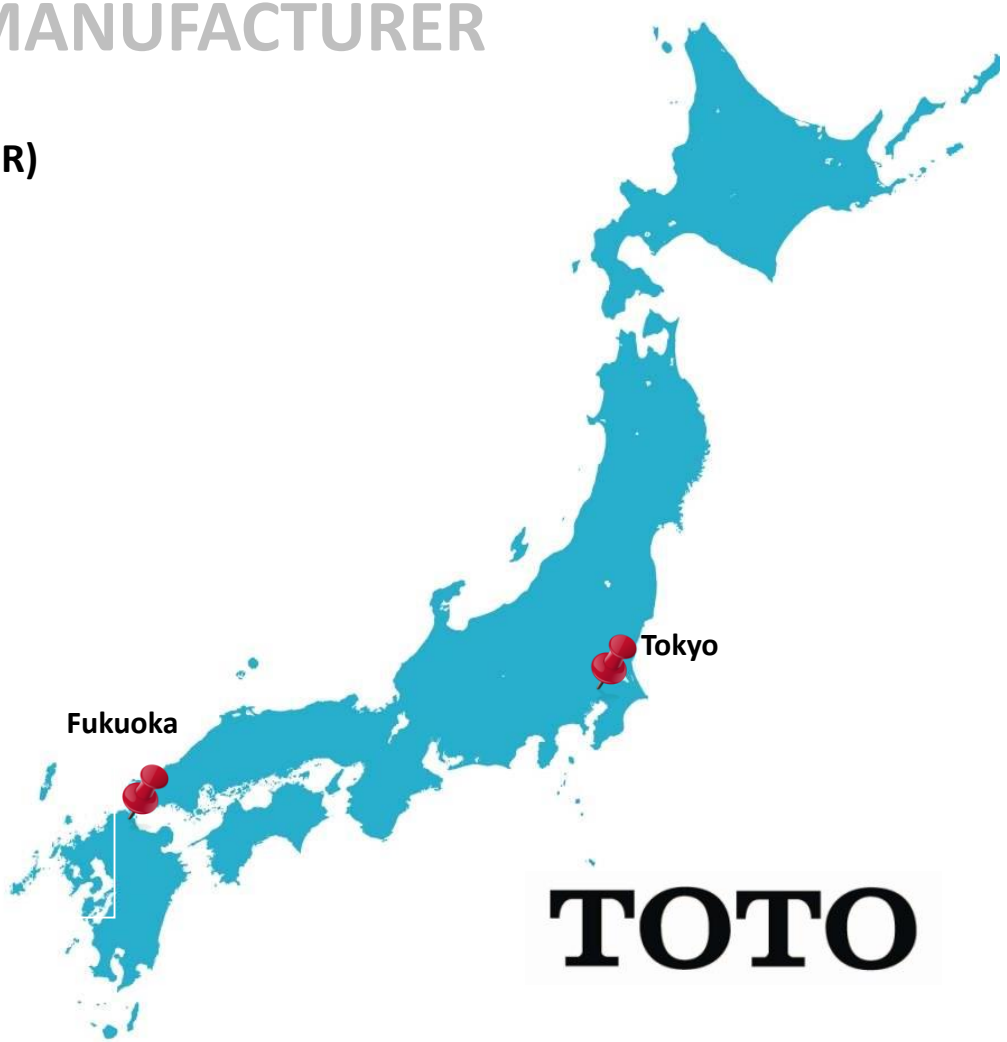

HYDROTECT
Laminam 2016
HYDROTECT

CONTENTS

A GLOBAL SANITARY WARE MANUFACTURER

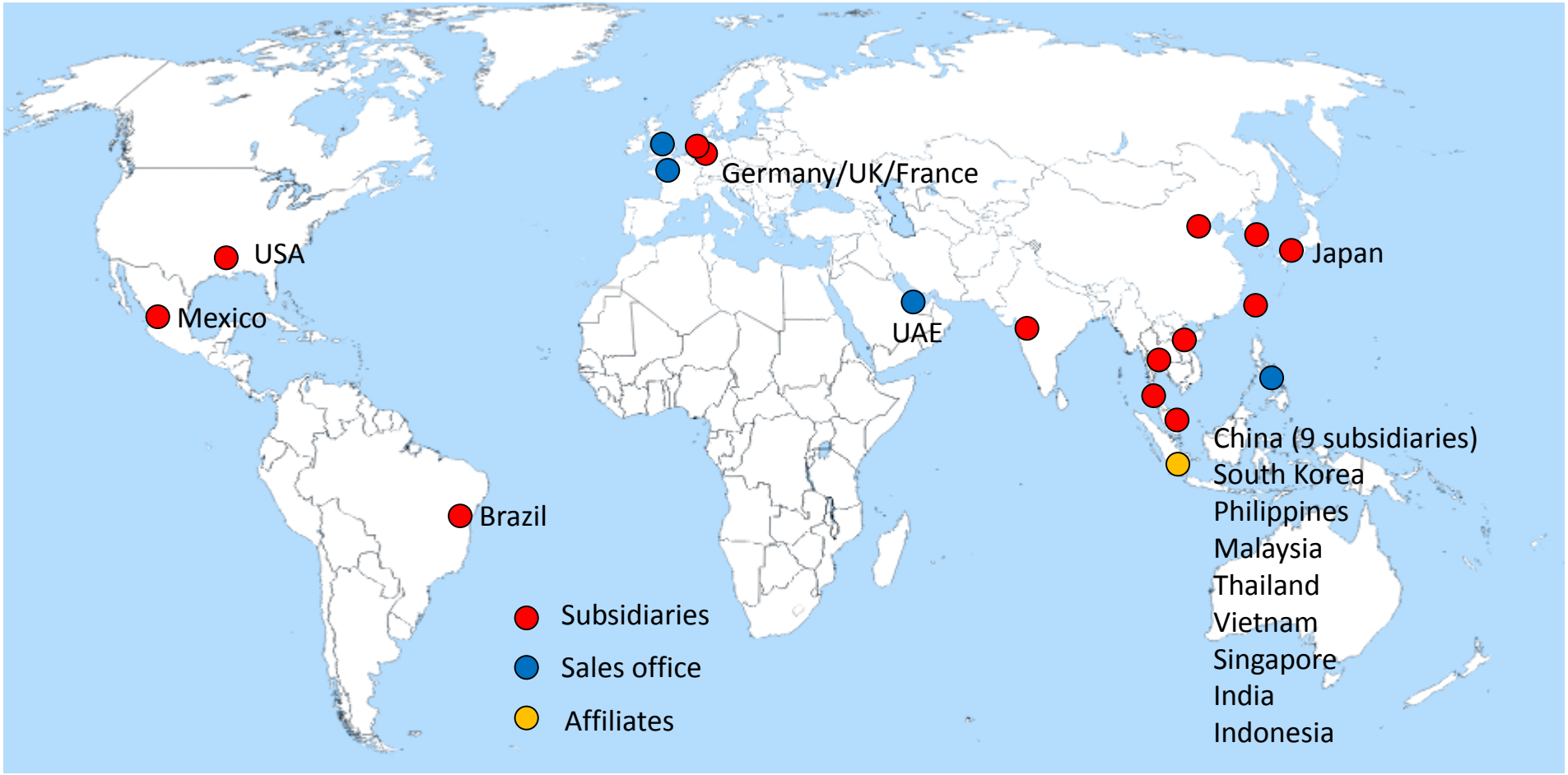
1. €3.9 Billion Revenue 2013 (1 JPY = 0.00705 EUR)
2. Founded 15th of May 1917
3. Head quarters - Fukuoka, JAPAN
4. 25,000 Employees
5. 1000 R&D Employee
6. No.1 Sanitary Ware company in Asia



TOTO




Photocatalysis & HYDROTECT



22 subsidiaries in 13 countries & 18 production bases in 14 countries

Photocatalysis & HYDROTECT

TOTO's Plumbing related products

NEOREST®

Bathtub

Faucet

Design restroom fixtures

Shower System

Wash basin

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Over the last 30 years, TOTO's innovations have led and revolutionized the Building/Plumbing and Green industries…

and the world!

World "Firsts" from TOTO

Tornado Flush

CeFiONtect

Rimless toilet bowl

ewater+

Actilight

WASHLET

CONTENTS

HYDROTECT: Catalyst TiO_2

Most important Crystalline Modifications of TiO_2

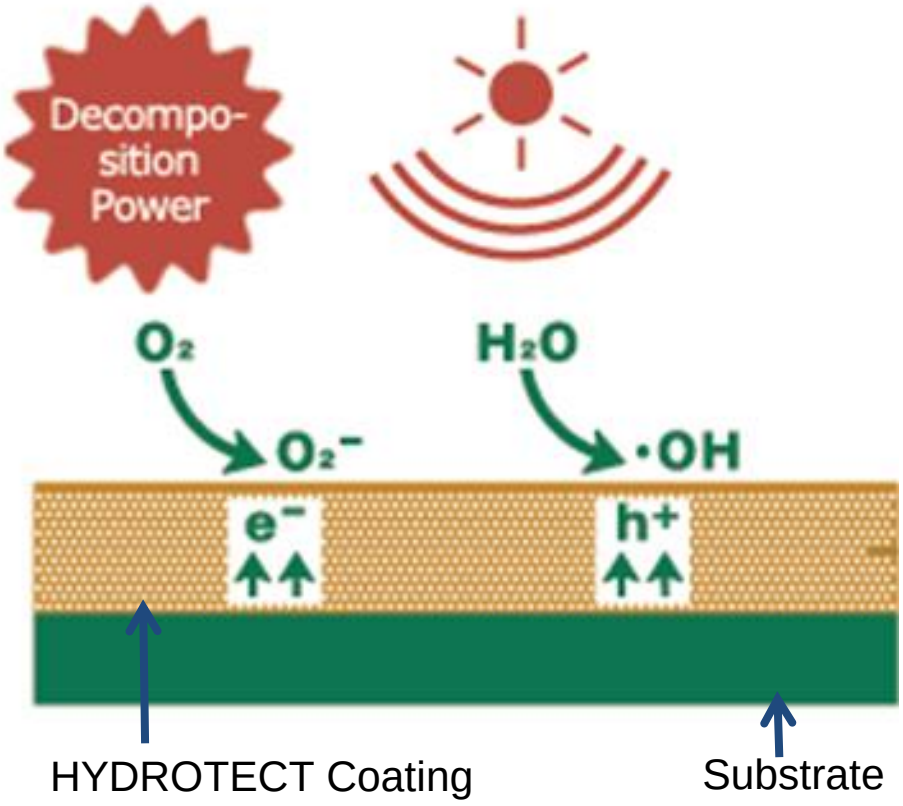
1.rutile:

not active, used as white Pigment or Filler in
→ Paints, Food, Tooth Paste, Cosmetics, Paper, etc.

2.anatase:

photo active → Photocatalyst

Benefit 1:
Degredation of Organic Materials



UV-B Light (e.g. Sun Light) on TiO_2

↓

Free Electrons e^- and Holes h^+

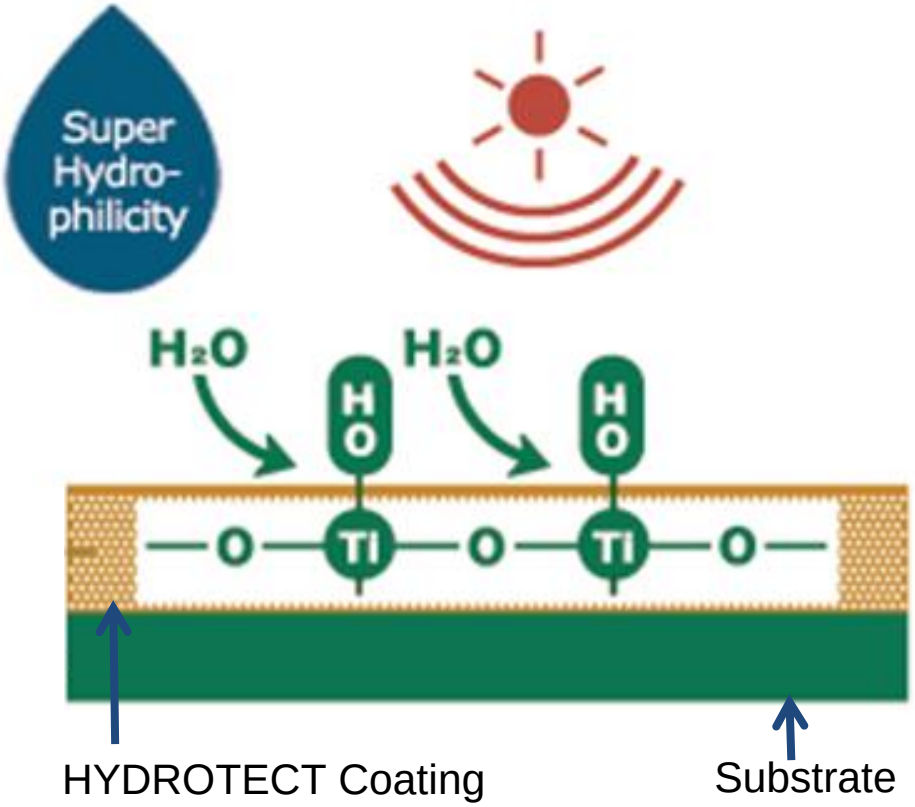
↓

Reaction:
Oxygen O_2 → activated Oxygen O_2^-
Water H_2O → Hydroxyle •OH

↓

Radicals O_2^- and •OH destroy organic Materials

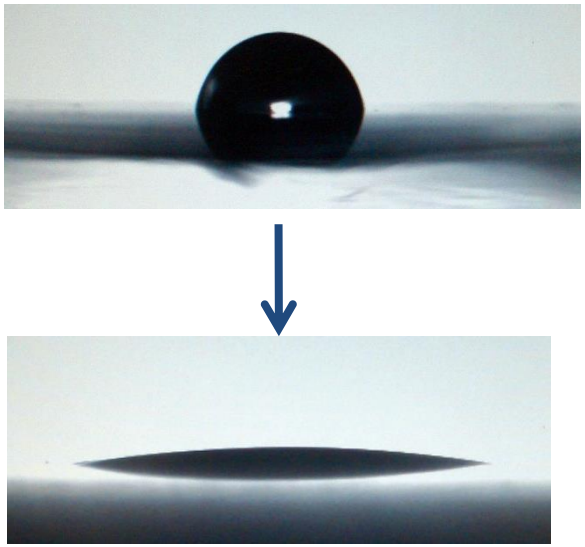
Benefit 2: Superhydrophilic Properties



Hydroxyle •OH bonds to Ti

↓

hydrophobic (water repellent)
Surface becomes superhydrophilic (water attractive)



HYDROTECT:
TOTO's patented Coating Technology

Mechanism:
TiO_2 as Photocatalyst → requires only Light, Water and Air

Superhydrophilic Properties + Decomposition of organic Materials =

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History

1967:

Akira Fujishima and Kenichi Honda (University of Tokyo) discovered active cleansing effect of TiO2 (photocatalytic decomposition)

-> Honda-Fujishima-Effect (Magazine *Nature*, 1972)

1990s:

TOTO together with University of Tokyo discovered the passive cleansing effect of TiO2 (hydrophilicity)

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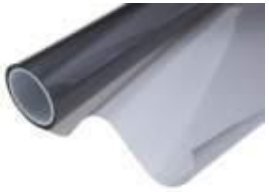
Glass

Ceramic Tile

Paint

Building Stone



Film

Panels

Membrane

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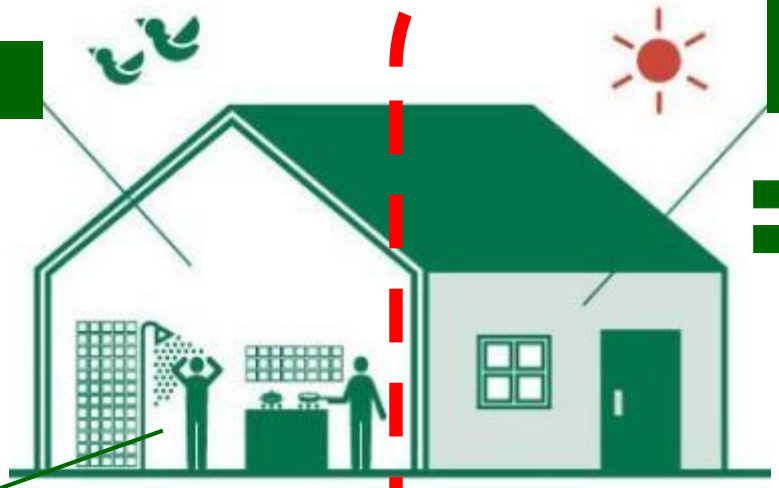
Functions

Interior

- Anti-Bacteria
- Anti-odor



Exterior

- Self-Cleaning
- NOx-Reduction (Air Purification)

Interior applications

Exterior applications

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Centre Pompidou
- Metz, France
- Shigeru Ban Architects Europe
- Makmax (Taiyo Europe GmbH)
- Architectural Membrane

Dallas Cowboy Stadium
- Dallas, USA
- Saint Gobain Performance Plastics
- Architectural membrane

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WORLD CUP 2014 in BRAZIL

Estádio Nacional de Brasilia (41,000sqm)
-Brasilia, Brazil
-Makmax(Taiyo Kogyo GmbH)
-Architectural membrane

Estádio Mineiraço (13,000sqm)
-Belo Horizonte, Brazil
-Makmax (Taiyo Kogyo GmbH)
-Architectural membrane

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WINTER OLYMPIC 2014 in SOCHI

Olympic Cauldron 2014

- Sochi, Russia
- Alcoa
- Aluminum composite panel

Iceberg (Apartment complex)

- Aarhus, Denmark
- Alcoa
- Aluminum composite panel

Best Residential Development at the 2013 MIPIM

CONTENTS

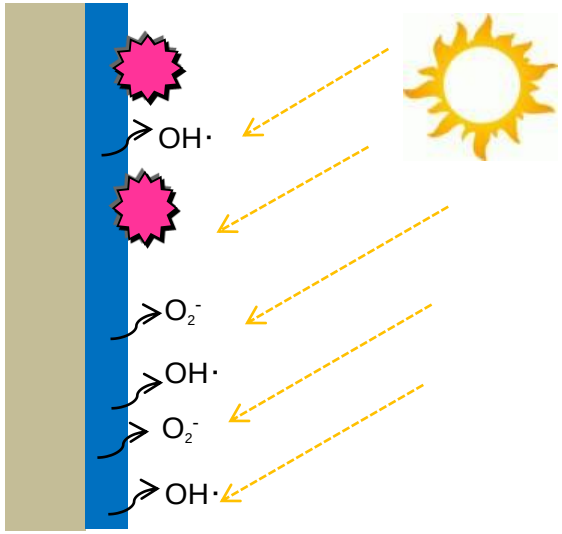
Self Cleaning:

Stains on façade are decomposed and washed away automatically by natural resources.

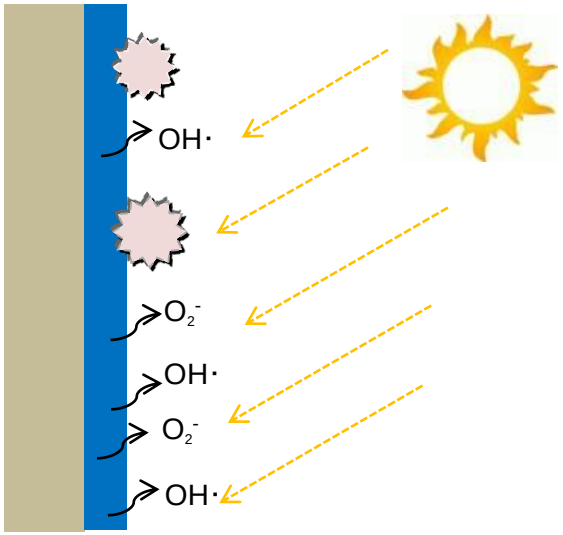
Hydrotect helps to keep original fresh appearance.

MECHANISM OF SELF-CLEANING

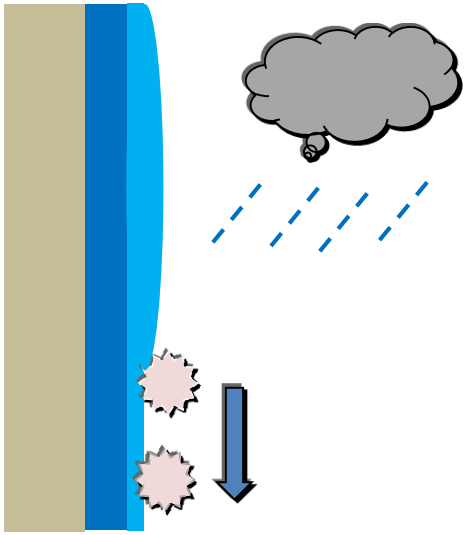
Super-hydrophilicity + **Decomposition of organic substances**



When sunlight (UV light) is irradiated onto Hydrotect surface, activated oxygen generates.



Activated oxygen decomposes grease and dirt into less adhesive substance.



When it rains, thin water layer is formed on Hydrotect surface, then less adhesive substance floats on the layer and is washed away automatically by rainwater.

4.4 Effective and NOT effective (self-cleaning)

Organic stain 1

Oil stain, dust, soot and exhaust gas

Effective

Organic stain 2

Silicone sealant, graffiti, paint, beehive, droppings and spider web

Difficult to remove completely

Non-organic stain

Rust, efflorescence, iridescence

NOT effective

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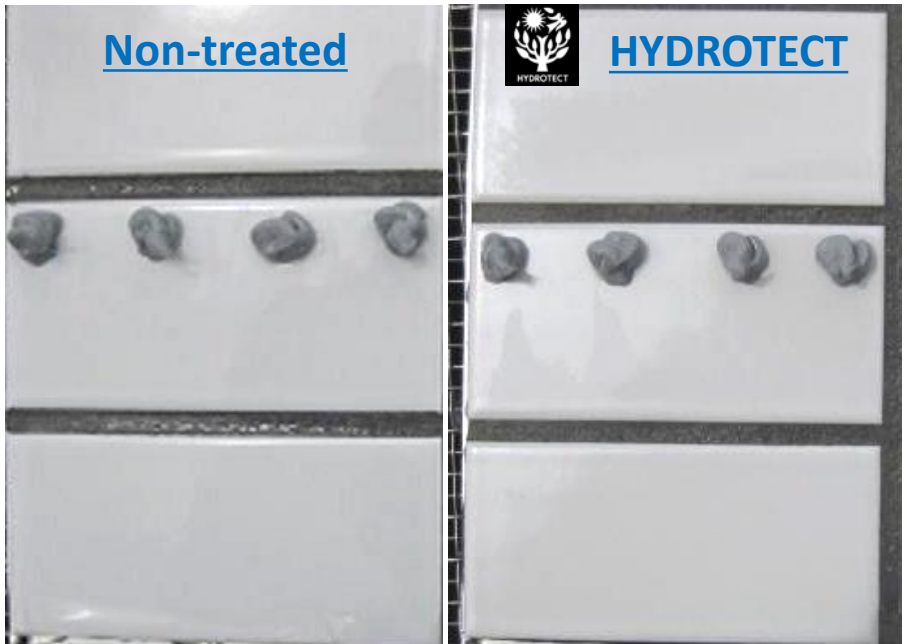
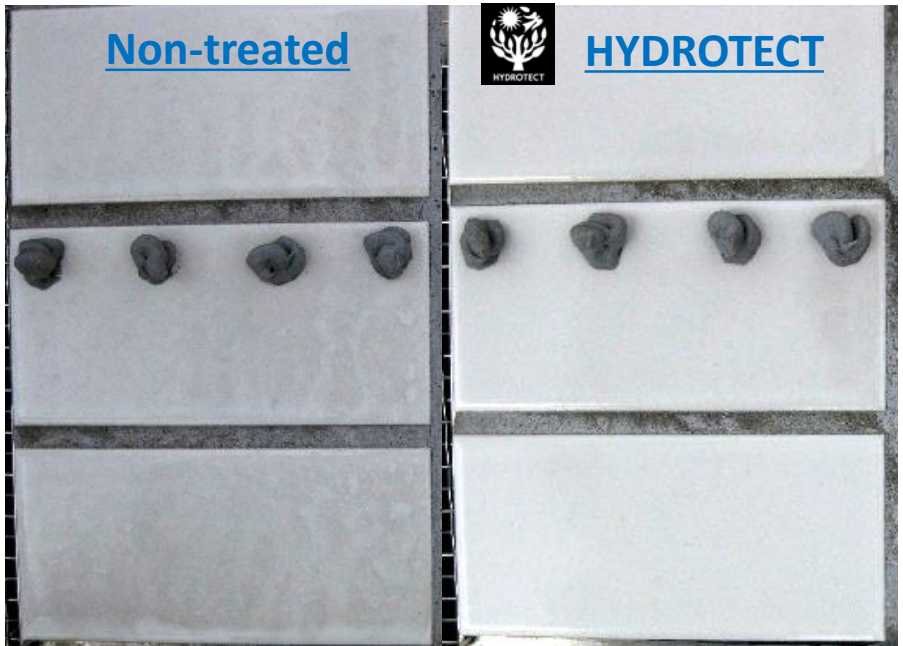
At the rooftop of the commercial building in Osaka (population = more than 2 million), Japan

Initial

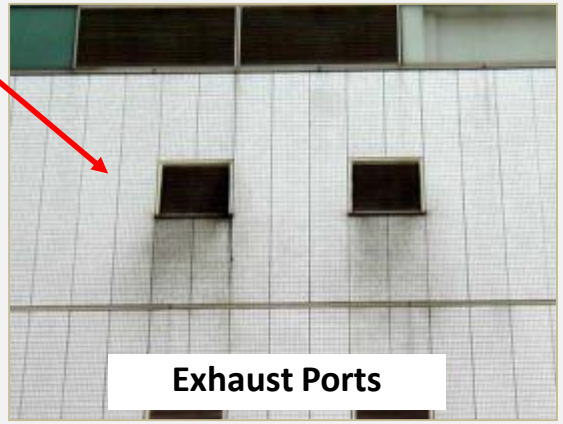
6months passed





PERFORMANCE

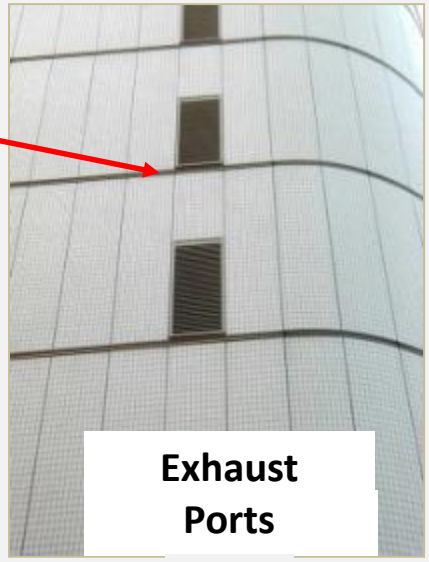
Non-treated



PERFORMANCE

Treated

Spandrel Areas



Exhaust Ports

CERTIFICATION of Self-Cleaning

Certified by Photocatalysis Industry Association of Japan

PIAJ 光触媒工業会
登録：2009－0016
空気浄化(窒素酸化物)
セルフクリーニング

ISO 27448 (JIS R1703-1*)

a) HYDROTECT's performance of Hydrophilicity;
Water Contact Angle: 5 -10 degrees
b) Qualification by PIAJ
Water Contact Angle to be 30 degrees or less

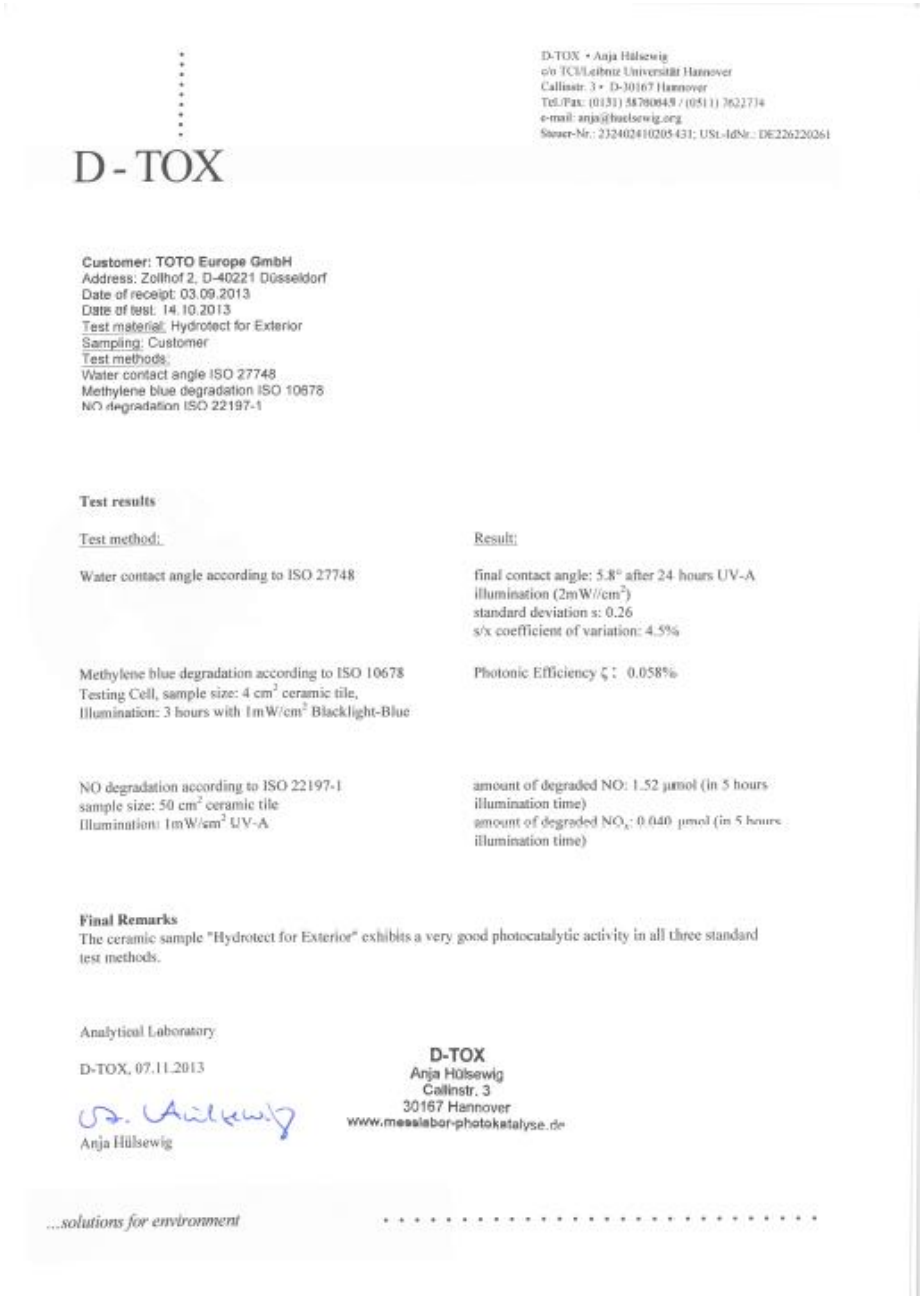
ISO 10678 (JIS R1703-2*)

a) HYDROTECT's performance of Decomposition;
Decomposition of wet methylene blue (Degradation rate): 14.7 (EWHPPA)

b) Qualification by PIAJ
Degradation to be 5 or more

***Test protocol to evaluate self-cleaning performance of photocatalytic products**
JIS R1703-1: Apply olein acid onto tile surface. Regulatively irradiate UV to tile and measure water contact angle.
JIS R1703-2: Contact dye solution to tile surface. Irradiate UV for regulated time and measure color value of the dye.

Photocatalysis & HYDROTECT



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D - TOX

Customer: TOTO Europe GmbH
Address: Zollhof 2, D-40221 Düsseldorf
Date of receipt: 03.09.2013
Date of test: 14.10.2013
Test material: Hydrotect for Exterior
Sampling: Customer
Test methods:
Water contact angle ISO 27748
Methylene blue degradation ISO 10678
NO degradation ISO 22197-1

Test results

Test method:	Result:
Water contact angle according to ISO 27748	final contact angle: 5.8° after 24 hours UV-A illumination ($2mW/cm^2$) standard deviation s: 0.26 s/x coefficient of variation: 4.5%
Methylene blue degradation according to ISO 10678 Testing Cell, sample size: 4 cm^2 ceramic tile, Illumination: 3 hours with $1mW/cm^2$ Blacklight-Blue	Photonic Efficiency ζ : 0.058%
NO degradation according to ISO 22197-1 sample size: 50 cm^2 ceramic tile Illumination: $1mW/cm^2$ UV-A	amount of degraded NO: 1.52 µmol (in 5 hours illumination time) amount of degraded NO_x: 0.040 µmol (in 5 hours illumination time)

Final Remarks
The ceramic sample "Hydrotect for Exterior" exhibits a very good photocatalytic activity in all three standard test methods.

Analytical Laboratory

D-TOX, 07.11.2013

Anja Hülsewig

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...solutions for environment

Final remarks from D-TOX

Clearly, HYDROTECT exhibits the best photocatalytic activity overall. All other samples tested here do not show any really significant photocatalytic activities

Hannover, 07.11.2013

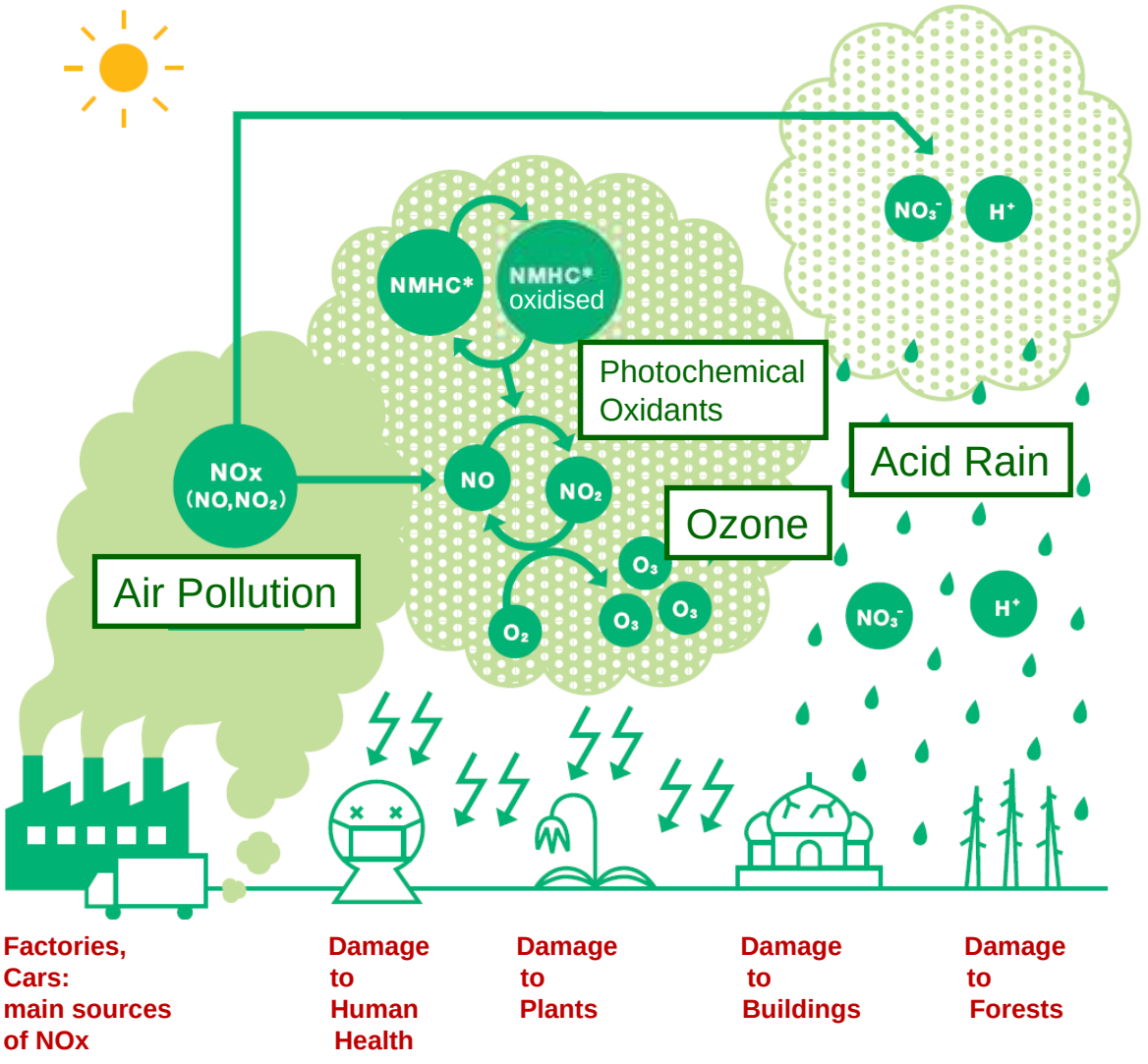
Anja Hülsewig

TOTO Europe GmbH

CONTENTS

DAMAGE OF NOx TO ENVIRONMENT

Damage to Environment by Nitrogen Oxides NOx (NO and NO_2)



* Non-Methane Hydro Carbon

DAMAGE OF NOx TO ENVIRONMENT

Main Sources of NOx:

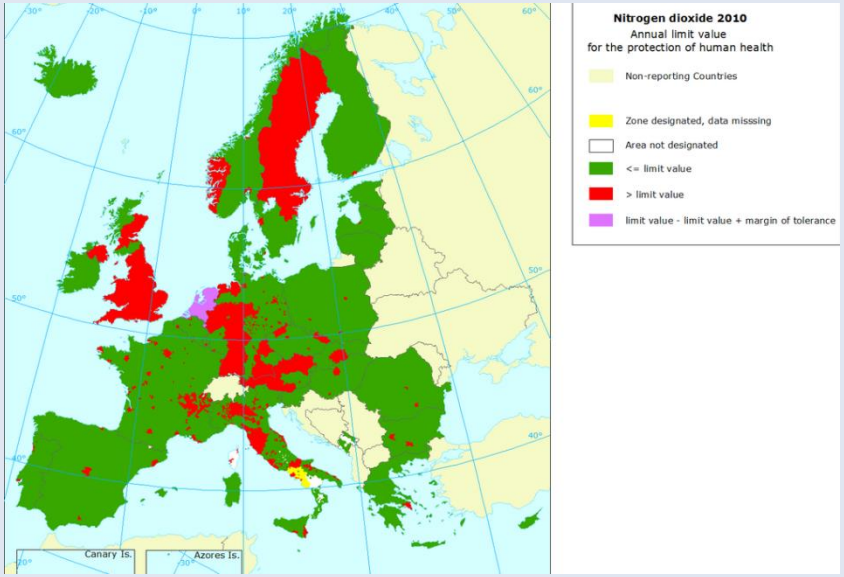
Diesel Trucks and Plants

European Regulation concerning NOx-Emmission
2008/50/EC:

- In Force since January 1st 2010:
  - 1-h-Value 200 µg/m3
  - Mean Value per Year 40 µg/m3

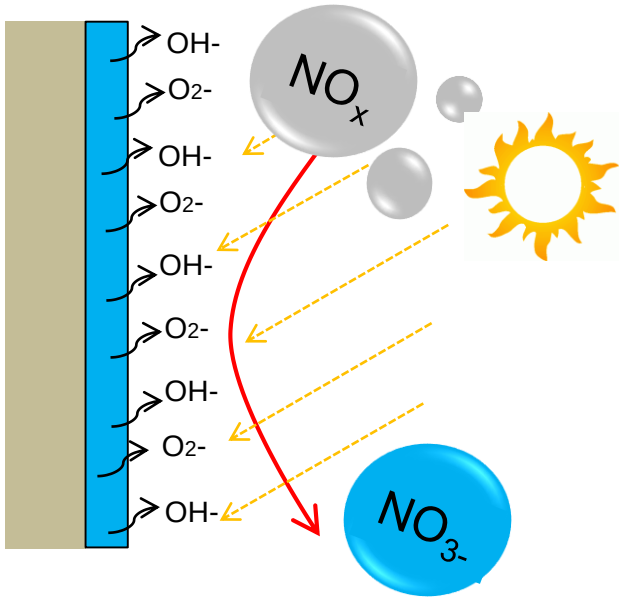
- Final Deadline of Regulation:

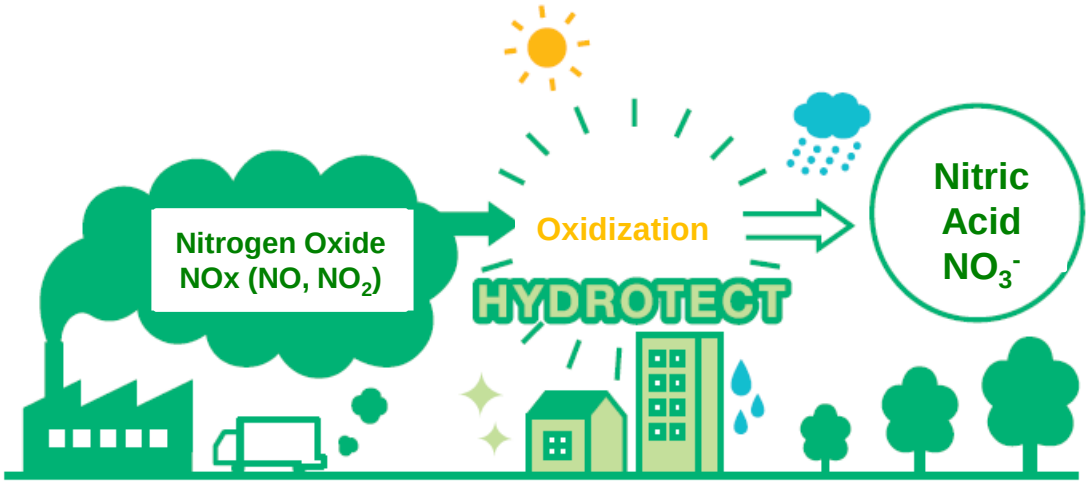
January 1st 2015



Photocatalysis & HYDROTECT

MECHANISM





Activated oxygen generated from HYDROTECT coated façade oxidizes NOx to non-harmful substance (NO_3-).

*NO3- is removed by rainwater in the atmosphere. NO3- oxidized by photocatalytic reaction does NOT influence acidification of soil due to its small quantity. Finally total balance does not change!

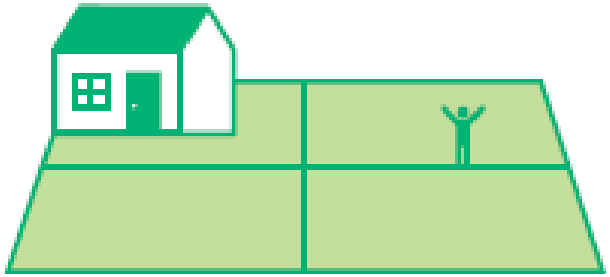
Photocatalysis & HYDROTECT

Air Purification (NOx reduction)

■Benefit of Air Purification

One HYDROTECT coated house (approx. 150m²)

=



Purifies the same amount of air as a forested area size of three Tennis Courts

=

Purifies NOx emitted from 11 cars*

*Current brand new cars, running 30 km/day

(NOx-Reduction: 0.026g/m2 per day, EW09)

CERTIFICATION of Air purification

Certified by Photocatalysis Industry Association of Japan

ISO 22197 (JIS R1701)
EXTERIOR TILE

Qualification by PIAJ
0.5 micro mol or more to decompose

Performance of HYDROTECT Exterior Tile: 1.25 micro mol (EWHPPA)

Photocatalysis & HYDROTECT

EMATEC *Environmental Management and Technology Center*
2-9-10, Kawaguchi, Nishi-ku, Osaka 550-0021, JAPAN

Client: TOTO MATERIA LTD.
Address:304-701,Oroshicho,Toki-city,Gifu-Pref,JAPAN

SUBJECT: Fine ceramics (advanced ceramics, advanced technical ceramics)-Test method for air purification performance of photocatalytic materials-Part1:Removal of nitric oxide

May 10, 2010

INTRODUCTION:
This report refered to results of the test based on Fine ceramics (advanced ceramics, advanced technical ceramics)-Test method for air purification performance of photocatalytic materials-Part1:Removal of nitric oxide (JIS R 1701-1).

Test Number	100450018	Description of the test piece	
Manufacturing company	TOTO MATERIA LTD.	Tile (width 49.3mm, length 99.2mm, thickness 4.5mm)	
Material Number	Hydrotect tile		
Reception Date	April 22, 2010		
Date of Removal test	April 28, 2010 (Tested by: Mr. Uehara) Temperature: 24.0°C Relative humidity: 35%	Date of Elution test	May 7, 2010 (Tested by: Mr. Hayano)

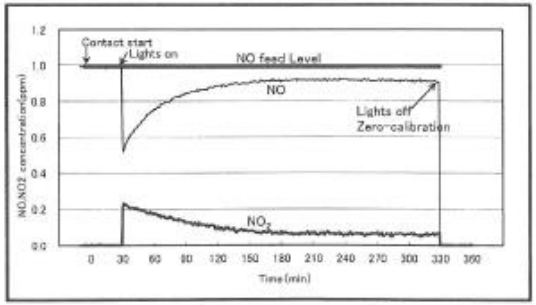
Testing Conditions

Supply Gas Concentration of NO:	0.995ppm	Relative Humidity:	50%	UV irradiance:	10W/m²	Temperature:	25°C	Flow rate:	3.00L/min

Results of the test

NOx absorbed (μ mol)	NO removed (μ mol)	NO_2 formed (μ mol)	NOx desorbed (μ mol)	NOx removed (μ mol)	Nitrogen eluted (μ mol)	Fractional recovery of nitrogen (%)
0.00	5.05	3.79	0.01	1.25	0.72	57.50

Any other matters of special importance, such as a change in the test piece noticed during the test.	



Description of testing equipment

Device name	Model number	Measurement range	Device name	Model number	Measurement range
Standard NO gas	NO Standard Gas JCSS Class 2	(±2%)	Light source	FL20SBL	—
			Hygrotransmitter	TMS-40D	5~98% (±2.5%RH) -40~+60°C (±0.2°C)
Zero Gas Generator	PG-125	0~10L/min	Photoreactor	—	produced by aluminum (Alumite treatment)
Automatic Calibrator	AFC-125	1/400~1/10000 (±2% of Calibration gas concentration)	UV Power Meter	05806-01,H8958	310~380nm
			Nitrogen Oxides Analyzer	NA-62G	0~2ppm(±2%)
Heating and Cooling System	CL-80R	—	Mass Flow Controller	M-1701	0~5.00L/min (Within ±2%FS)
	DGC1150	—			

Protocol JIS R1701 (ISO 22197-1)
Issued by “Environmental Management and Technology Center” (Japan)

D-TOX

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D-TOX, 07.11.2013

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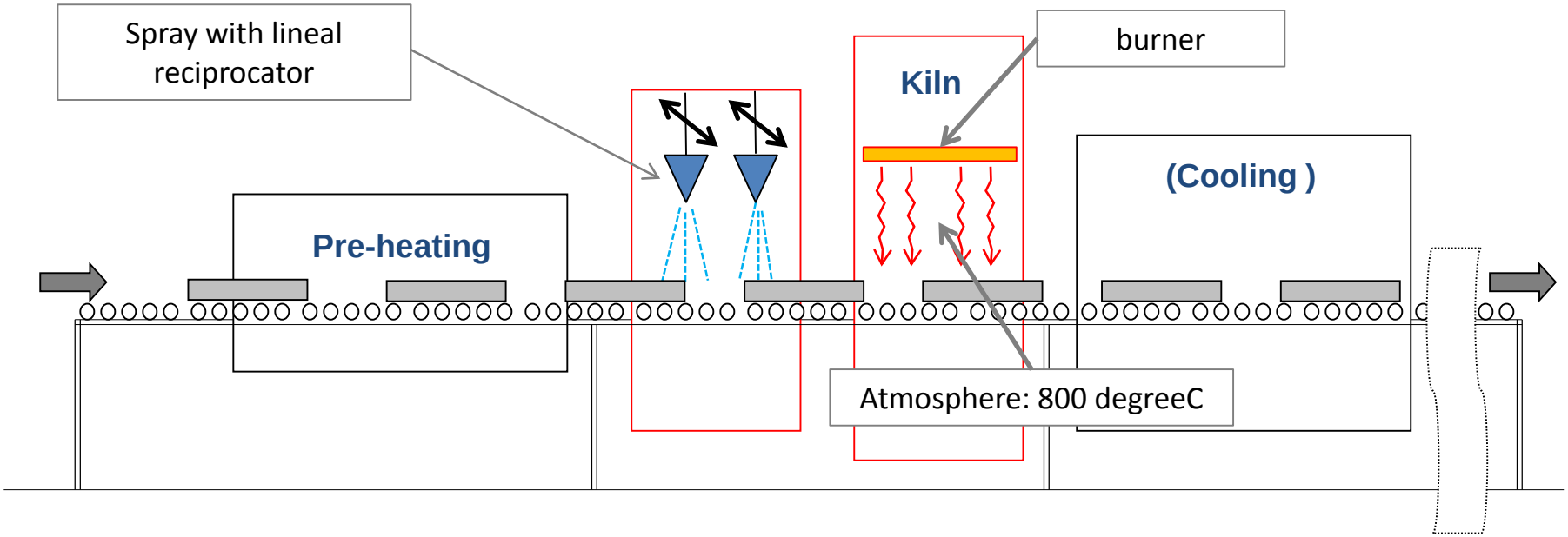
Protocols ISO 22197-1, 27748, 10678
Issued by “D-TOX”, Hannover:

The ceramic sample “Hydrotect for Exterior” exhibits a very good photocatalytic activity in all three standard test methods.

CONTENTS

Process of HYDROTECT Application



-Hydrotect raw material is water-base coating liquid including TiO_2.
-Apply coating liquid on tiles by spray.
-Bake tiles under 800 Celsius degrees.

Silicone issues

Avoid using conventional silicone sealant as movement joint, grout and wet glazing to other construction members.

Conventional silicone sealant: composed of silicone oil (siloxane) which easily migrates and is more difficult to be decomposed.

Solution: Use modified Silicone

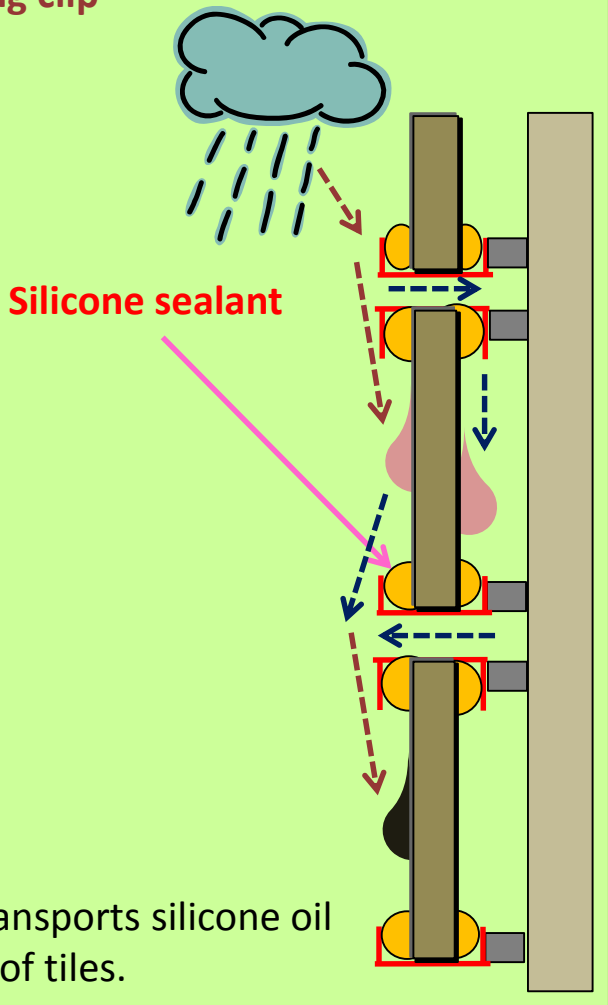
Field test conducted in Japan

Modified Silicone

Example of silicone issues

Use silicone sealant as wet glazing to other members

Use silicone sealant to fill the gap between tile and fixing clip



Rainwater transports silicone oil to front side of tiles.

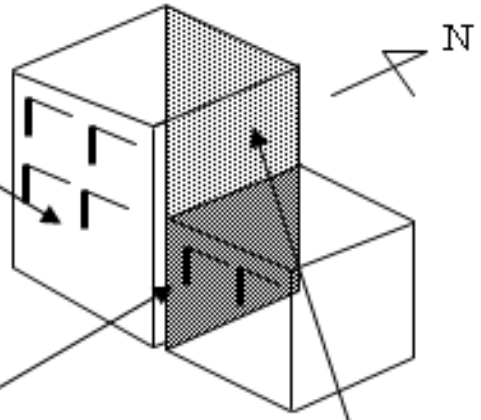
4.3 Direction and exposure to rain

Photocatalyst is activated under UV irradiation for more than 0.1mW/cm^2 .

Cloudy day
50% - 80% of sunny day

Rainy day
20% - 30% of sunny day

Southern side
More than 1.0 mW/cm^2



Between buildings*
Less than 0.4 mW/cm^2

Northern side
Less than 0.7mW/cm^2

*At least, 1 meter of gap is necessary.

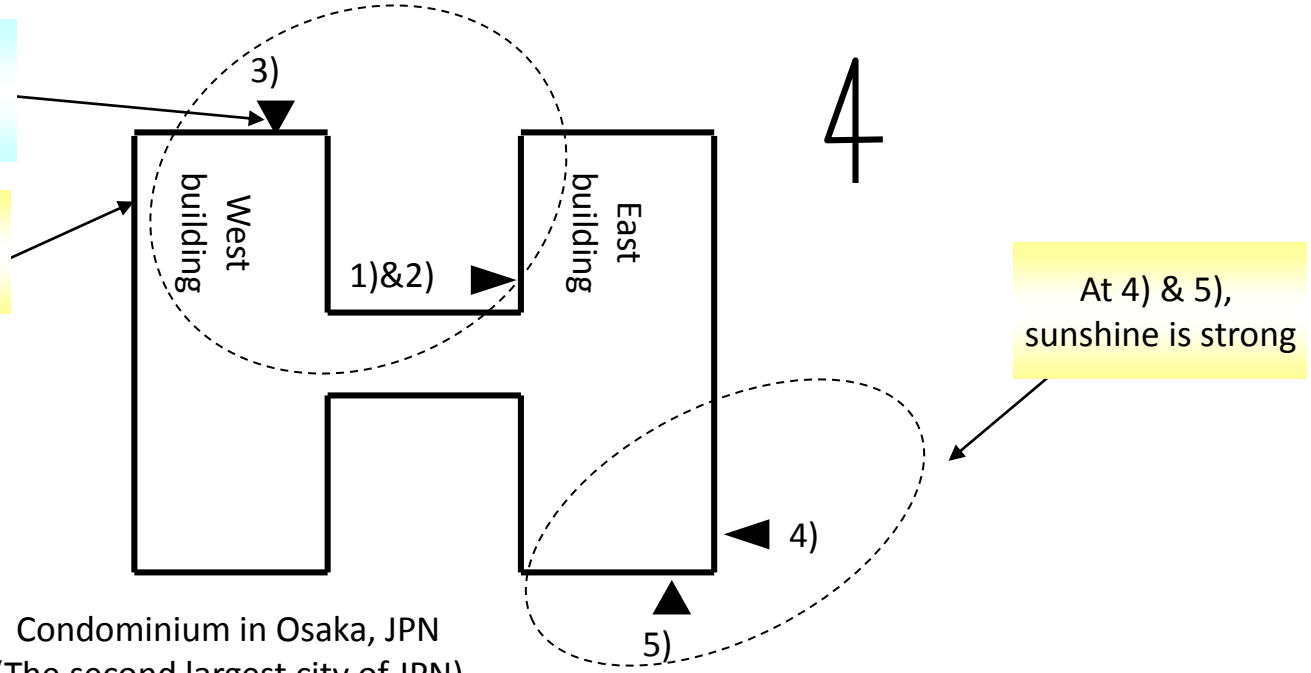
4.3 Direction and exposure to rain

Check self-cleaning performance of each point

	Direction (sunshine)	Exposure to rainwater	Contaminated water from drainer
1)	West side (weak)	Good	Yes
2)	West side (weak)	Good	No
3)	North side (weak)	Not much	No
4)	East side (strong)	Good	Yes
5)	South side (strong)	Good	No

3)
Not exposed to rainwater due to stairs

At 1), 2), 3),
sunshine is weak



Condominium in Osaka, JPN
(The second largest city of JPN)

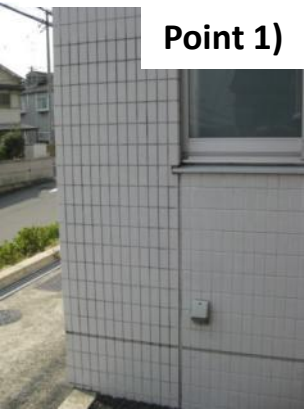
4.3 Direction and exposure to rain

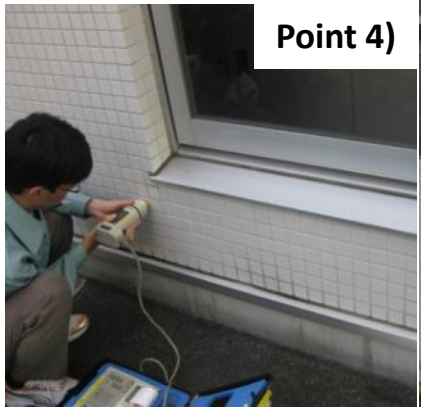
Results

	Direction (sunshine)	Exposure to rainwater	Contaminated water from drainer	Water contact angle (7 years passed)	Water contact angle (10 years passed)
1)	West side (weak)	Good	Yes	< 15 degrees	< 15 degrees
2)	West side (weak)	Good	No	< 15 degrees	< 15 degrees
3)	North side (weak)	Not much	No	20 -25 degrees	40 – 50 degrees
4)	East side (strong)	Good	Yes	< 15 degrees	< 15 degrees
5)	South side (strong)	Good	No	< 15 degrees	< 15 degrees

→ **Less self-cleaning performance without rain.**

Photos: 10 years passed since installation



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Thank you!