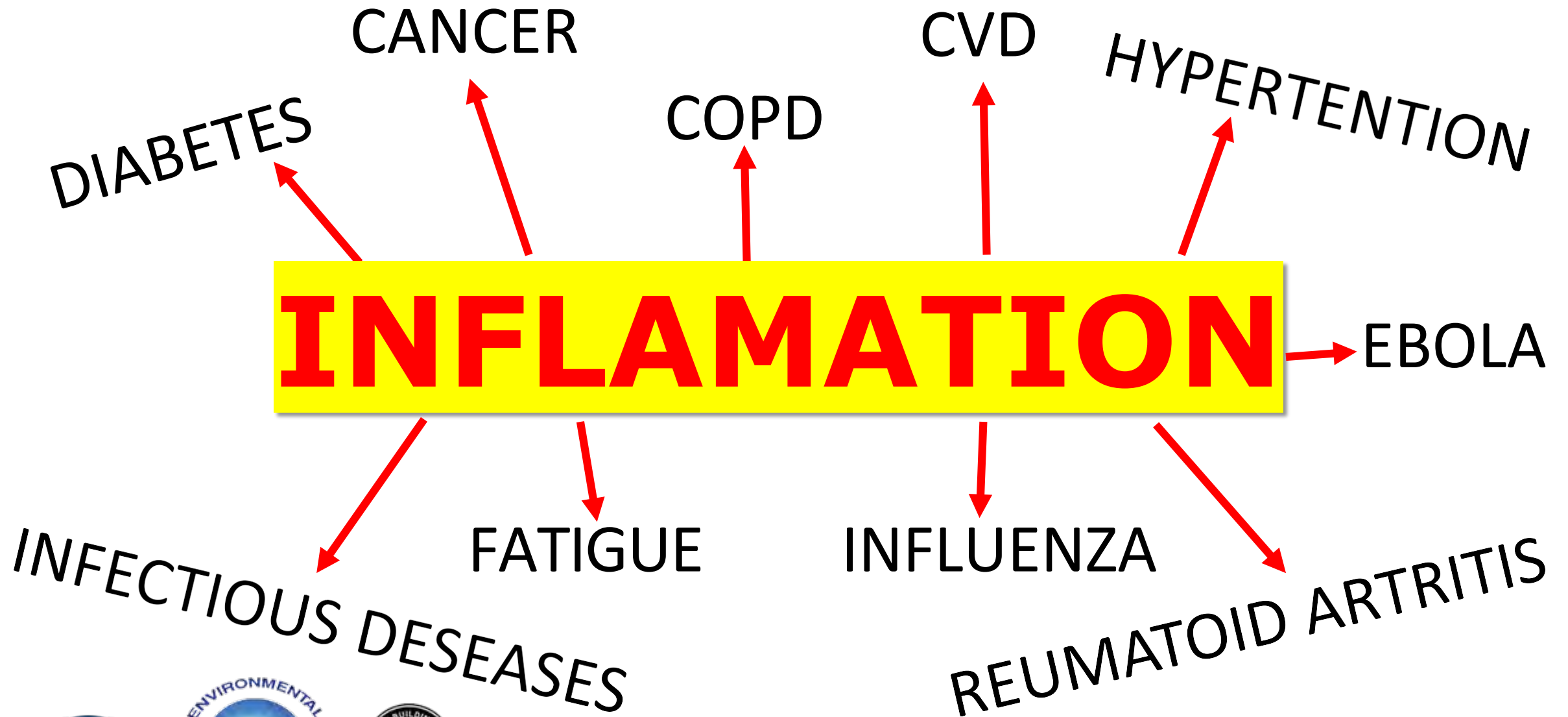
Photocatalytic Coatings Applications

We'll now review various applications for photocatalytic coatings. Photocatalytic coatings can be beneficial if applied to interior walls, ceilings, exterior facades, and various other surfaces. Coatings are extremely efficient in helping eliminate microorganisms on their highly oxidative surface. Instead of using toxic and harmful chemicals, inert and safe



Hospitals







Photocatalytic Coatings Applications



Hospitals can be breeding grounds for infections. According to the Centers for Disease Control and Prevention, every year, an estimated 648,000 people in the U.S. develop infections during a hospital stay, and about 75,000 die with one of those infections. That's more than twice the number of people who die each year in car

Hospitals

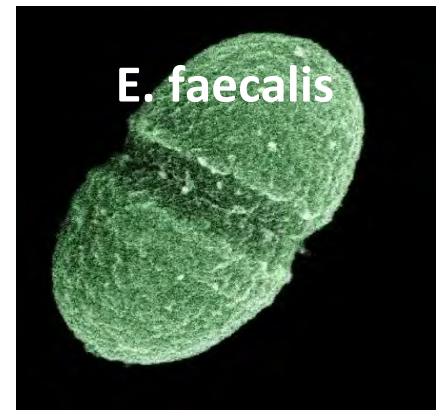
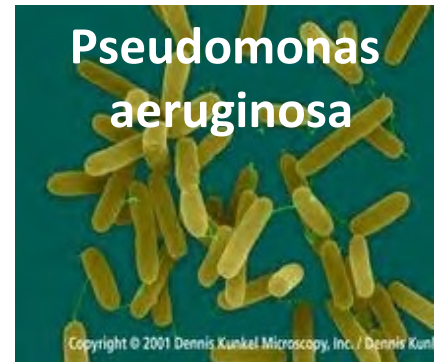
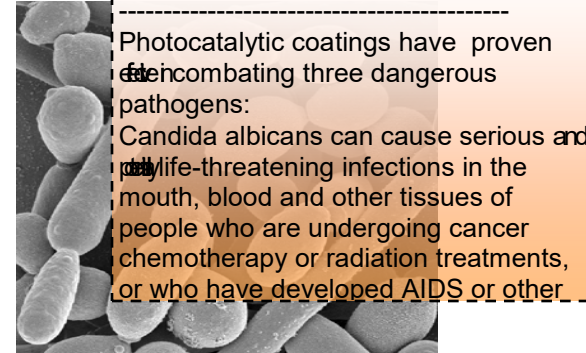


Photocatalytic Coatings Applications

Microorganism	UV Exposure time (min)	UV Intensity mW/cm2	START concentration (CFU)	END concentration (CFU)	Reference sample END concentration (CFU)	BACTERIA REDUCTION ON FN2 SURFACE (%)
Bakteriophage E.Coli ΦX 174 (MODEL VIRUS)	60 min	0.05-0.1	0.2 ml 1.00E+06	60	1.00E+06	99.9940%
	60 min	0.05-0.1	1.00E+06	30	1.00E+06	99.9970%
	6 hours	0.05-0.1	1.00E+08	88	1.00E+08	99.9999%
	6 hours	0.05-0.1	1.00E+05	0	1.00E+05	100%
	6 hours	0.05-0.1	1.00E+08	400	1.00E+08	99.9996%
	6 hours	0.05-0.1	1.00E+05	15	1.00E+05	99.9850%
	60 min	0-dark	1.00E+06	1.00E+06	1.00E+06	0%
Candida albicans	120 min	0.05-0.1	0.2 ml 1.00E+06	0	1.00E+06	100%
Candida albicans	120 min	0.05-0.1	1.00E+06	0	1.00E+06	100%
Pseudomonas aeruginosa	120 min	0.05-0.1	0.2 ml 1.00E+06	0	1.00E+06	100%
Pseudomonas aeruginosa	120 min	0.05-0.1	1.00E+06	0	1.00E+06	100%
Enterococcus faecalis 4224	120 min	0.1-0.3	0.3 ml 1.50E+08	767	not countable	99.99949%

Hospitals

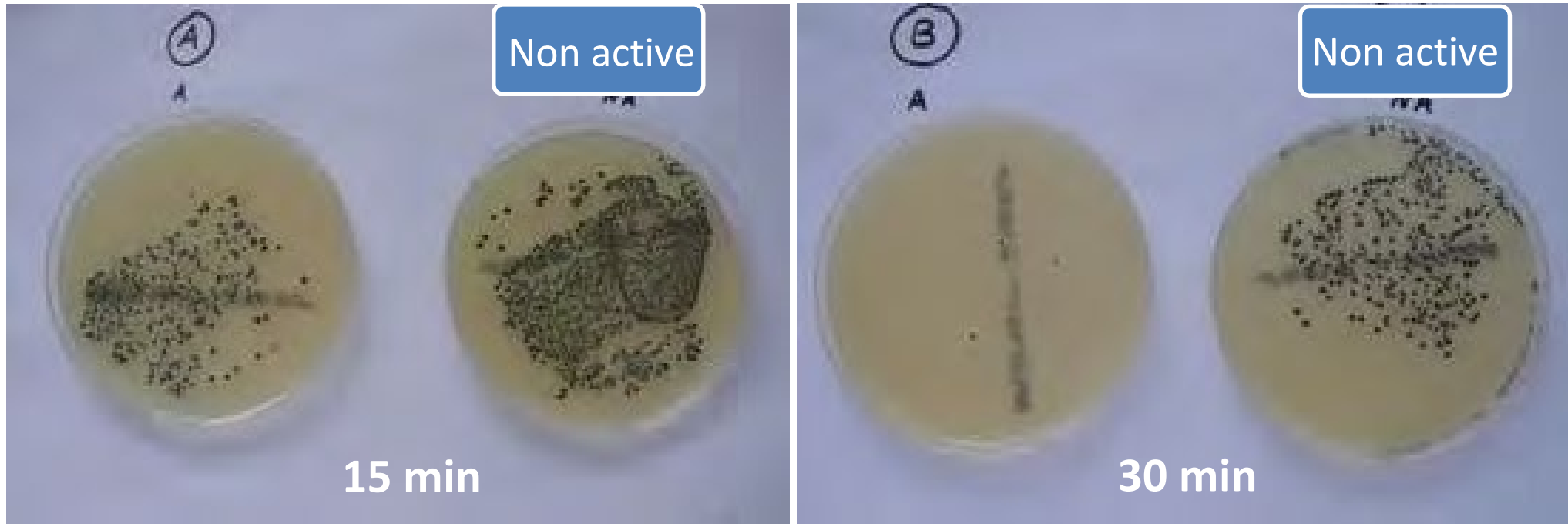
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Photocatalytic Coatings Applications

The antibacterial effect of titanium dioxide coatings under weak UV illumination against e. coli is very successful. For decades, titanium dioxide panels have been installed in Japan in hospital rooms where sterile conditions are important. After the tiles were installed, the bacterial counts dropped significantly on the walls as

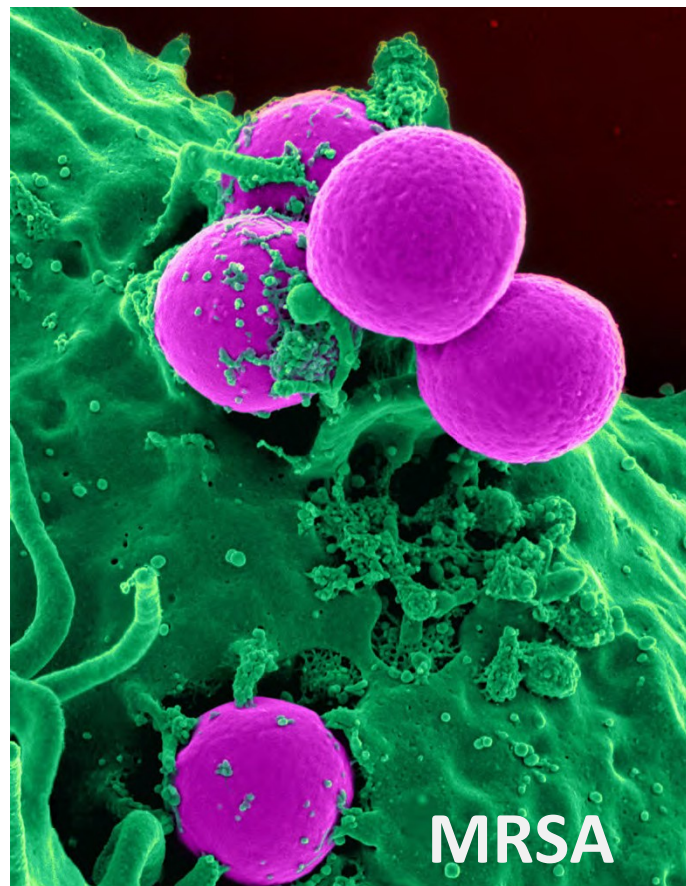


Hospitals





Photocatalytic Coatings Applications



According to the Mayo Clinic, ~~Methicillin-resistant Staphylococcus aureus~~, or MRSA infection is caused by a type of staph bacteria that's become resistant to many of the antibiotics used to treat ordinary staph infections. Most MRSA infections occur in people who've been in hospitals or other health care settings, such as nursing homes and dialysis centers.

Hospitals

UV Activation Light



Here we can see an internal medical room. The walls and ceiling have been treated with photocatalytic coatings. Soft UV lights are installed for cloudy days when there is little natural sunlight. Otherwise the main source of activation for the photocatalytic process is the natural sunlight coming through the windows.

Daylight –Main Source of Activation





Photocatalytic Coatings Applications

Photocatalytic coatings are easily applied in a similar fashion as paint. The most preferred application of coatings on smooth surfaces is a low pressure spray gun. Spray will provide even coating and less material consumption on smooth, porous, and fast drying surfaces, such as drywalls. A



Hospitals





Photocatalytic Coatings Applications

Photocatalytic coatings can help disinfect and deodorize surfaces all at the same time. The coatings can help surfaces be protected from:

- UV Radiation
- Dirt
- Soot
- Dust
- Deadly microorganisms



Hospitals





Photocatalytic Coatings Applications

In addition, photocatalytic coatings can combat foul odors in hospitals. Airborne bacteria and toxins are present in hospital odors. Hospital odors find themselves embedded in bedding, curtains, and furniture. It is crucial that all the bedding be odorless and sanitary before the next resident is required to use them, it is important to



Hospitals





Photocatalytic Coatings Applications

According to the EPA, one-half of our nation's 115,000 schools have problems linked to indoor air quality. Students are at greater risk because of the hours spent in school facilities and because children are often susceptible to pollutants. The health and comfort of students and teachers are among the many factors that contribute to learning.



Schools





Photocatalytic Coatings Applications



The EPA notes that indoor air quality problems can be prevented and resolved by school staff through simple, inexpensive measures and that the cost and effort needed to prevent most air quality problems is significantly less than the cost and effort required to resolve problems after they develop. Photocatalytic coatings provide a cost

Schools





Photocatalytic Coatings Applications

Failure To Prevent Air Quality Problems Can:

- Increase potential for long- and short-term health problems for students and staff.
- Negatively impact student attendance, comfort, and performance.
- Reduce teacher and staff comfort and performance.
- Accelerate deterioration and reduce efficiency of school facilities and equipment.

The EPA explains that failure to prevent or respond promptly to indoor air quality problems in schools can:

- Increase potential for long- and short-term health problems for students and staff.
- Negatively impact student attendance, ~~and~~ performance.
- Reduce teacher and staff comfort and performance.



Schools





Photocatalytic Coatings Applications

Failure To Prevent Air Quality Problems Can:

- Increase potential for school closings or relocation of occupants.
- Strain relationships among school administration, parents, and staff.
- Create negative publicity.
- Impact community trust.
- Create liability problems.

- Increase potential for school closings or relocation of occupants.
- Strain relationships among school administration, parents, and staff.
- Create negative publicity.
- Impact community trust.
- and Create liability problems.
- Photocatalytic coatings can provide solutions to address these



Schools





Photocatalytic Coatings Applications



The Centers For Disease Control and Prevention estimates 48 million people get sick, 128,000 are hospitalized, and 3,000 die from foodborne diseases each year in the United States. The CDC has conducted several research projects to understand foodborne disease outbreaks. Foodborne disease surveillance is a critical component of a



CENTERS FOR DISEASE
CONTROL AND PREVENTION

Restaurants





Photocatalytic Coatings Applications

The CDC states that the spread of germs from the hands of food workers to food is an important cause of foodborne illness outbreaks in restaurants. It accounts for 89% of outbreaks in which food was contaminated by food workers. Proper handwashing can reduce germs on workers' hands and the spread of



Restaurants / Supermarkets





Photocatalytic Coatings Applications

5 Germs That Cause Illnesses From Food:

- Norovirus
- Salmonella
- Clostridium perfringens
- Campylobacter
- Staphylococcus aureus (Staph)

According to the CDC, the top 5 germs that cause illnesses from food eaten in the United States are:

- Norovirus
- Salmonella
- Clostridium perfringens
- Campylobacter
- Staphylococcus aureus (Staph)

Research has indicated that photocatalytic



Restaurants / Supermarkets





Photocatalytic Coatings Applications

FRESH FLOWERS, FRUIT AND
VEGETABLES longer.
FN NANO Photocatalytic Coatings
Lowering of ethylene.

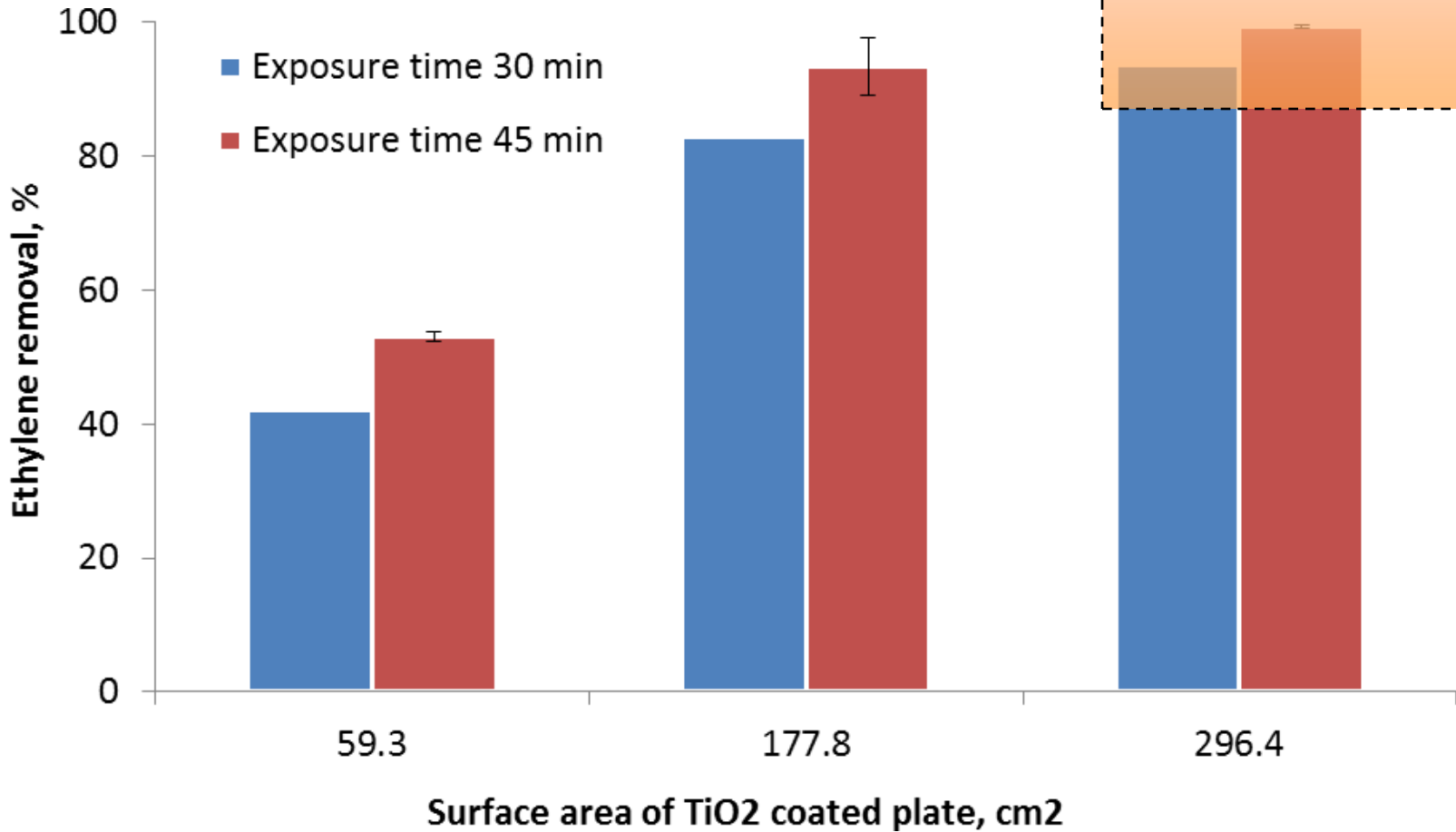


Supermarkets



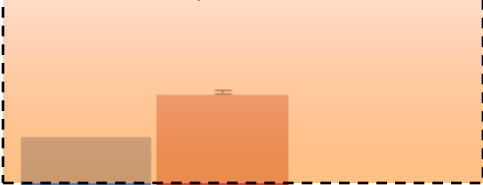


ETHYLENE=trigger to rotten and dye



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FRESH FLOWERS, FRUIT AND
VEGETABLES
Low concentration of ethylene
Excellent for Supermarkets!!!



Supermarkets





Photocatalytic Coatings Applications



Photocatalytic coatings can be applied to the exterior of a building to protect it from air pollution, graffiti, mold, algae, dust, and dirt. If we look at the image of the building on the left, we can see this structure has suffered from air pollution and is stained from polluted water running from the top of the roof. Photocatalytic coatings were applied to



Exterior Surfaces

Ecological function:

Objects treated with FN® coatings work as cleaning eco-machines.

SELF- CLEANING, AIR PURIFYING FACADES , NEW STANDARD

1 m² of FN® cleans an average of 3,000,000 m³/y of air from photocatalytically degradable pollutants (NO_x, CO, SO_x, VOCs, benz-a-pyrene and others)





Photocatalytic Coatings Applications

Photocatalytic coatings provide antimicrobial protection against algae. The highly oxidative surface of the top coat is very effective and prevents growth of microorganisms like algae and mold. If we look at these images, we can see a significant difference between treated and untreated surfaces. Instead of using carcinogenic chemicals, exterior

Treated

Untreated



Green Algae

Untreated

Treated



Black Algae

Exterior Surfaces





Photocatalytic Coatings Applications

Photocatalytic coatings can help prevent regrowth of algae, fungi and subsequently, moss and lichens on fences and walls for over a decade. There are over 12,000 species of moss. Killing moss will not prevent regrowth unless conditions favorable to their growth are changed. Photocatalytic coatings stop moss

Treated

Untreated

Untreated

Treated



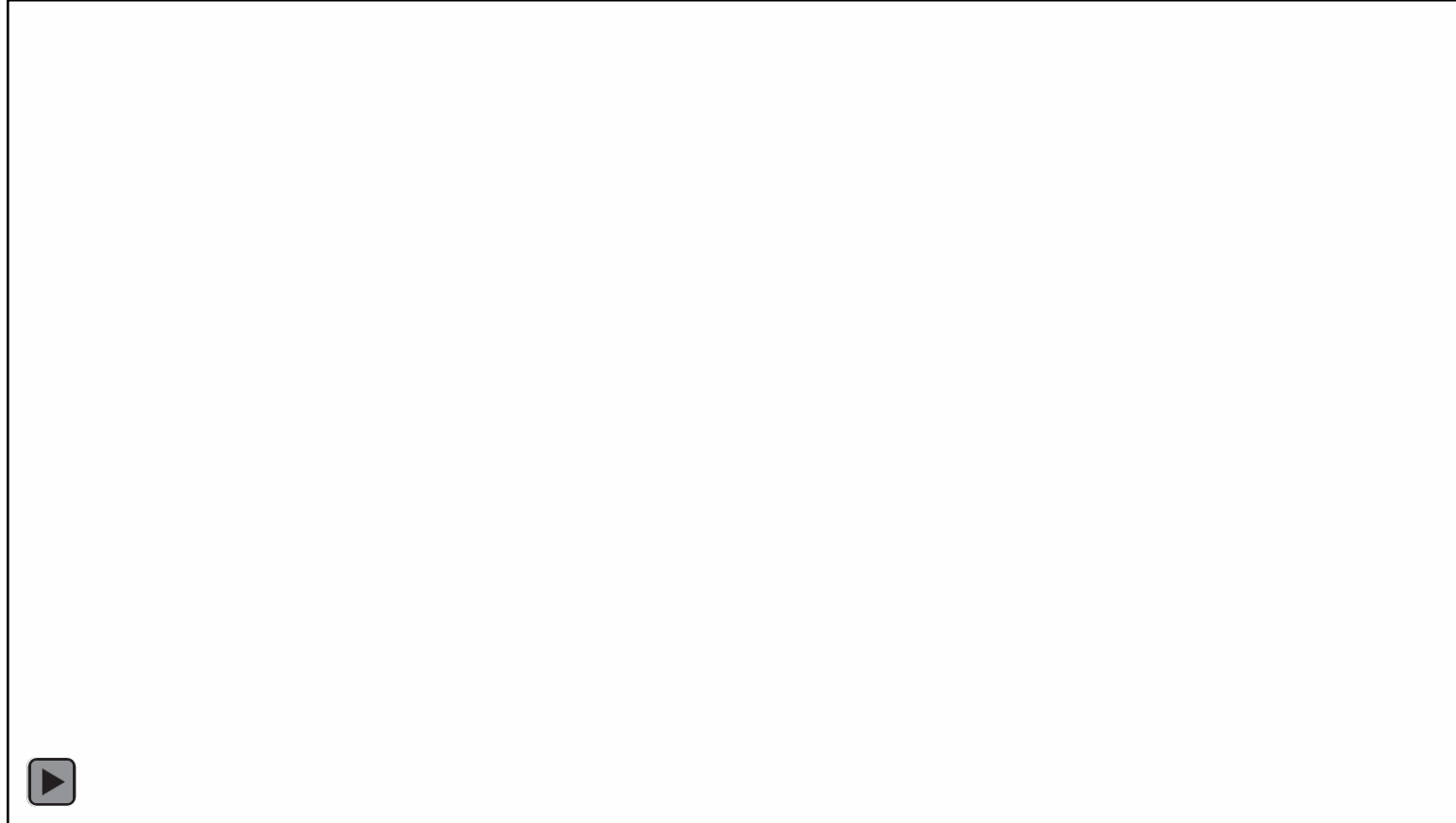
Exterior Surfaces





Photocatalytic Coatings Applications

(Note: this video will be edited to remove copyright information. The video will play and use the captions on screen as a voice over) A combination of several properties help protect the exterior surface of a building against graffiti. These properties include:
Hydrophilicity – The spray solvent used doesn't allow graffiti to penetrate



Graffiti Protection & Removal





Photocatalytic Coatings Applications

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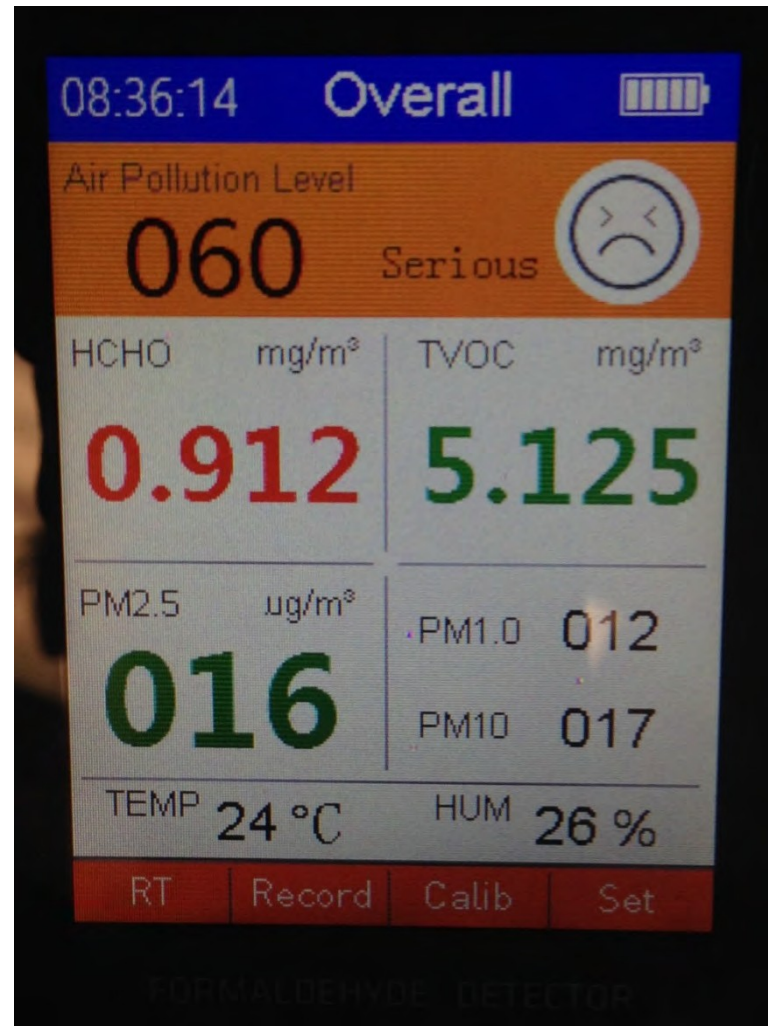
In addition to building surfaces, photocatalytic coatings can help protect outdoor statues, historical monuments, and artwork. The coatings can protect against UV, dirt, soot, tar, dust, graffiti, and other contaminants. In the image on the left we can see two statues. The statue on the left has been treated and the statue on the right is untreated. The



Graffiti Protection & Removal



Before



After FN NANO



FN® NANO Coatings was invented by Jan Prochazka, PhD, and holds two exclusive patents in the USA granted in 2014 and 2015.
The multifunctional FN® Coatings are the result of nanotechnology research.
The nanoparticles do not obstruct the photocatalytic properties of the TiO₂.
Therefore, FN® NANO Coatings are the most effective photocatalytic agents on the market today. They exceed the effectiveness of competing products by up to 100 times.



c101 Patent No.: S 8,647,565 82
(451) Date of Patent: Feb. 11, 2014

(57) A HIR, R, T

Surface treatment of atag et "ill bigh pho caly nical aud &anitary
eff ck ba edon TiO₂ mmonaples comp rising l0to 500gof
TiO₂ 2 13mQJ3ricle per l itrof water, and binding ingredienl
w, whicb ift ao In JBao ic binder selected from the group
compr ing ZnO, MnO, ilio, C (OH), Mg(OH), , dCO,
Ag O., a, O., K, O, in t he amo unt o f O i.e to 10 % bl
weight rellted to the weight of TiO₂ genrl for treat 111ent of
surfaces for applica tio n on surfac whc h compr ise a mini-
mun lo f50% of substances selected from thec group fmil.: Glyb
a CO., MgCO, 2.iO, MgO, CaO, a(OMI, lg(OH), or
theirmO., u .S: wJK"rc the agent cou lains:lOIO 500 g of li
nan pl.rich p,er 1 liter of chf wiler, and fljll in to the co nw in s:
mil pl l in fo of l. w l % l :e r, o relncd ilo, flylo to fTio:







Conclusion

Now course participants should be able to:

- **Discuss** the LEED v4 Indoor Environmental Quality (EQ) category and common indoor air quality issues that affect the health of building occupants.
- **Describe** how photocatalytic coatings can help protect the health and comfort of building occupants.
- **Review** how Titanium dioxide (TiO₂) helps eliminate VOCs, allergies, odors, mold, bacteria, and viruses in buildings.
- **Explain** how TiO₂ photocatalytic coatings can clean interior and exterior building surfaces and help combat air pollution.

Presenter

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As we have seen throughout the presentation, NANO coatings provide architects, specifiers, interior designers, and contractors a host of solutions to improve indoor and outdoor air quality, protect building occupants from dangerous pathogens, and meet LEED v4 design requirements. Now course participants



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