

製品概要説明資料

■ Contents

◆ ～光触媒って何？（弊社製品の特徴）～

◆ ～どう提案する？どう使う？～

MAJ

株式会社エムエージャパンでは・・・

株式会社 エムエージャパン

光触媒コーティング剤及び応用製品の 研究開発・製造

■ 本社工場：佐賀県佐賀市久保田町大字久富**3309**番地

販売・施工・・・全国の代理店様

■ 光触媒コーティング剤・可視光応答型光触媒コーティング剤
ティオスカイコート・OEM
(屋外・屋内施工実績は多数)

■ クロスコーター

■ 光触媒空気清浄機
TiO II FRESH

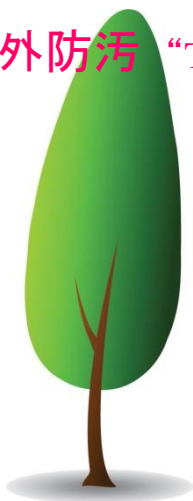


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R&D and manufacturing of photocatalyst technology

光触媒関連商品群

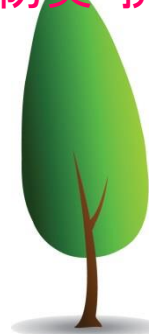
■屋外防汚 “TiOSKYCOAT”



■ハンドスプレー “TiO2”



■室内防臭・抗菌 “スマイライト”



■空気清浄機 “TiO II FRESH”



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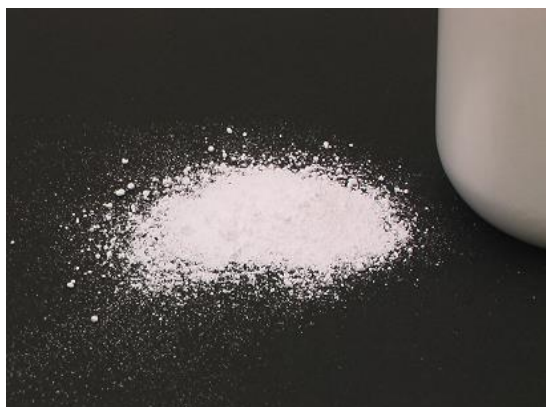
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光触媒とは・・・

■ 「二酸化チタン」を用いた技術です



塗料・紙・繊維等の白色顔料として利用

■ 結晶型：アナターゼ・ルチル・(ブルックライト)

紫外線を吸収して、表面に強力な酸化力が発生



光触媒技術へ応用

従来は・・・



- 可視光線を散乱し易いように
粒子径(0.25 μ m程度)を調整
- 金属酸化物($\text{SiO}_2/\text{Al}_2\text{O}_3$)で表面処理

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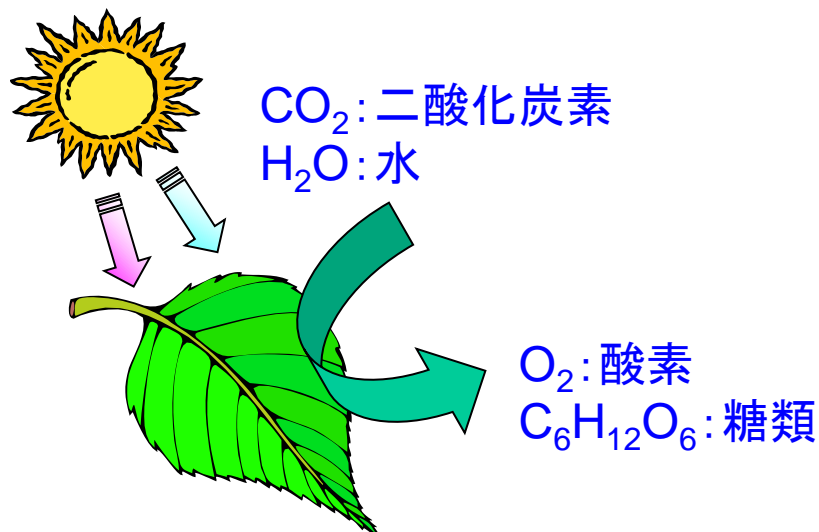
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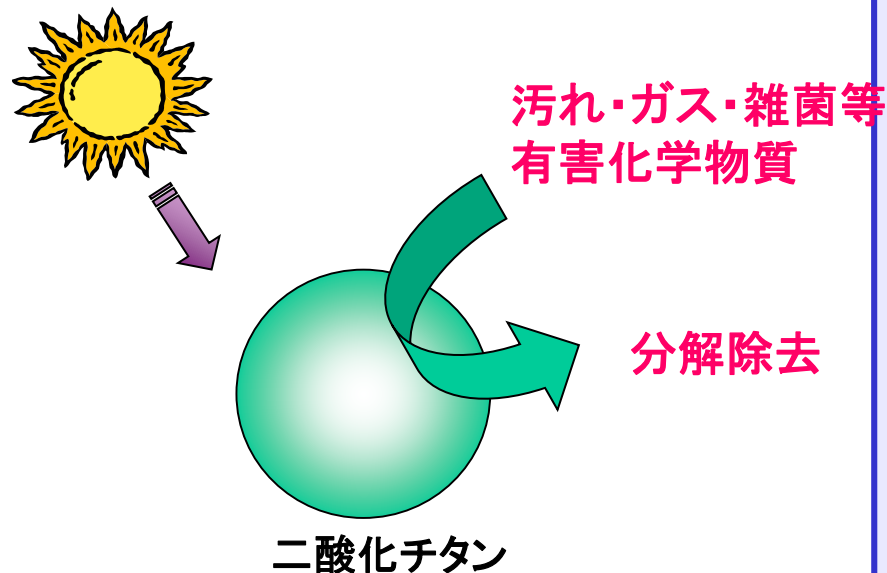
光触媒とは・・・

■ よく植物の光合成に例えられます。



□ 光合成

太陽光の赤・青色領域の光線を吸収し、
大気中の CO_2 と H_2O から、 O_2 と糖類を合成。



□ 光触媒

太陽光の紫外線領域の光線を吸収し、
大気中の水などから、活性酸素種を合成し
有害物質を分解

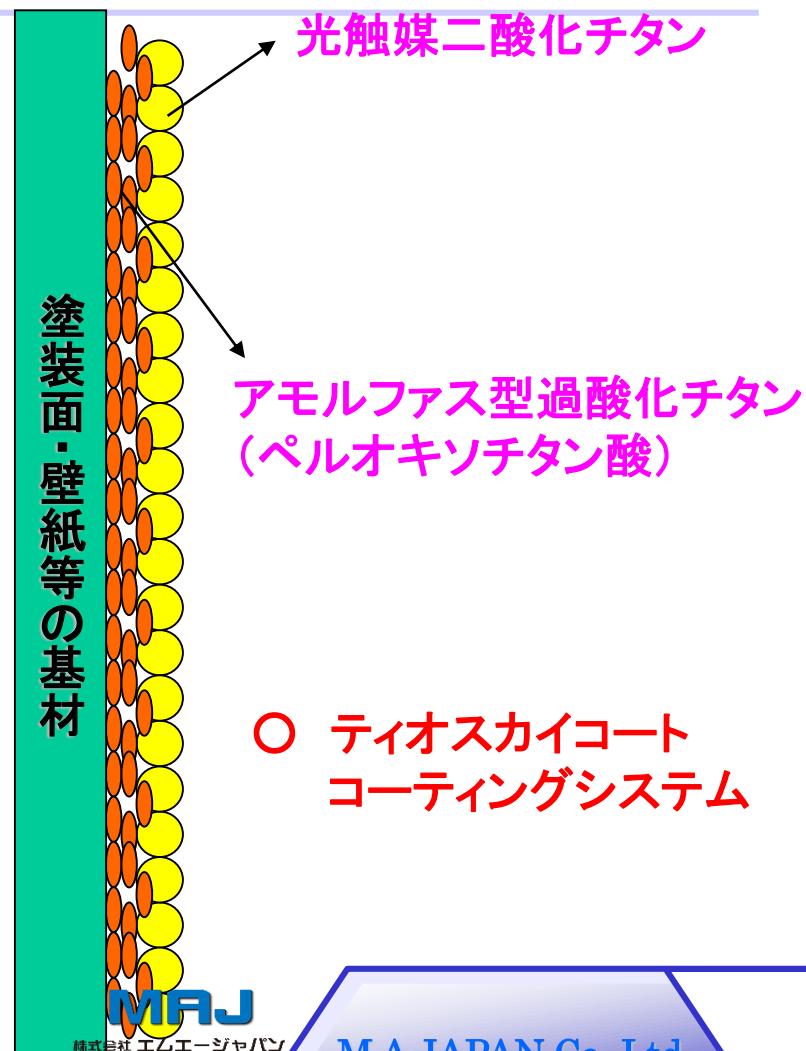
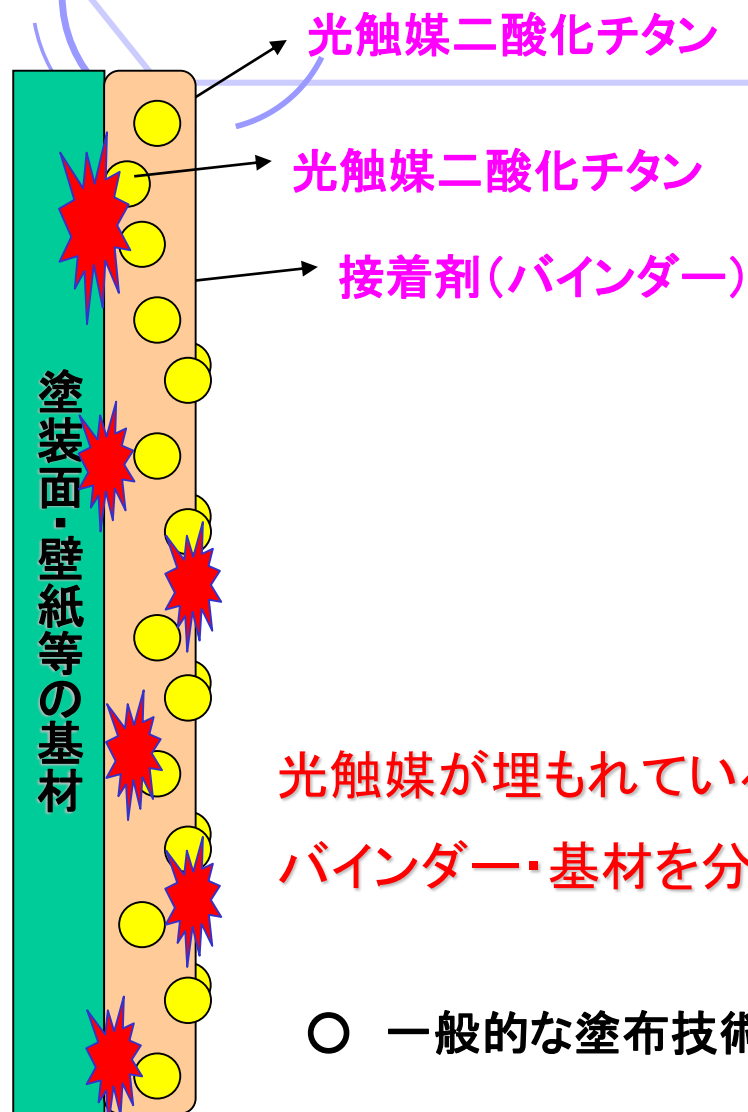
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光触媒応用における課題

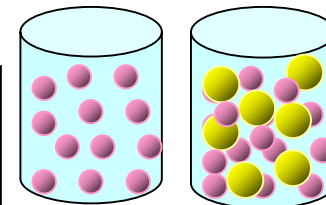


ティオスカイコート 造膜モデル

基本製造法：佐賀県有特許

光触媒作用の高性能・高耐久化

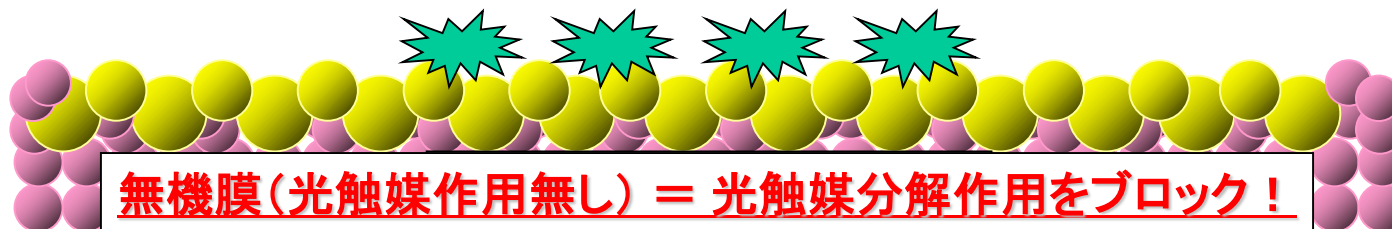
* 材料イメージ図



下塗り

上塗り

光触媒作用



無機膜(光触媒作用無し) = 光触媒分解作用をブロック！

塗装面等の基材

● アモルファス(非結晶)型 過酸化チタン : 高い定着力・光触媒作用無し

● アナターゼ型 酸化チタン : 高い光触媒性能

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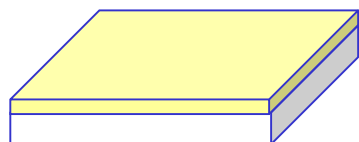
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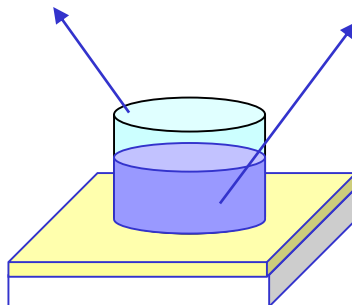
有機物分解性能の評価

光触媒コーティング



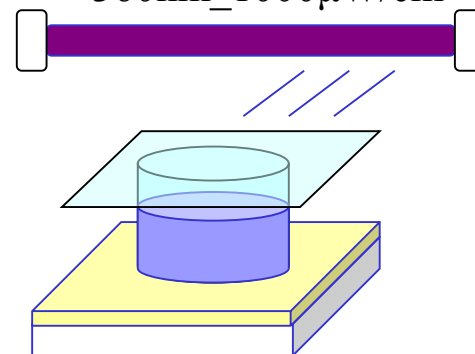
Sample①

アクリル製筒 (メチレンブルー水溶液0.01mmol/L)

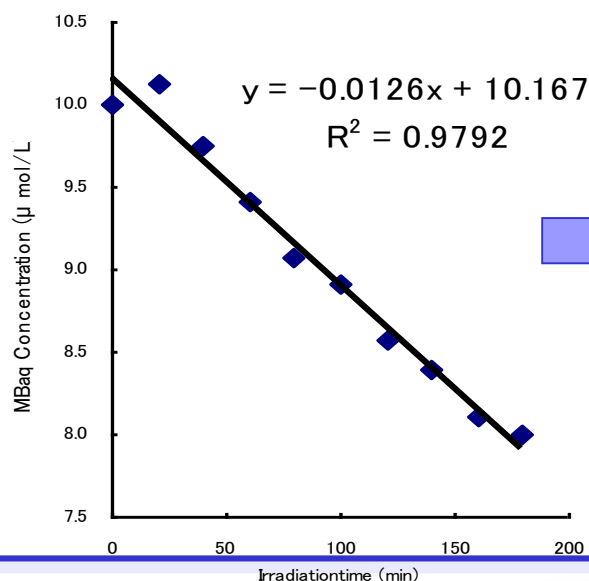


Methyleneblue aq

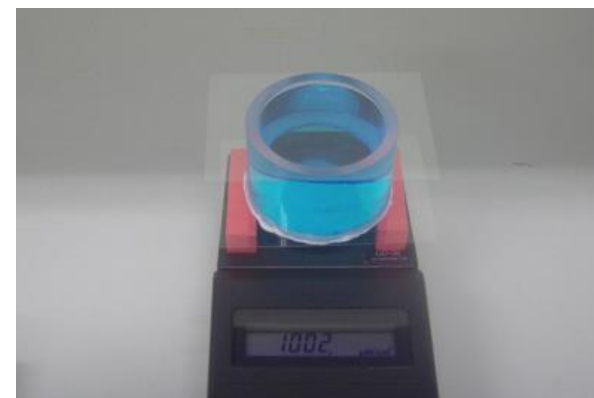
360nm_1000 μ W/cm²



20分間隔でメチレンブルーの吸光度を計測



➡ グラフ中の傾き×1000を、
分解指数として評価



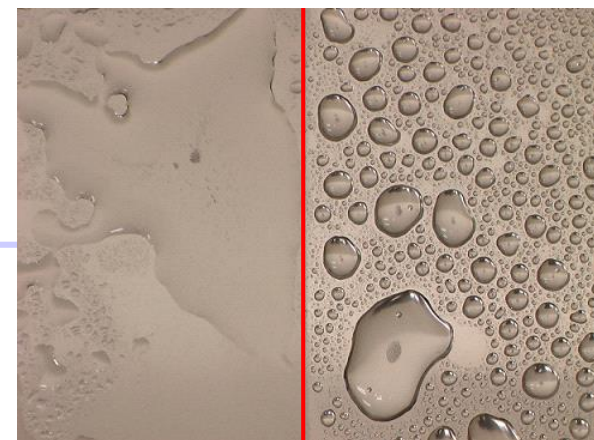
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超親水性（接触角による評価）



コーティング面 ← → 非コーティング面

θ

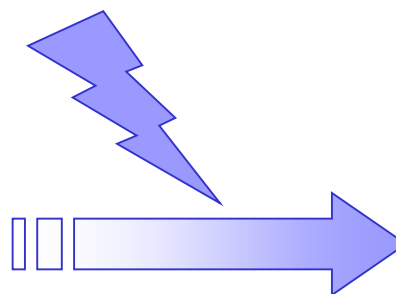
暗所下

水滴

θ

光触媒膜

UV



光触媒膜

セルフクリーニングに寄与

$\theta < 10^\circ$ ・超親水性

θ

光触媒膜

光触媒膜が剥離したり、難分解性の汚れが堆積すると接触角も大きくなる。

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塗膜の耐久性 (屋外曝露 8~10年相当「促進耐候試験」前後での評価)

■ サンシャインウェザーメーター

(促進耐候試験機 : 参考 300時間 ⇒ 実曝露1年に相当)

太陽光(主に紫外線) / 温度 / 湿度 (定期的な降雨)を人工的に再現し、
屋外曝露の数倍~百倍で促進倍率で、塗料や建材の劣化を観察する。



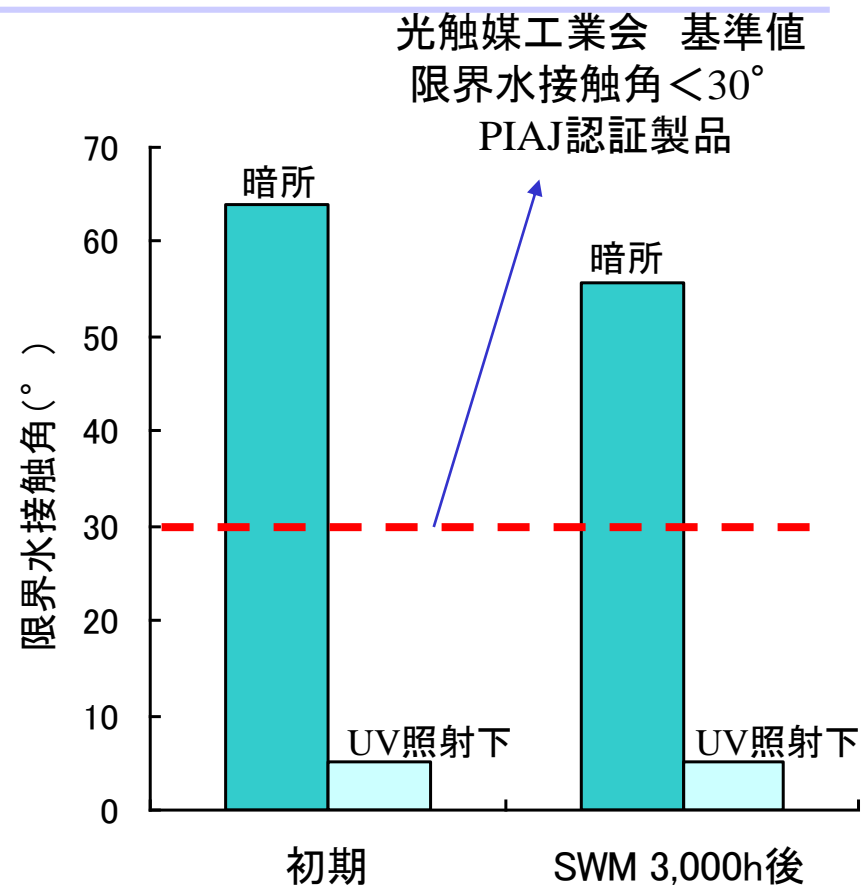
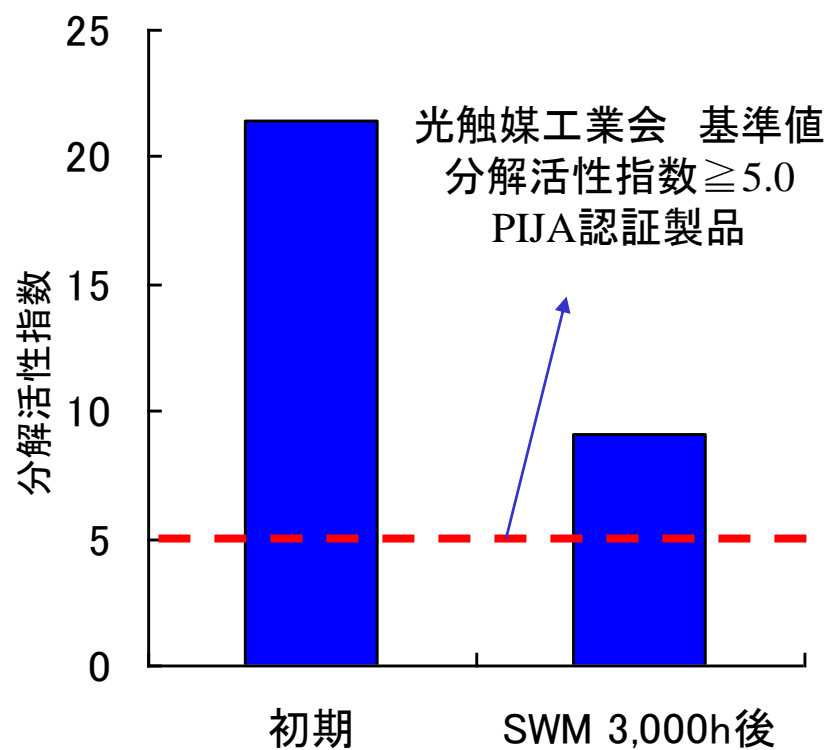
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塗膜の耐久性 (屋外曝露 8~10年相当「促進耐候試験」前後の分解活性指数)



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■施工場所L社九州工場(福岡県八女市)

施工1年3ヶ月後のそれぞれの比較

②第一工場(ティオスカイコート施工)・・・施工当時の美観を維持しています



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「ティオスカイコート」効果検証

於：佐賀県窯業技術センター内壁面（平成25年9月26日～再検証開始）



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「ティオスカイコート」効果検証

(平成22年11月～検証開始)

光触媒無し

光触媒有り



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屋外防汚ご提案 Case - 1

■ 新築・改築・洗浄時の美観を維持したい
(施設の外観イメージ向上)



＜佐賀県立病院好生館＞

2013年5月完工

ティオスカイコートK

コンクリート壁面への採用

短期間で汚れやすい

特許第3953504号(2007/05/11) 汚れが目立ちやすい



＜柳川病院＞
2012年8月完工

ガラス面・茶色タイル壁面への採用
設計後の提案だが、美観対策として追加採用

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屋外防汚ご提案 Case - 2

■ 洗浄のコストを削減したい(状況により洗浄が必要、または実施している施設等)



＜イオンモール神戸北＞
2006年11月完工



＜博多駅ビル＞
2011年2月完工



＜天神PARCO 新館＞
2015年3月完工

綺麗に保つためには、頻繁に洗浄が必要となる

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屋外防汚ご提案 Case - 3

■洗淨することが困難な場所(洗淨したいけど出来れば放っておきたい)



コーティング
未処理

光触媒
コーティング

＜ウェーブリフレクター(光触媒機能付反射材)＞
首都高速道路・阪神高速道路等

＜京都タワー展望室＞



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■光触媒導入目的

① 美観の維持

建物の外壁に対する汚れを抑制し、美観の印象向上に寄与します。

② メンテナンスコストの削減

本来、綺麗に保つために必要な、清掃の手間・コストを節減することができます。

③ 空気清浄効果

光触媒コーティング面に接触する車の排気ガスや有害ガス、悪臭の除去効果が期待できます。外壁200㎡の建物にティオスカイコート进行コーティングするとポプラの成木60本分の空気浄化能力に相当します。

Product Overview Information

■ Contents

◆ What is ... photocatalyst? (Features of our products)

◆ How do you propose? How to use it To

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In MA Japan Inc. ...

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R & D / manufacture of photocatalyst coating agent and applied products

■ Head Office Factory: 3309 Kutoshi Ogata Kubota-cho, Saga Prefecture

Sales ・ Construction ・ ・ ・ Agency in the whole country

■ Photocatalyst coating agent ・ Visible light responsive photocatalyst coating agent

Tio Sky Court / OEM

(There are many outdoor and indoor

■ Cross coater

■ Photocatalytic air cleaner
TiO₂ FRESH

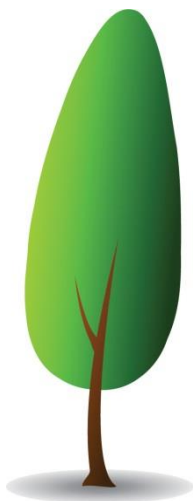


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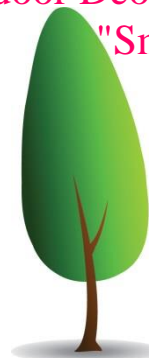
R&D and manufacturing of photocatalyst technology

光触媒関連商品群

■ Outdoor antifouling "TiOSKYCOAT"



■ Indoor Deodorant / Antibacterial "Smilelight"



■ Hand spray "TIO2"



■ Air cleaner "TiOII FRESH"



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What is a photocatalyst?

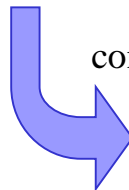
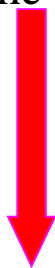
■ Technology using "titanium dioxide"



Used as a white pigment in paints, paper, fibers, etc.

Crystal form: anatase rutile (brookite)

Absorbs ultraviolet light and generates strong oxidizing power on the surface



conventionally·

- To scatter visible light easily
- Adjust particle size (about 0.25 μm)
- Surface treatment with metal oxides (SiO_2 / Al_2O_3)

Application to photocatalyst technology

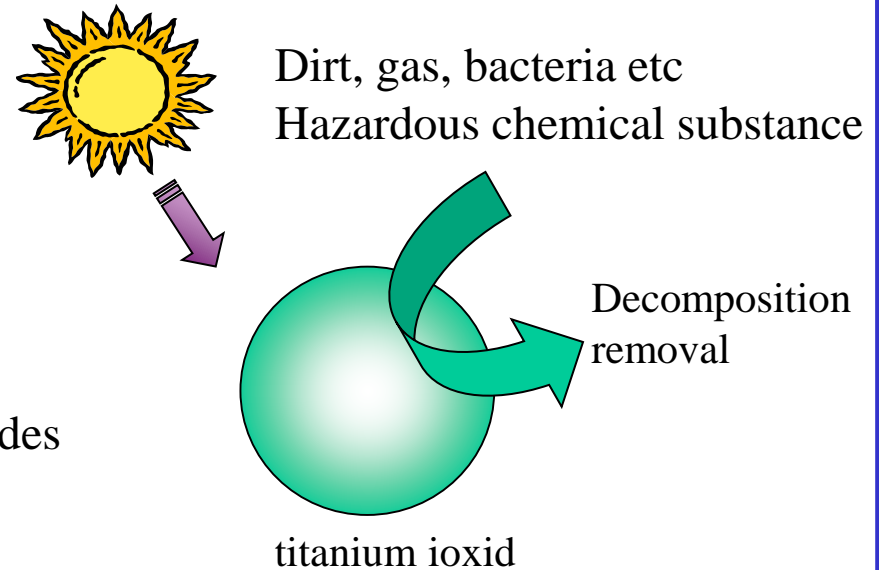
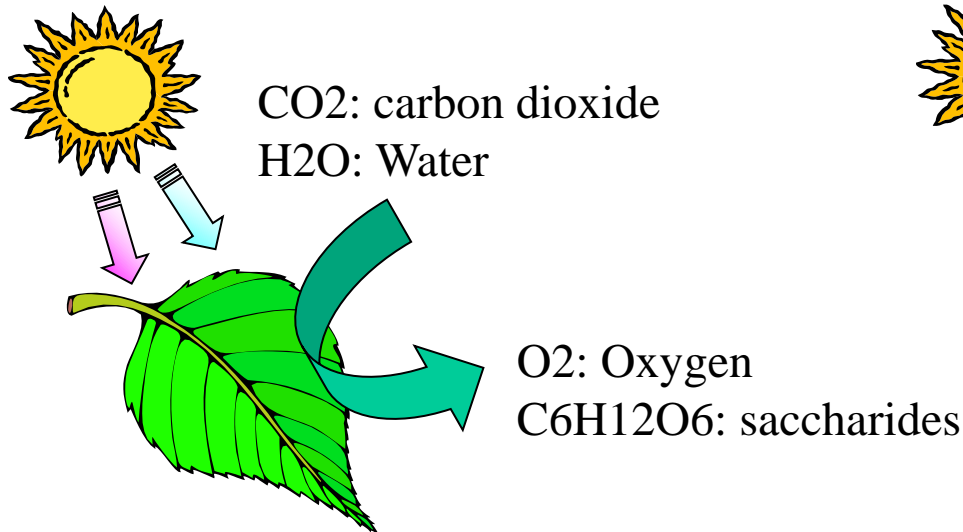
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What is a photocatalyst?

■ It is often compared to plant photosynthesis.



☐ Photosynthesis

Absorbs the rays of the sun's red and blue regions,
Synthesis of O₂ and saccharides from atmospheric
CO₂ and H₂O.

☐ Photocatalyst

Absorbs rays in the ultraviolet range of sunlight,
Active oxygen species are synthesized from
water in the atmosphere, etc.
Decomposition of harmful substances

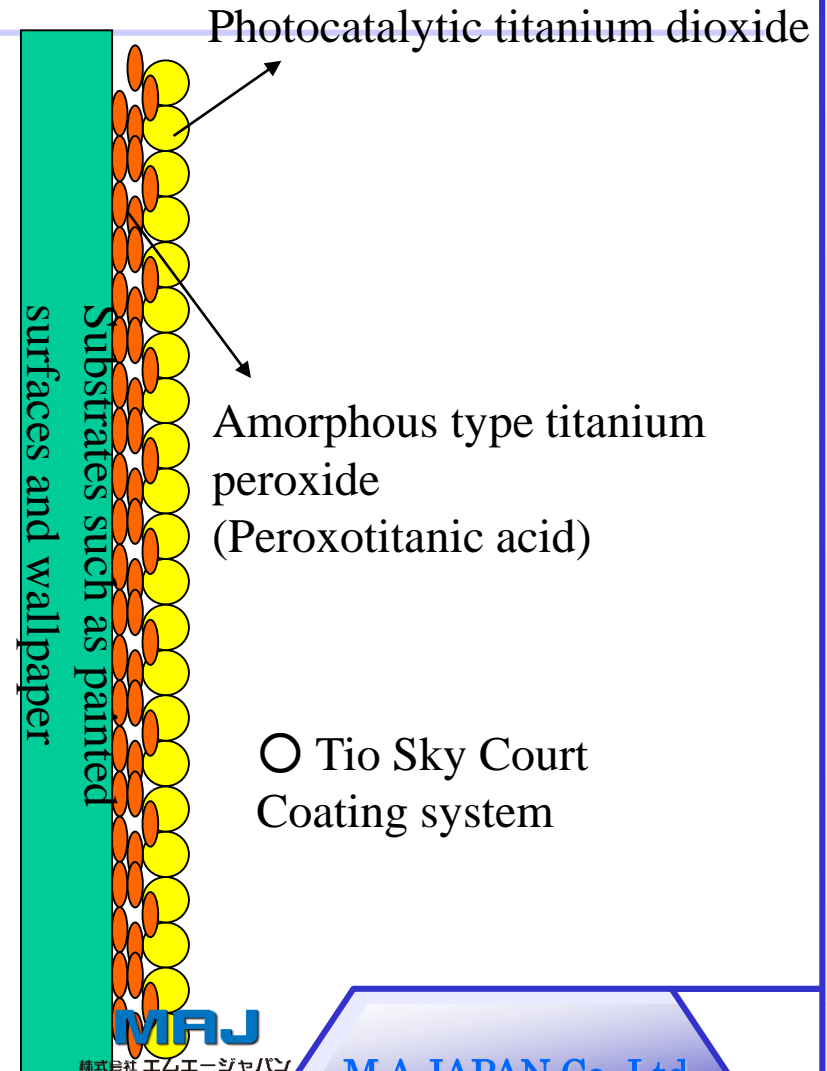
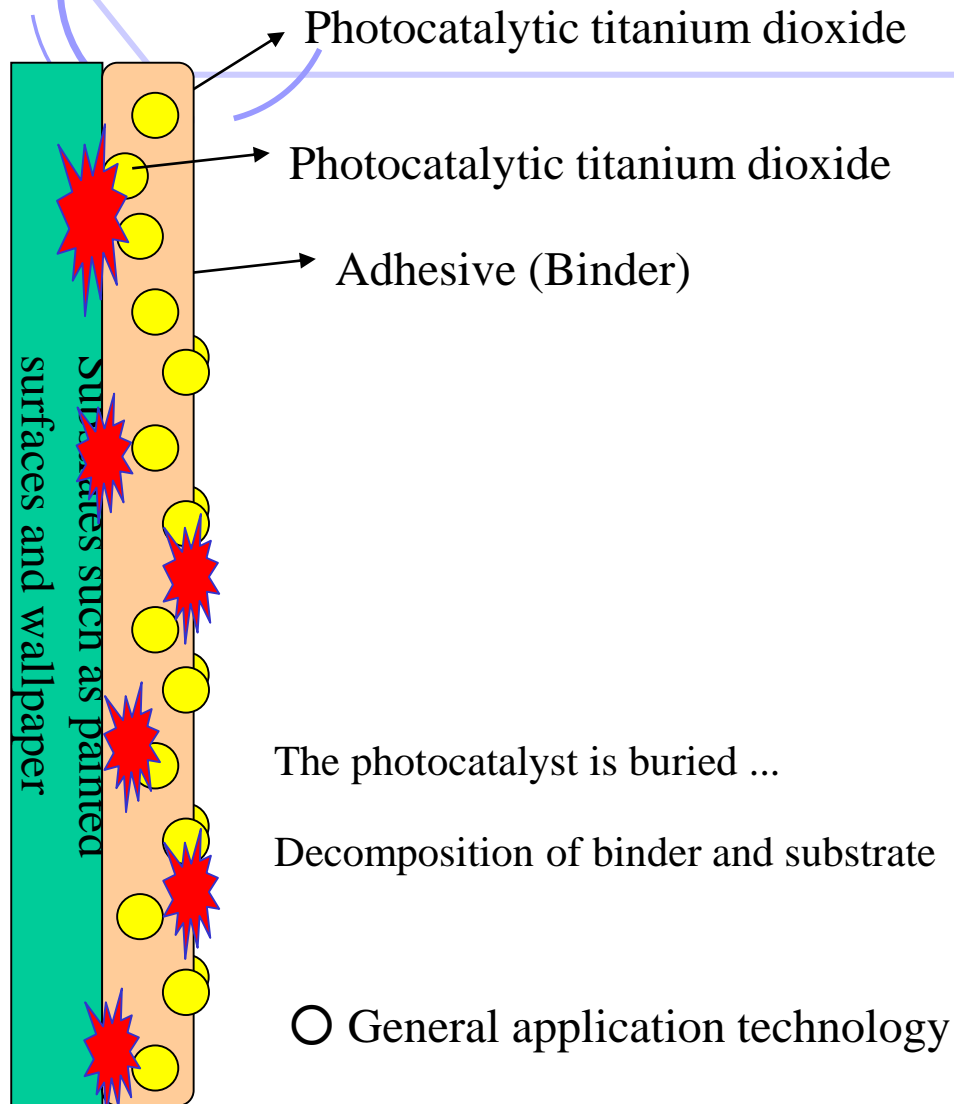
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Challenges in photocatalyst application



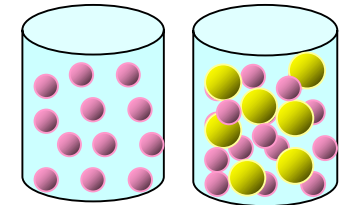
Tio Sky Coat film forming model

Basic manufacturing method: Saga prefecture patent

High performance and high durability
of photocatalysis

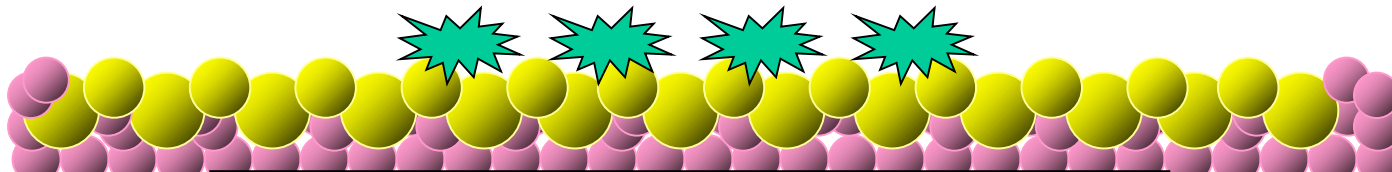
Photocatalysis

* Material image



undercoat

Top coat



Inorganic membrane (no photocatalytic action) = Block photocatalytic degradation!

Base material such as painted surface



Amorphous (non-crystalline) type titanium peroxide: High fixing power, no photocatalytic action



Anatase-type titanium oxide: high photocatalytic performance

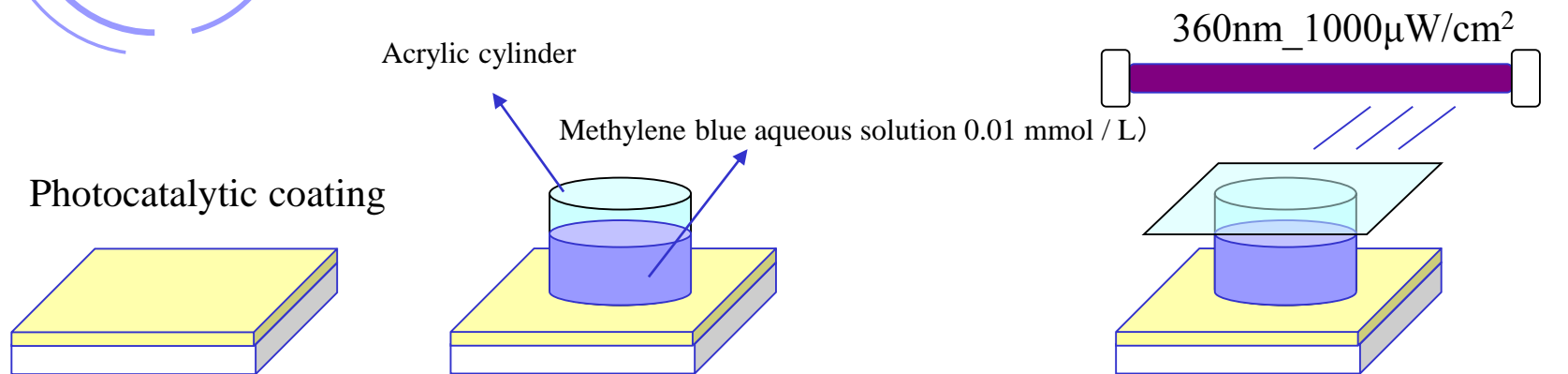
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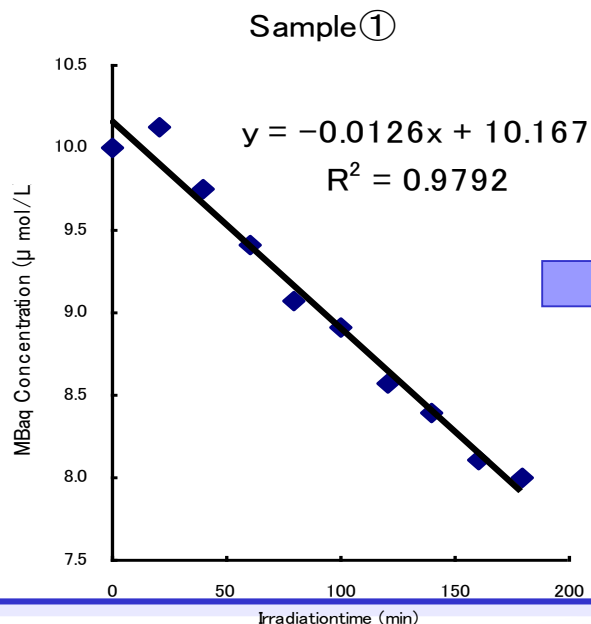
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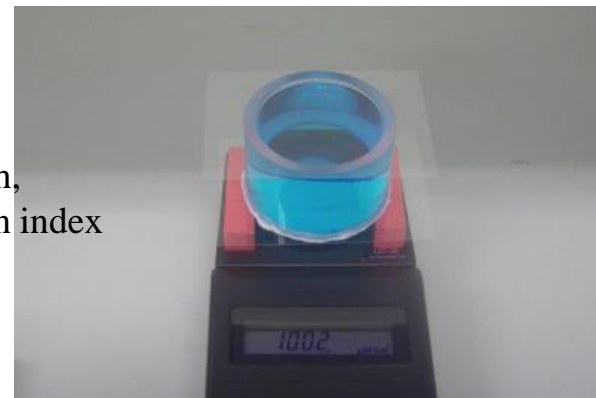
Evaluation of organic matter decomposition performance



Measure the absorbance of methylene blue at intervals of 20 minutes



The slope x 1000 in the graph,
Evaluated as a decomposition index



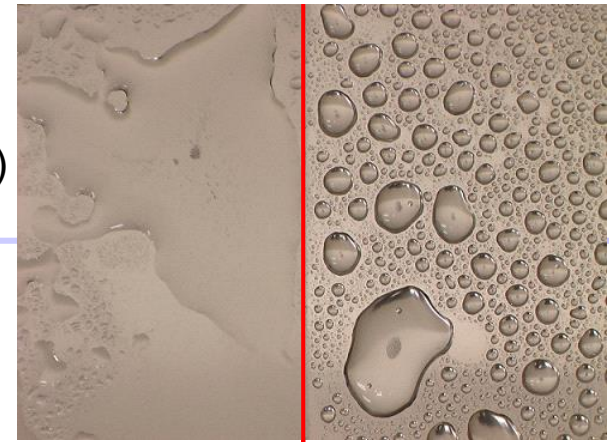
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Superhydrophilic (Evaluation by contact angle)



Coated surface

Uncoated surface

θ

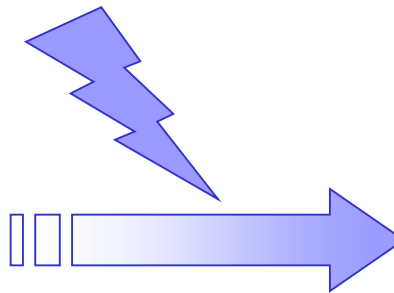
Under the dark

Water drop

θ

Photocatalytic film

UV



Photocatalytic film

Contributing to selfcleaning
 $\theta < 10^\circ$. . . super hydrophilic

θ

Photocatalytic film

When the photocatalytic film is exfoliated or non-degradable dirt is deposited,
the contact angle is also increased.

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Durability of coating film (Outside exposure 8 to 10 years equivalent Evaluation before and after "Accelerated weathering test")

■ Sunshine Weather Meter

(Accelerated weathering tester: Reference 300 hours equivalent to 1 year of actual exposure)

Artificially reproduces sunlight (mainly UV light) / temperature / humidity (periodic rainfall),
Observe the deterioration of paints and building materials at an accelerating rate several times to
one hundred times the outdoor exposure.



Evaluation of photocatalytic performance
= Evaluation of durability

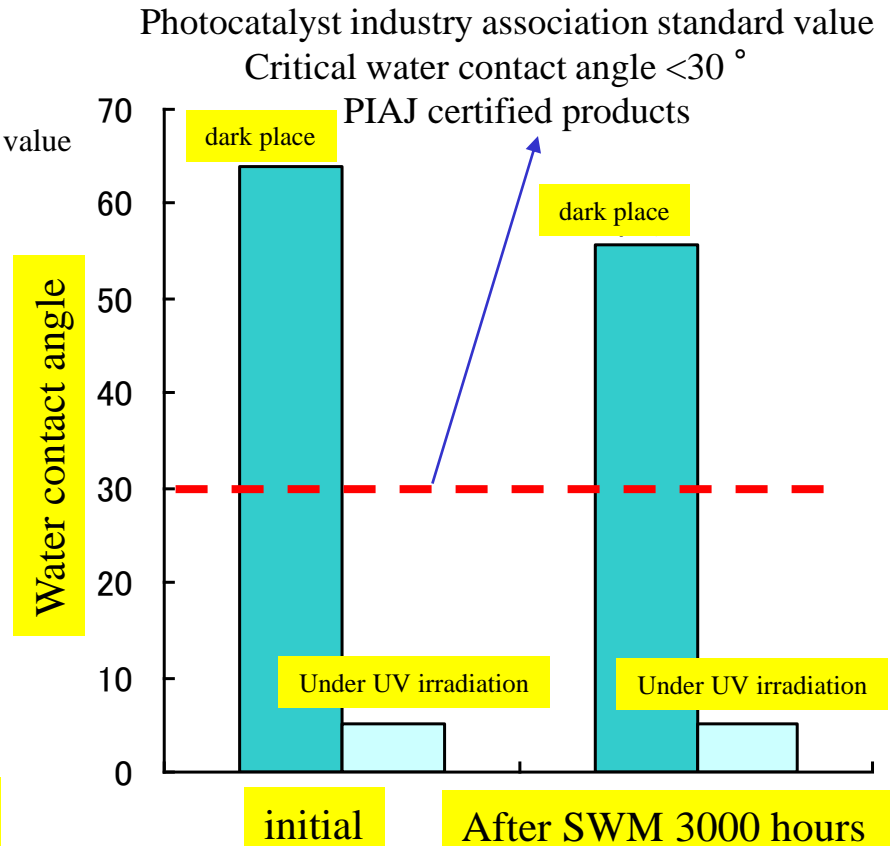
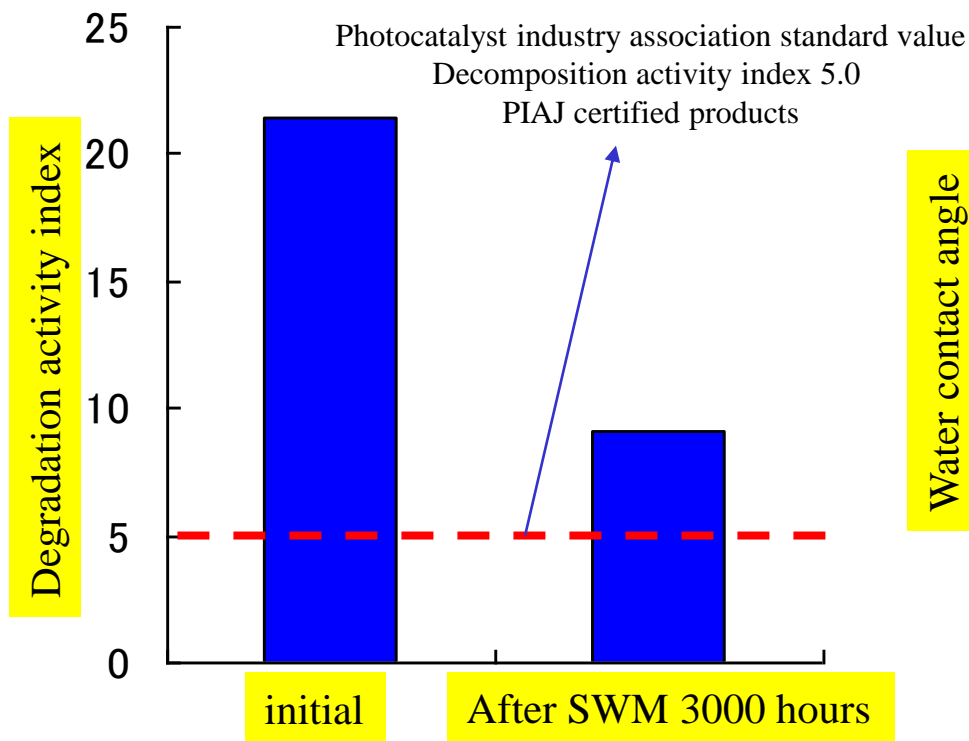
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R&D and manufacturing of photocatalyst technology

Durability of coating film (Outside exposure equivalent to 8 to 10 years Degraded activity index before and after "Accelerated weathering test")



Outdoor antifouling proposal Case-1 Comparison with other companies like photocatalyst and Tio Sky Coat

■ Construction place

L company Kyushu plant (Yame city, Fukuoka) Comparison of each one year and 6 months after construction

1) The second factory (other company like photocatalyst construction) ... mold, moss, dirt adhere to the whole outer wall



- Construction site L Company Kyushu plant (Yame city, Fukuoka Prefecture)
Comparison of each one year and 3 months after construction
- 2 First factory (Tio Sky Court construction) ... maintaining the aesthetics of the construction



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"Thio Sky Court" effect verification
At: Wall surface of Saga Ceramics Technology Center
(September 26, 2013-re-verification start)



At the time of last verification
The picture is about 2 years after application



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"Thio Sky Court" effect verification

At: Saga Oxygen Co., Ltd. (November, 2010-Verification started)



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Outdoor antifouling proposal Case-1

- I want to maintain the aesthetics of new construction, remodeling and cleaning
(Improvement of the exterior image of the facility)



<Saga Prefectural Hospital Yoshiokan>
Completed May 2013

Adoption to concrete wall

It is easy to get dirty in a short time
Dirt is noticeable

Tio Sky Court K

Patent No. 3953504 (2007/05/11)



<Yanagawa Hospital>
Completed in August 2012

Adoption to glass surface, brown tile wall
Proposal after design, but added as a measure for aesthetics

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Outdoor antifouling proposal Case-2

- We want to reduce the cost of cleaning
(facility where cleaning is necessary or is carried out depending on the situation)



<Aeon Mall Kobe Kita>
Completed in November 2006



<Hakata Station Building>
February 2011 completed



<Tenjin PARCO New Building>
Completed in March 2015

In order to keep clean, frequent cleaning is required

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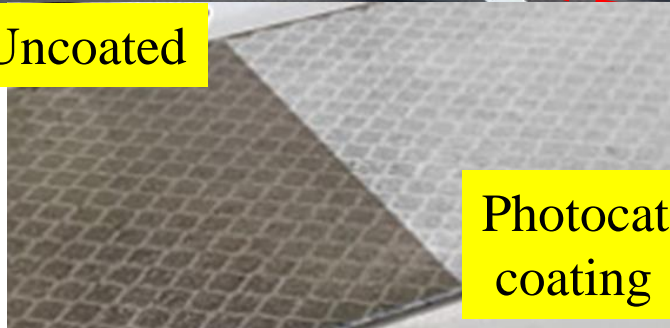
R&D and manufacturing of photocatalyst technology

Outdoor antifouling proposal Case-3

■ A place where it is difficult to wash (I want to wash but I want to leave it if I can)



Uncoated



Photocatalytic
coating

<Wave reflector (reflecting material with photocatalytic function)>
Metropolitan Expressway, Hanshin Expressway, etc.

<Kyoto Tower Observatory>



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■ Purpose of introducing photocatalyst

① Maintenance of aesthetics

We control dirt to the outer wall of building and contribute to impression of beauty.

② Reduced maintenance costs

Inherently, you can save the time and cost of cleaning required to keep it clean.

③ Air cleaning effect

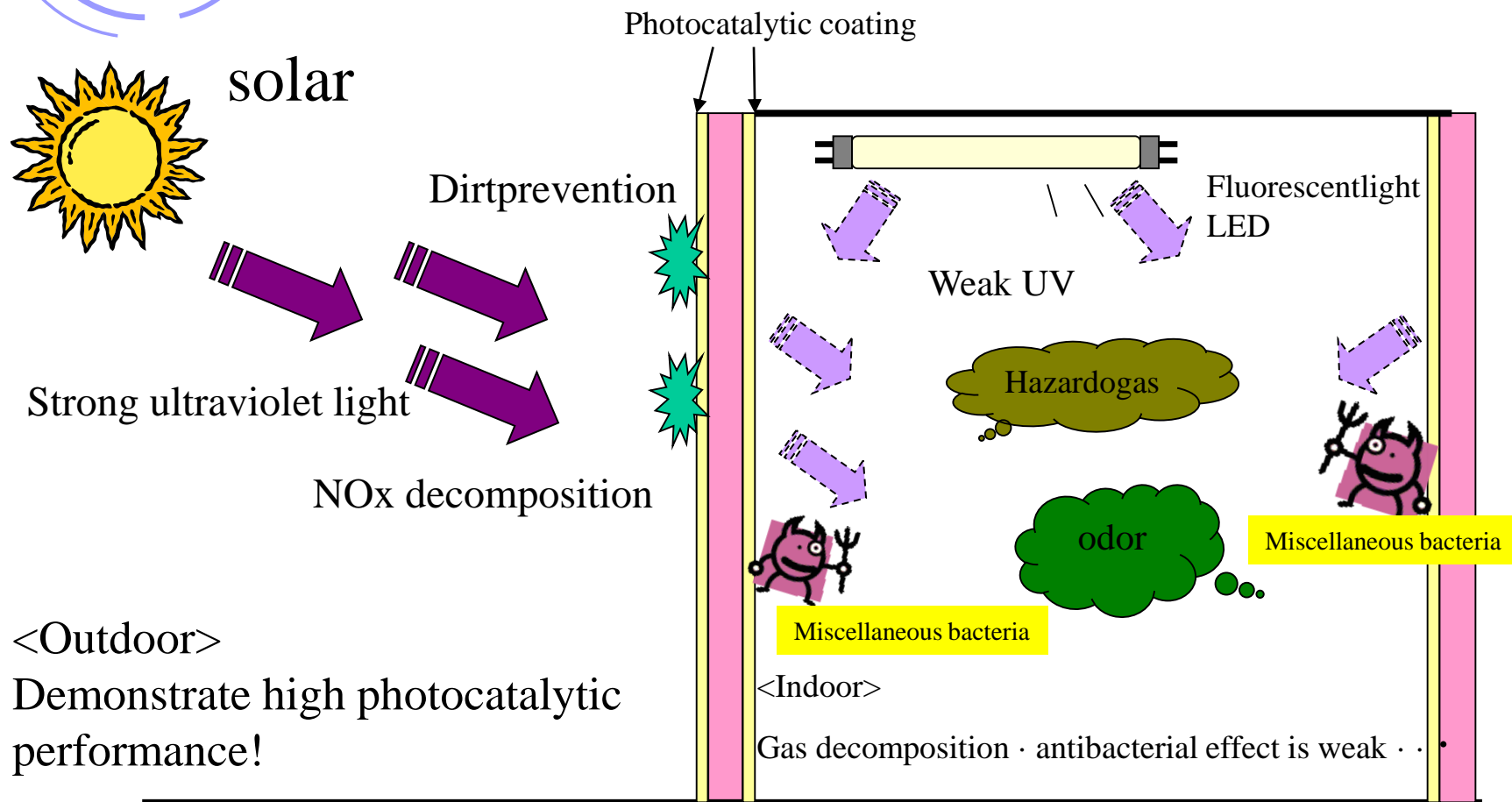
It is expected to be effective in removing car exhaust gases, harmful gases and odors that come in contact with the photocatalytic coating surface.

By coating Tio Sky Coat on a 200 m² outer wall building,
the air purification capacity for 60 poplar trees
It corresponds to the force.

Background and purpose of visible light responsive photocatalyst research and development

<Effect and limitations of UV response type>

= It is difficult to demonstrate the effects that customers are looking for



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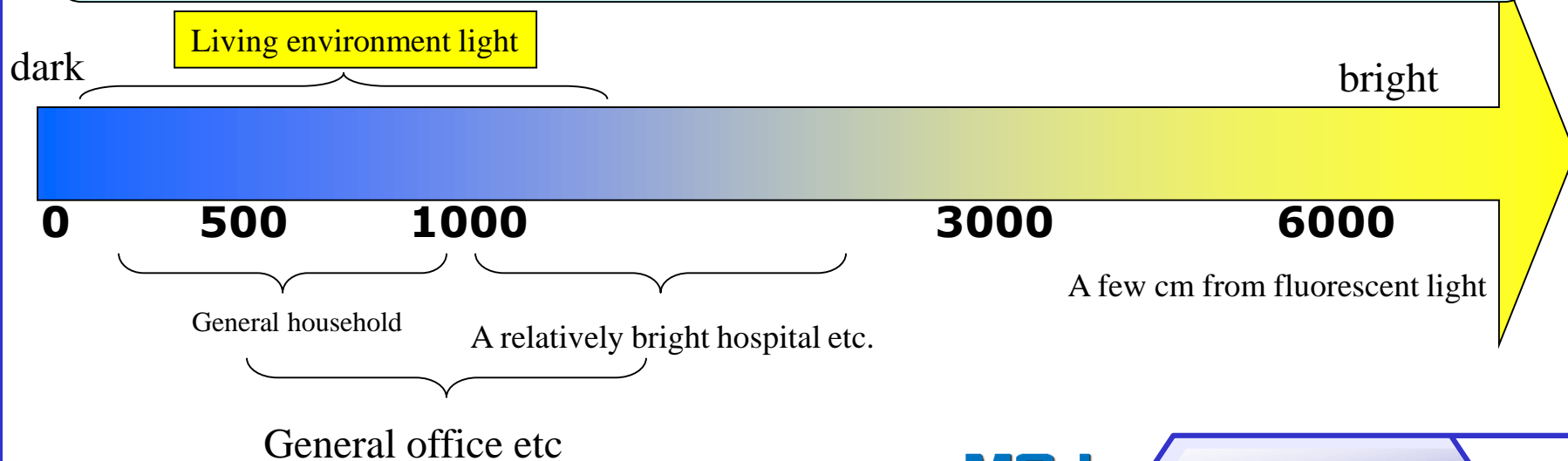
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Outline of research and development

<Life environment light is very different from the test condition>

- Several major companies are developing visible light responsive photocatalysts
- Few have been put to practical use as coating agents and wallpaper,
Many are rated at a brightness of 3000 to 6000 lux

In this research and development, we carry out effect verification at a brightness of about 500 lux,
Production of products that match the needs of customers



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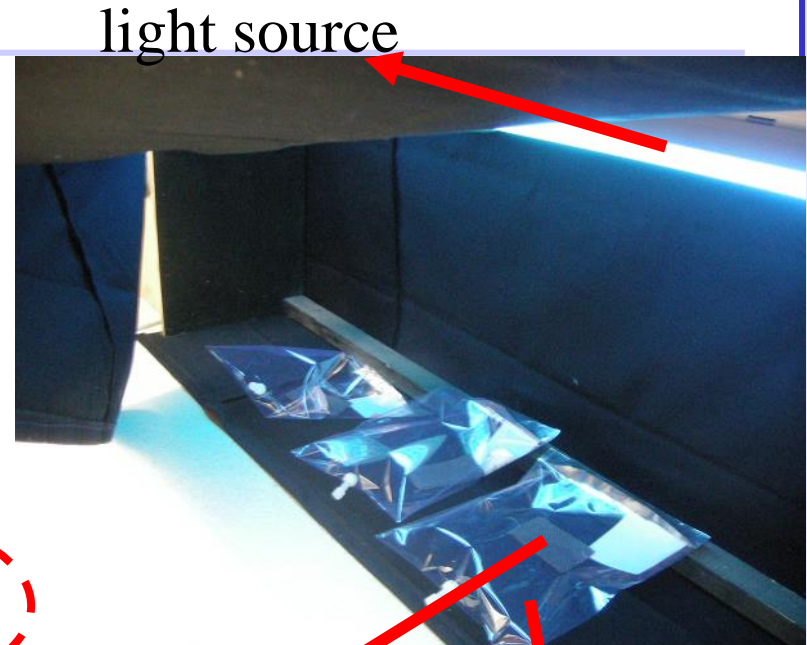
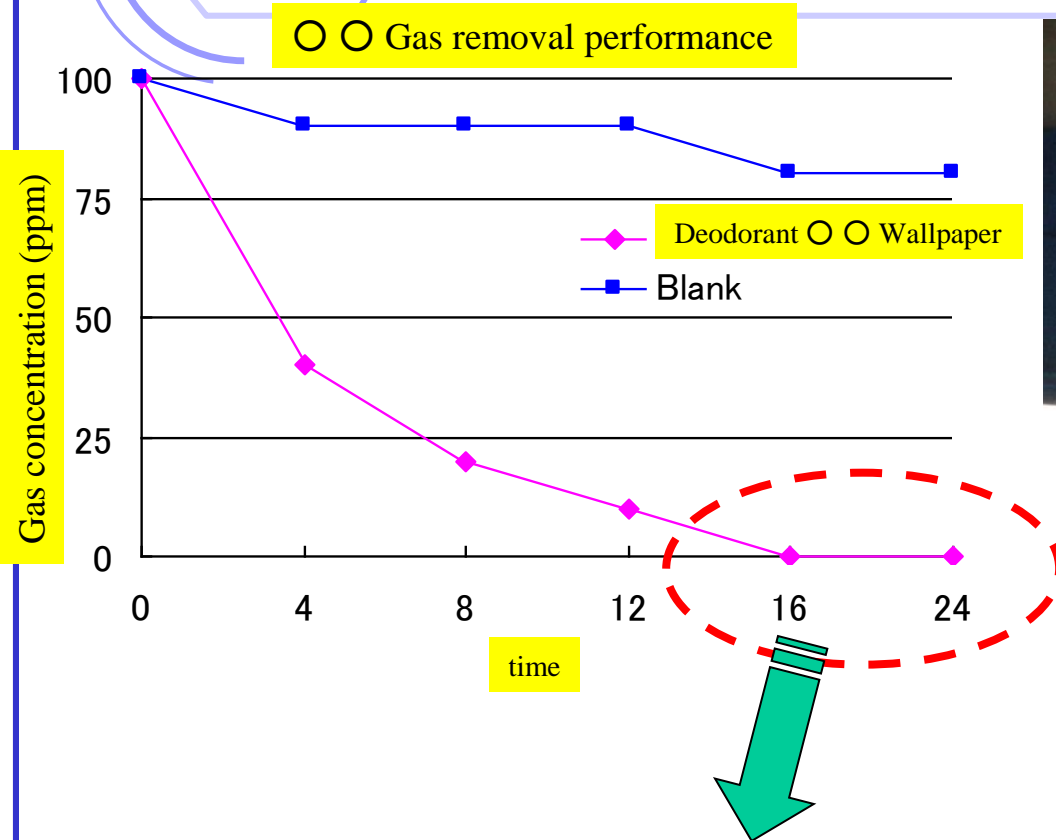
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Why do we need a demonstration test?

Common photocatalyst evaluation test method



sample

Gas bag (container)

The smell of the room, "this number" is a game

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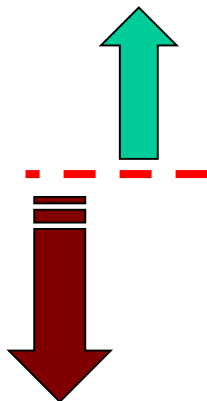
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"Odor" is felt at extremely low concentration

○ Six step odor intensity method

In general, you will not be bothered by the smell

I am worried about odor
odor...



Odor intensity	Contents
0	Odorless
1	The smell that I can finally sense
2	Weak smell to understand what kind of smell
3	Smell that can be detected easily
4	Strong smell
5	Intense smell

For example: The concentration at the four major bad smells of life is ...

Name of substance	smell	Concentration at odor intensity "2"
Hydrogen sulfide	Smell like rotten eggs	0.006 ppm
Methyl mercaptan	Smell like rotten onions	0.0007 ppm
Trimethylamine	Smell like rotten fish	0.001 ppm
ammonia	Smell like night soil	0.6 ppm

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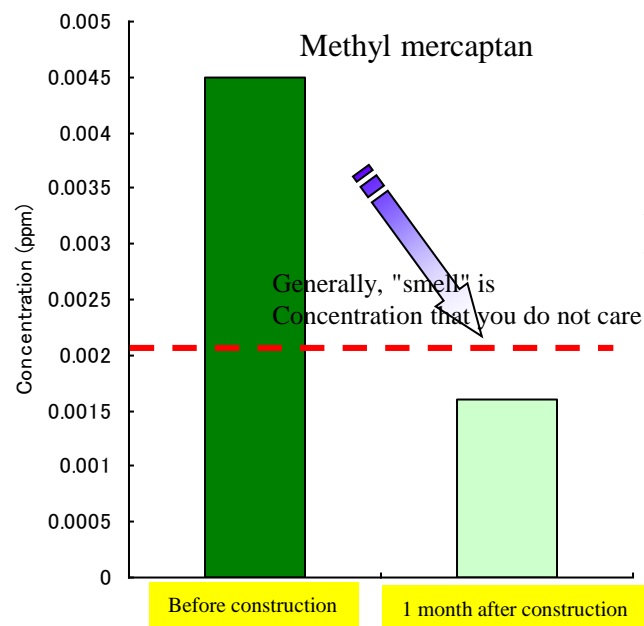
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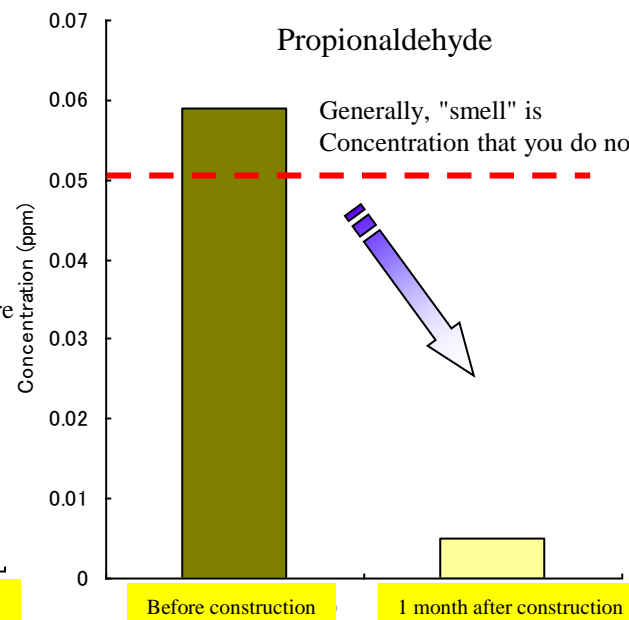
Indoor odor elimination / antibacterial (visible light response development product: demonstration test)



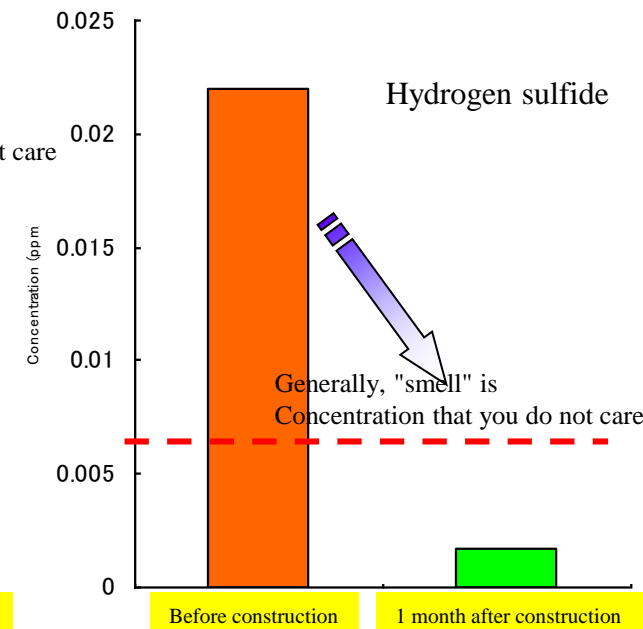
<Odor component data about 1 month after test construction: Hospital specific odor is significantly reduced>



(Stimulating sweet and sour charred odor)



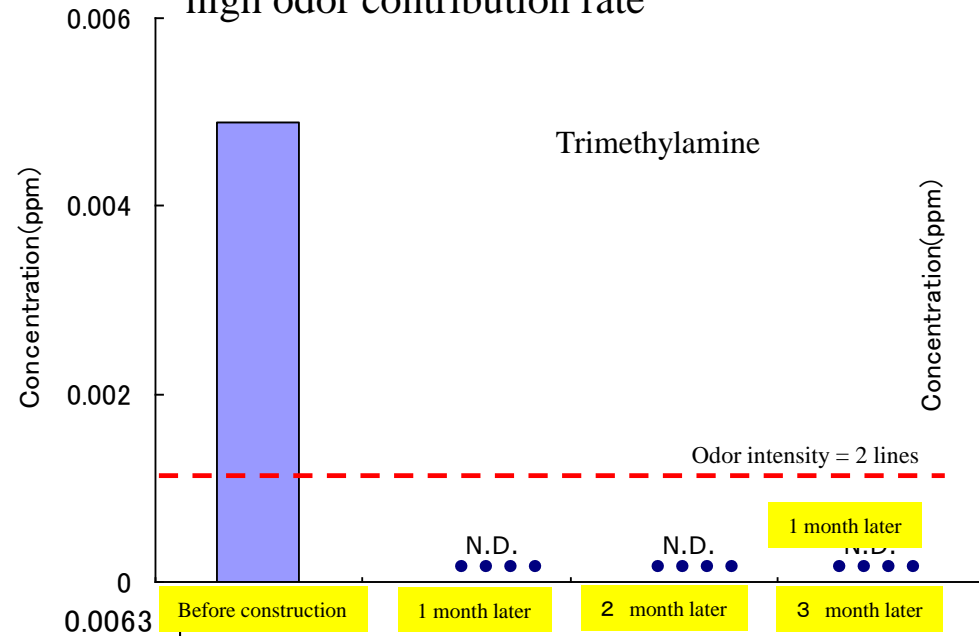
(Scent like rotten onion)



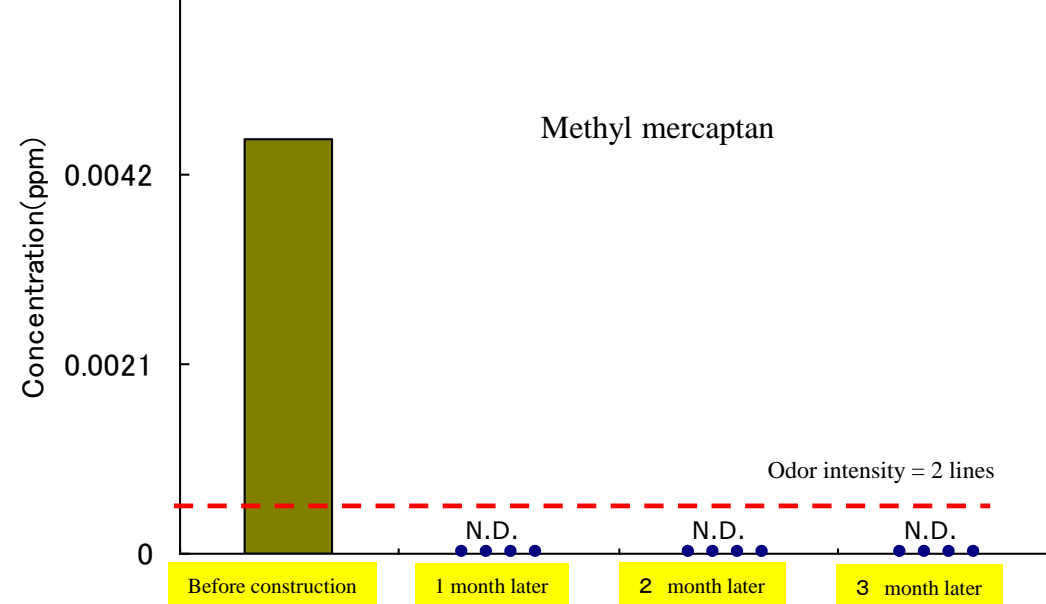
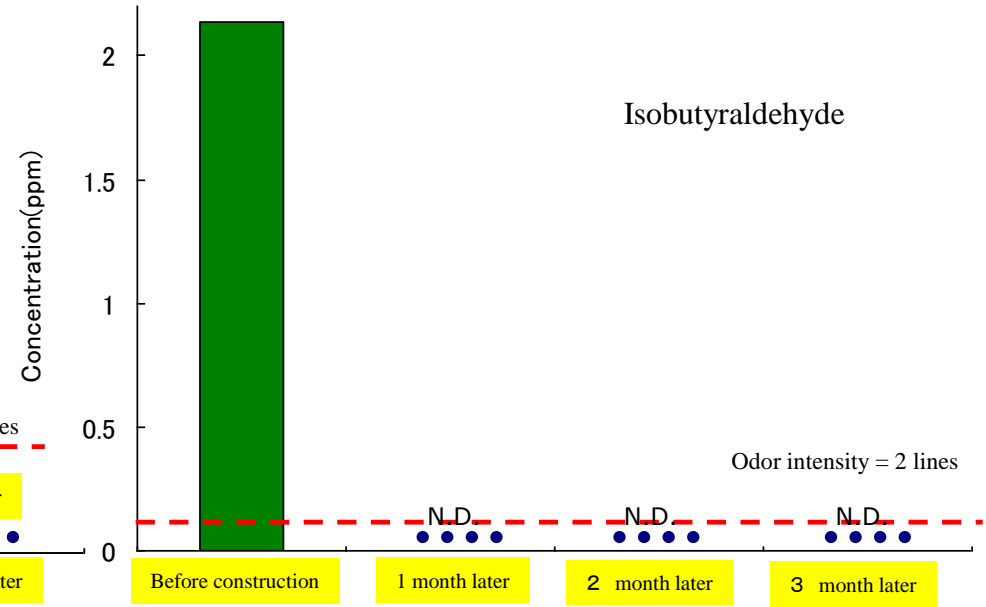
(Scent like rotten onion)

Offensive odor analysis result graph

Before construction by component with high odor contribution rate



Before and after demonstration construction (each odor component data up to about 3 months later)
Fukuoka City A Hospital Private Room



Odor intensity = 2 lines

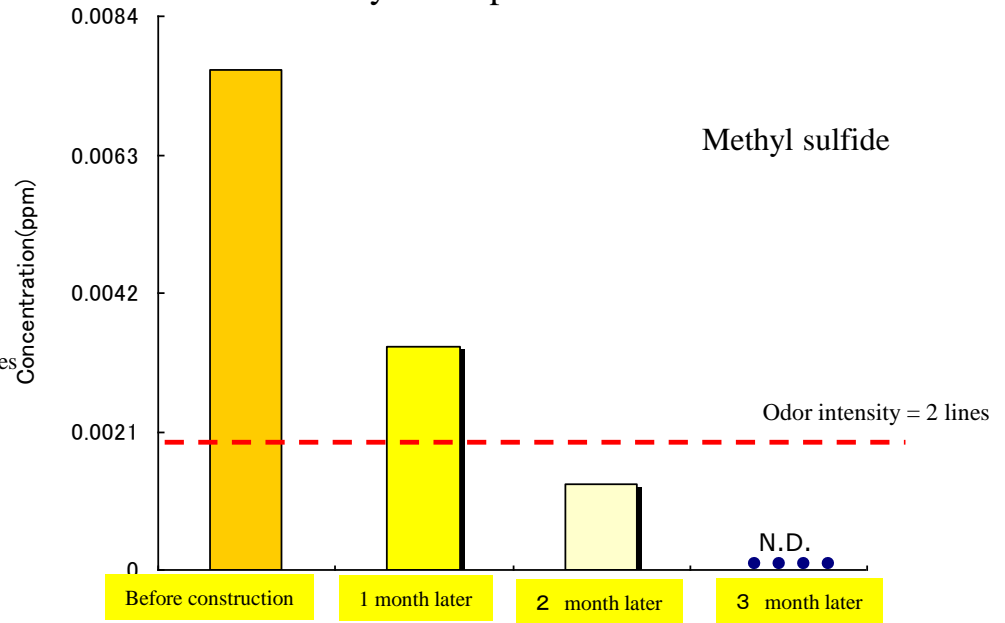
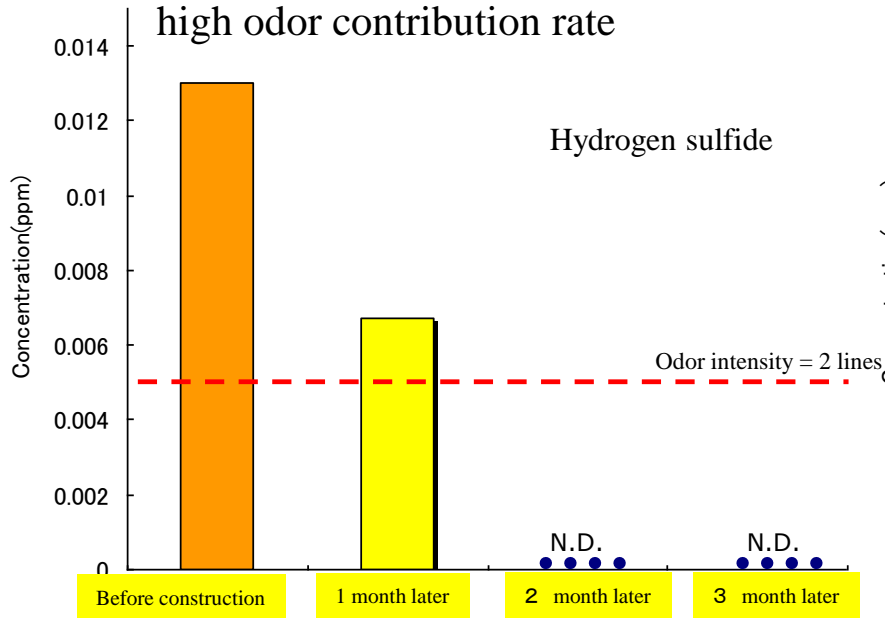


In general, the concentration at which you do not care about the smell

Offensive odor analysis result graph

Before and after demonstration construction (each odor component data up to about 3 months later)
Fukuoka City A Hospital Private Room

Before construction by component with high odor contribution rate



--- Odor intensity = 2 lines



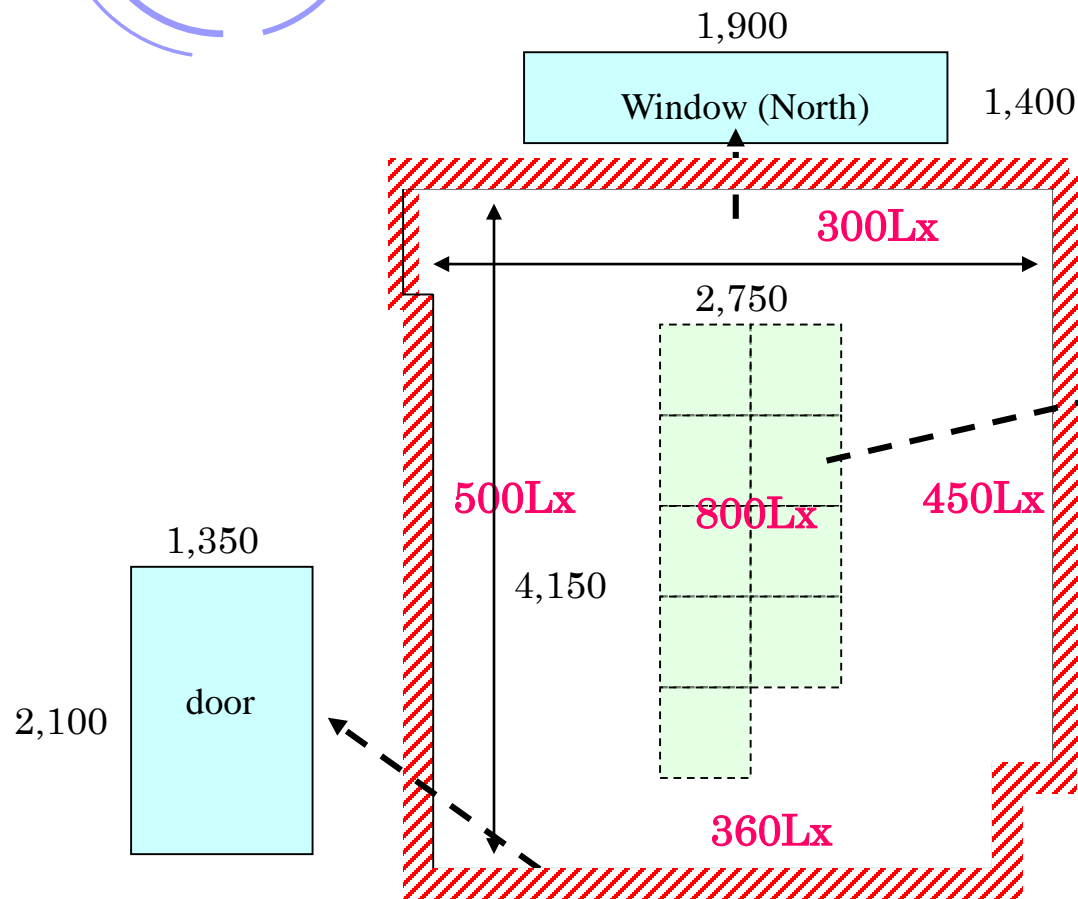
In general, the concentration at which you do not care about the smell

Test construction site outline figure: The second floor private room

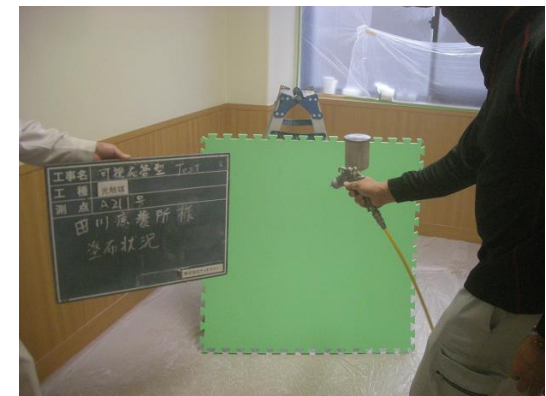
(A210: Odor analysis object)

* Red numbers in the figure are the illuminance at 1,500 points in height (lux)

- Wall + ceiling area: Approximately 52 square meters
- Floor mat (soft mat): Approximately 18 square meters
- Light condition: About 500 lux on average
- Material: wall and ceiling wallpaper



Floor mat (spread in room A211)
Approximately 1 m2 × 9 pieces: Back and front construction



Testing department

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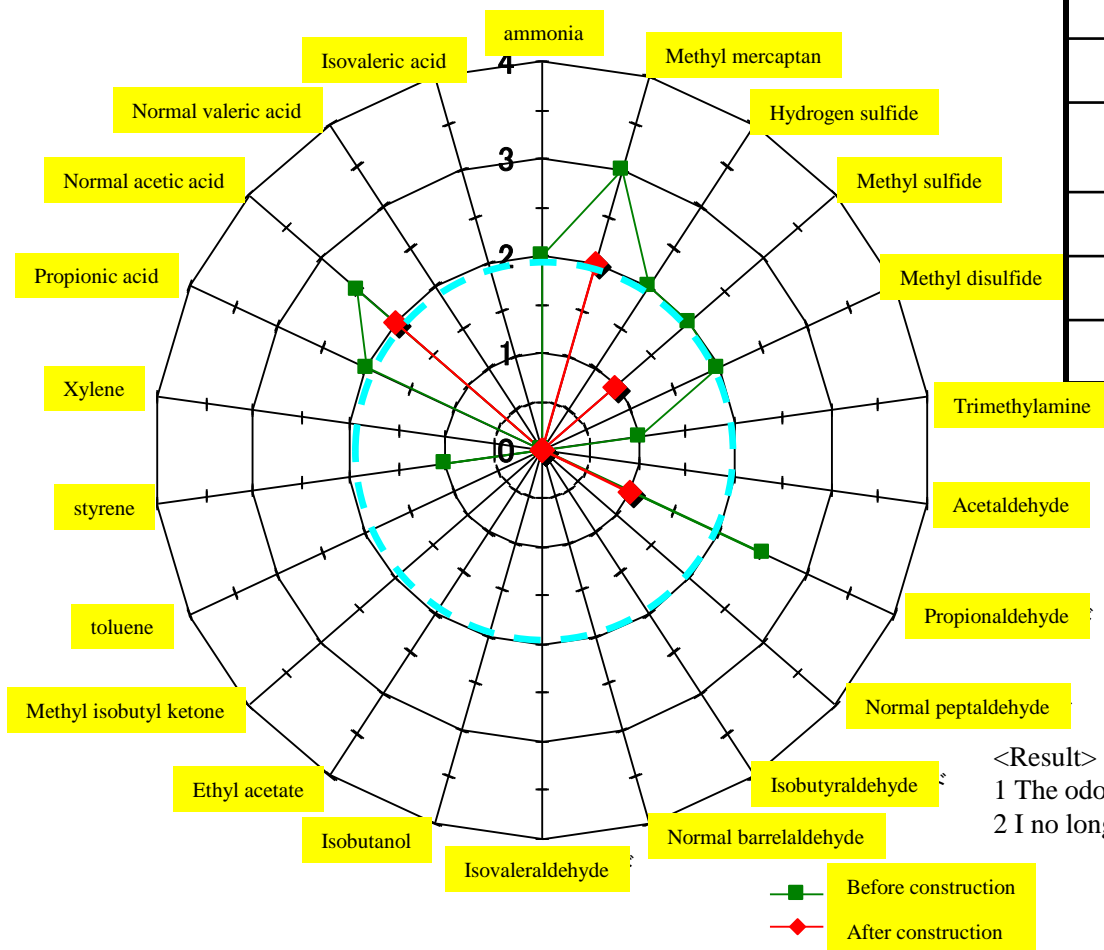
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Offensive odor analysis result graph

Before test construction-after test construction

○ Six-step odor intensity method
(number on the vertical axis in the graph)

Odor intensity	Contents
0	Odorless
1	The smell that I can finally sense
2	Weak smell to understand what kind of smell
3	Smell that can be detected easily
4	Strong smell
5	Intense smell



From the above, generally
Almost no odor is felt inside the dashed line
in the grap

<Result>

- 1 The odor concentration decreased even under relatively low light intensity.
- 2 I no longer feel particularly offensive odor in terms of bodily sensation.

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Verification summary

In the operation room (total of 10 rooms) in the university hospital, Tio Sky Coat was coated on the wall at the time of renovation, and the antibacterial test of the wall was carried out over a year in collaboration with a general contractor.



The presence or absence of viable bacteria on the inner wall surface was examined using "Pethan Check 25 standard agar medium (for measuring viable cell count)" (manufactured by Eiken Instruments Co., Ltd.).

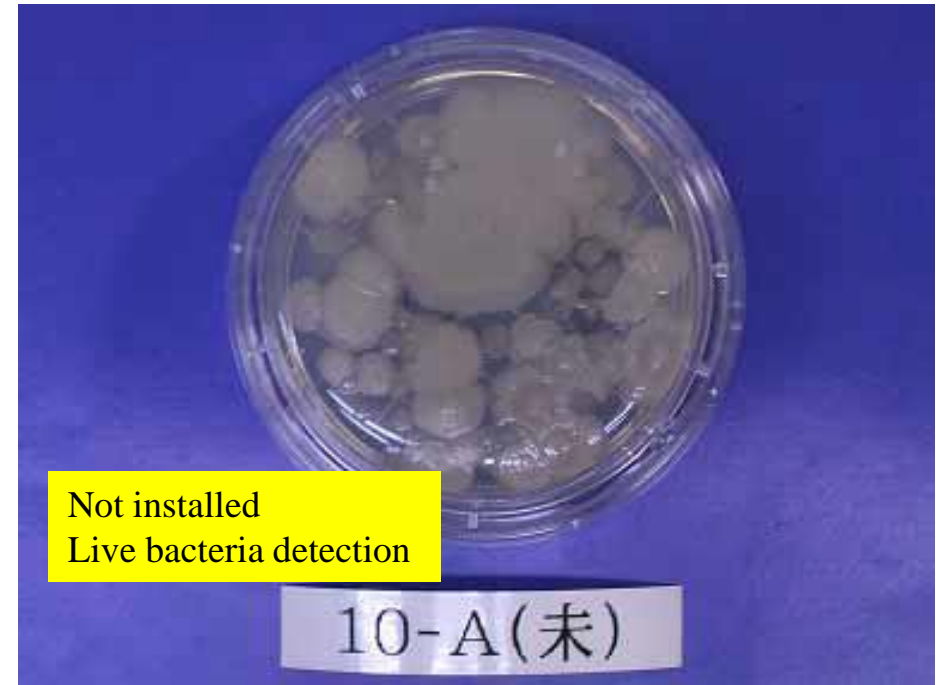
In the method, the agar medium is lightly pressed against the wall, and cultured in a shaker (constant temperature incubator) at 35 ° C. for 24 hours. If viable bacteria are present on the wall, colonies of viable bacteria can be visually confirmed on the medium after 24 hours.

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Result photo

About half a year after construction (lower left photo), no construction (lower right photo) is shown.



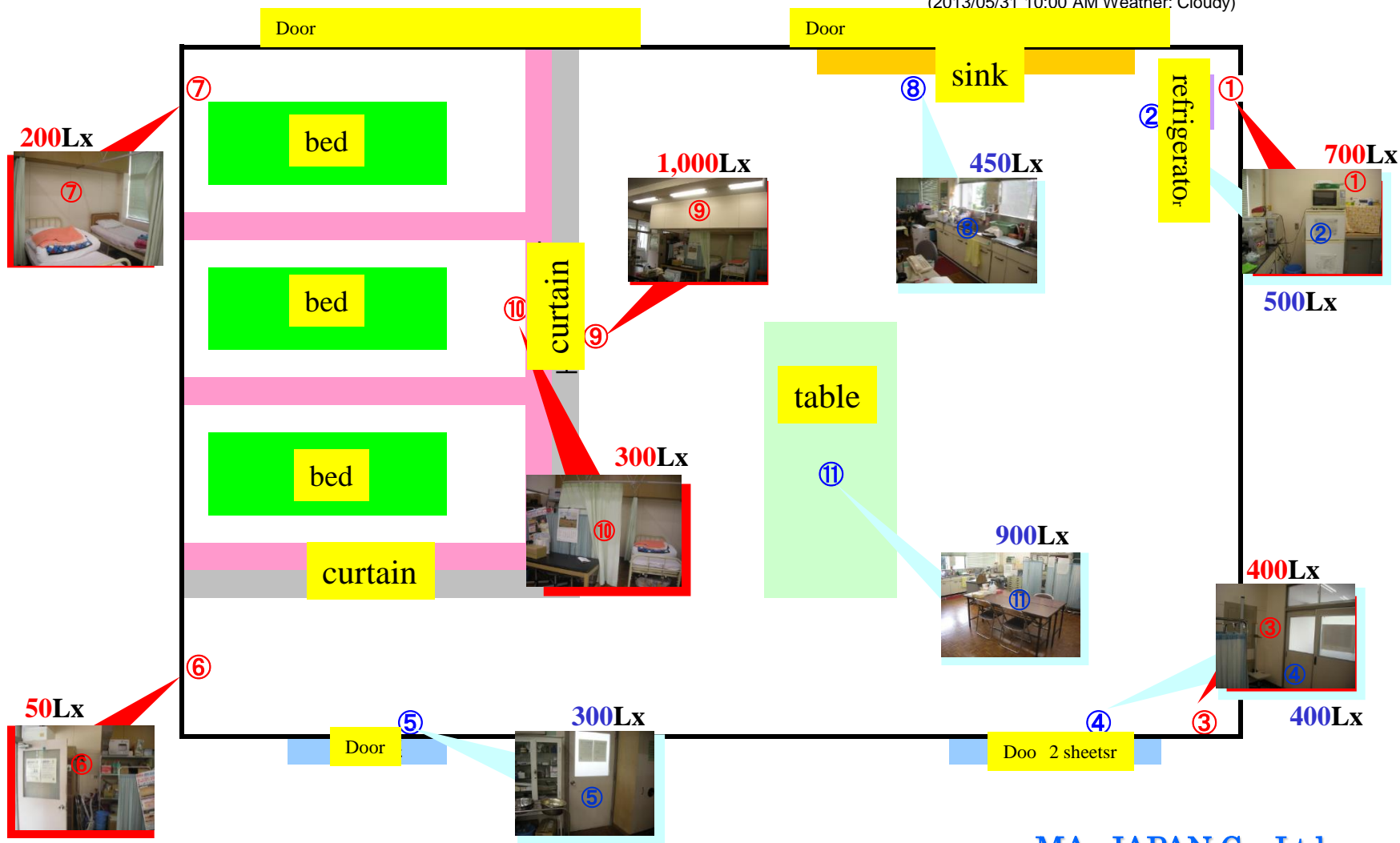
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Verification place outline figure ... Saga Prefectural Ureshino Senior High School Health Room

Red O part: Completed (①③⑥⑨⑩) Blue O part: Not constructed (②④⑤⑧⑪)

The numbers at the top and bottom of the photo indicate the site illumination (lux) at the time of verification.
(2013/05/31 10:00 AM Weather: Cloudy)



Measurement result table

No,	measured valu	Illuminance (Lx)	Explanation of verification location
①	51	700	Painted surface, smile light construction
②	3120	500	Refrigerator door painted surface
③	30	400	Painted surface, smile light construction
④	293	400	Entrance door, painted surface
⑤	473	300	Entrance door / painted surface (high frequency of use)
⑥	48	50	Painted surface, smile light construction
⑦	56	200	Painted surface, smile light construction
⑧	560	450	Sink door part painted surface
⑨	85	1,000	Painted surface, smile light construction
⑩	94	300	Curtain, smile light construction (not washed)
⑪	2317	900	Wooden table (high frequency of use)

<Measurement result>

Construction-In the non-construction part,
There was a clear difference in the measured values.

(Red: Construction section / Blue: Non-construction section)

* About measured value (management standard setting)
Less than 200 RLU for smooth (metal, glass etc.)
Irregular things and scratches
(Resin products, etc.) should not exceed 500 RLU.
<Example>
Cutting board: 500
Monkey bowl: 200
Kitchen knife: 200
Fingers: 1,500

Above, from measuring instrument manufacturer HP

* At the time of measurement: Blind closed, fluorescent light lit

* Measurement unit is RLU (Relative Light Unit relative luminescence amount)

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Smile light construction results



hospital



Nursing home



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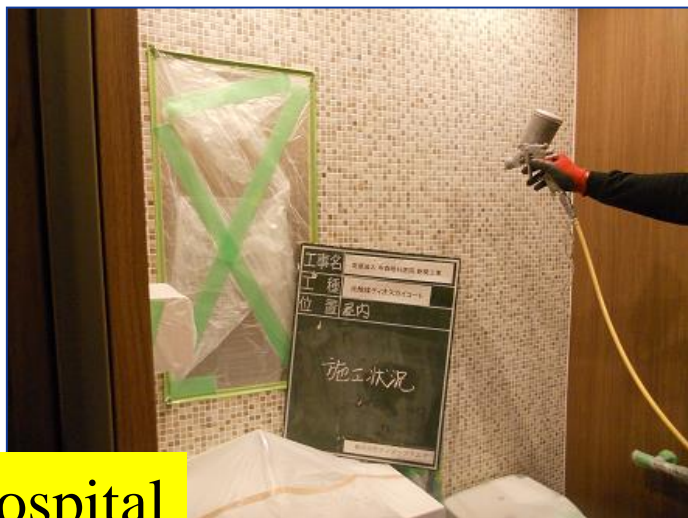
Smile light construction results



Nursing home



kindergarten



hospital



Nursing home

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"Smile Light" Cross processing (Cross material loading) Contract processing at our company



■ On-site application In the case of existing cross, painted surface, partition, tile, dipton etc

■ Advantages of cross processing for on-site application

1. Cost reduction
2. No need for installation period by field application