

TESTBERICHTE



PRODUCT PERFORMANCE TESTING LABORATORY
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 Email testing@tcnatile.com Web www.TCNAtile.com

TCNA TEST REPORT NUMBER: TCNA-0002-21 **PAGE:** 1 OF 4

TEST REQUESTED BY: Italcer
 Attn: Elena Vandelli
 Via Emilia Ovest 53/a
 Rubiera, 42048
 ITALY

TEST SUBJECT MATERIAL: Identified by client as: **“Product name: Gold - Royal Stone collection - Italcer Group”**

TEST DATE: 10/21/2020 - 1/8/2021

TEST PROCEDURE:
 ISO 18061:2014(E): *Fine Ceramics (Advanced Ceramics, Advanced Technical Ceramics) — Determination of antiviral activity of semiconducting photocatalytic materials.*
 Test method was modified to test with Human Coronavirus 229E.

TEST VIRUSES AND CELL LINES:

Virus	Cell line
Human Coronavirus 229E ATCC VR-740	MRC-5 ATCC CCL-171

ASTM Guidance on SARS-CoV-2 Surrogate Selection:

Surrogates of SARS-CoV-2 used in this testing are Human Coronavirus 229E and OC43. Surrogates were selected based on guidance provided by ASTM E35 Committee for Pesticides, Antimicrobials, and Alternative Control Agents. Further information on surrogate selection guidance provided by ASTM can be found here – https://www.astm.org/COMMIT/GuidanceCOVID19SurrogateSel_April242020press.pdf

TEST CONDITIONS:

Test sample size: 50 mm x 50 mm
 Volume of test suspension applied on test sample: 0.15 mL
 Infectivity titer of virus: 10⁶ TCID₅₀/mL
 Exposure conditions: UV irradiation and Dark conditions
 Exposure time: 30 minutes to 8 hours
 Environmental conditions for UV exposure: Temperature at 25°C ± 1
 RH ≥ 90%
 UV exposure intensity: 0.25 mW/cm²
 UV lamp: Interlight F40 T10/BLB 130V 40W
 UV light radiometer: Mannix UV340

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TCNA TEST REPORT NUMBER: TCNA-0002-21 PAGE: 2 OF 4

Test Results: Results of UV irradiation test performed on “Gold - Royal Stone collection - Italcser Group”

ISO 18061 using Human Coronavirus 229E on Gold - Royal Stone collection - Italcser Group					
Sample	Infectivity Titer	Exposure Conditions	Exposure Time	Reduction under UV exposure on non-treated*	Reduction under UV exposure on Gold - Royal Stone collection - Italcser Group *
“Gold - Royal Stone collection - Italcser Group”	10 ⁶ TCID ₅₀ /mL	UV Irradiation at 0.25 mW/cm ²	15 minutes	No reduction	90%
			30 minutes	No reduction	90%
			1 hour	No reduction	90%
			2 hours	No reduction	90%
			3 hours	No reduction	90%
			4 hours	No reduction	96%
			6 hours	No reduction	100%
			8 hours	No reduction	100%

* Reduction calculated as percentage per the initial infectivity titer inoculated on the surface of the tile sample



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Test Results: Results of Dark condition test performed on “Gold - Royal Stone collection - Italcser Group”

ISO 18061 using Human Coronavirus 229E on Gold - Royal Stone collection - Italcser Group					
Sample	Infectivity Titer	Exposure Conditions	Exposure Time	Reduction under Dark conditions on non-treated*	Reduction under Dark conditions on Gold - Royal Stone collection - Italcser Group *
“Gold - Royal Stone collection - Italcser Group”	10 ⁶ TCID ₅₀ /mL	Dark (no UV light)	15 minutes	No reduction	No reduction
			30 minutes	No reduction	90%
			1 hour	No reduction	90%
			2 hours	No reduction	90%
			3 hours	No reduction	90%
			4 hours	No reduction	90%
			6 hours	No reduction	93%
			8 hours	No reduction	99%

* Reduction calculated as percentage per the initial infectivity titer inoculated on the surface of the tile sample



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1/13/2021

Dr. Jyothi Rangineni
 Research Scientist

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TCNA TEST REPORT NUMBER: TCNA-0492-20 PAGE: 1 OF 3

TEST REQUESTED BY: Italcer
 Attn: Elena Vandelli
 Via Emilia Ovest 53/a
 Rubiera, 42048
 ITALY

TEST SUBJECT MATERIAL: Identified by client as: "B, B3"

TEST DATE: 8/27/2020 - 9/30/2020

TEST PROCEDURE:
 ISO 27447:2019(E): Test method for antibacterial activity of semiconducting photocatalytic materials – E. coli and S. aureus.

TEST CONDITIONS:
 Test sample size: 50 mm x 50 mm
 Test bacteria: E. coli ATCC 8739
 S. aureus ATCC 6538P

Volume of test suspension applied on test sample: 0.15 mL
 UV exposure intensity: 0.25 mW/cm² and 1 mW/cm²
 UV exposure time: 8 hours
 Environmental conditions for UV exposure: Temperature at 25°C ± 1
 RH ≥ 90%
 UV lamp: Interlight F40 T10/BLB 130V 40W
 UV light radiometer: Mannix UV340

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TCNA TEST REPORT NUMBER: TCNA-0492-20 PAGE: 2 OF 3

Test Results: Results of testing performed on sample "B" UV irradiation

Sample	Bacteria	Inoculum cfu/ml	Test number	Percentage Reduction UV 0.25 mW/cm ² *	Percentage Reduction UV 1 mW/cm ² *	Percentage Reduction Dark*
"B"	E. coli	10 ⁶	Test 1	96.4%	100%	93.4%
			Test 2	95.0%	100%	95.7%
			Test 3	95.9%	100%	95.9%
	S. aureus	10 ⁶	Test 1	100%	100%	96.7%
			Test 2	99.9%	100%	95.5%
			Test 3	100%	100%	97.2%

* Reduction in bacteria calculated per the initial number of bacteria inoculated on the surface of the bacteria

Test Results: Results of testing performed on sample "B3" UV irradiation

Sample	Bacteria	Inoculum cfu/ml	Test number	Percentage Reduction UV 0.25 mW/cm ² *	Percentage Reduction UV 1 mW/cm ² *	Percentage Reduction Dark*
"B3"	E. coli	10 ⁶	Test 1	90.8%	100%	92.8.4%
	S. aureus	10 ⁶	Test 1	99.1%	100%	94.9%

* Reduction in bacteria calculated per the initial number of bacteria inoculated on the surface of the bacteria



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10/15/2020

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in collaborazione con Prof. Pier Giorgio Balboni
incarico di insegnamento come cultore della materia
"Microbiologia" dell'Università di Ferrara

Rapporto di Prova / Test report N. 002/Cfr AV2020

Data/ Date: 10/09/2020

Revisione 1 / Updated 1: 30/11/2020

Revisione 2 / Updated 2: 30/11/2020

ISO 27447:2019 (E)

Measurement of antibacterial activity on plastics and other non-porous surfaces

Committente / Customer: GRUPPO ITALCER Via Emilia Ovest 53/A 42048 Rubiera (Reggio Emilia)

Campione/ Sample: Serie Advance, linea Royal Stone – Gold. /
Advance series, Royal Stone - Gold line.

Introduzione / Introduction

ISO 27447:2019. Fine ceramics (advanced ceramics, advanced technical ceramics) – Test method for antibacterial activity of semiconducting photocatalytic materials.

La norma specifica un metodo di prova è generalmente applicabile ai materiali fotocatalitici e a prodotti con effetto antibatterico. La tipologia di materiali può essere di diversa caratteristica, ad esempio materiali utilizzati nei materiali da costruzione, quali ceramici fotocatalitici o semiconduttori in lamiera piana, cartone, a forma di lastra o tessuti che sono le forme di base dei materiali per varie applicazioni.

The standard specifies a test method is generally applicable to photocatalytic materials and products with an antibacterial effect. The type of materials can be of different characteristics, for example materials used in building materials, such as photocatalytic ceramics or semiconductors in flat sheet, cardboard, sheet shape or fabrics which are the basic shapes of materials for various applications.

Sommario: / Abstract:

Questa norma internazionale specifica un metodo di prova per la determinazione dell'attività antibatterica di materiali che contengono un fotocatalizzatore o hanno pellicole fotocatalitiche sulla superficie, misurando il conteggio dei batteri sotto l'irradiazione della luce ultravioletta.

This International Standard specifies a test method for the determination of the antibacterial activity of materials that contain a photocatalyst or have photocatalytic films on the surface, by measuring the enumeration of bacteria under irradiation of ultraviolet light.



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Termini e Definizioni / Terms and Definitions

Fotocatalizzatore

sostanza che svolge molte funzioni basate su reazioni di ossidazione e riduzione sotto irradiazione ultravioletta (UV), compresa la decomposizione e la rimozione di contaminanti dell'aria e dell'acqua, deodorizzazione e azione antibatterica, autopulente e antiappannante.

Photocatalyst

substance that carries out many functions based on oxidization and reduction reactions under ultraviolet (UV) irradiation, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, self-cleaning and antifogging actions.

Antibatterico

condizione che inibisce la crescita di batteri sulla superficie di materiali o panni a superficie piana.

Antibacterial

condition inhibiting the growth of bacteria on the surface of flat surface materials or cloths.

Valore dell'attività antibatterica del fotocatalizzatore per il metodo di adesione del film

differenza tra il numero totale di batteri vitali dei materiali a superficie piana trattati fotocatalitici e dei materiali non trattati dopo l'irradiazione UV.

Photocatalyst antibacterial activity value for film adhesion method

difference between the total number of viable bacteria of photocatalytic treated flat surface materials and non- treated materials after UV irradiation.

Lampada UV fluorescente

lampada che fornisce l'irradiazione UV-A entro un intervallo di lunghezze d'onda da 300 nm a 400 nm

Fluorescent UV lamp

lamp that provides UV-A irradiation within a wavelength range of 300 nm to 400 nm

Attività antibatterica

differenza nel logaritmo della conta delle cellule vitali rilevata su un prodotto trattato con antibatterico e un prodotto non trattato dopo l'inoculazione e l'incubazione dei batteri test.

antibacterial activity.

difference in the logarithm of the viable cell counts found on an antibacterial-treated product and an untreated product after inoculation with and incubation of bacteria.



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È stata valutata l'attività antimicrobica di provini di piastrelle di ceramica, trattate con una dispersione fotocatalitica effettuando il metodo secondo ISO 27447: 2019.

In accordance with the ISO 27447: 2019 method, the antimicrobial activity of ceramic tile specimens treated with a photocatalytic dispersion was evaluated.

Norma ISO applicata /	ISO standard applied	EN 27447:2019
Data ricevimento: /	Receipt date:	03/09/2020
Data inizio method test /	Start of test method	03/09/2020
Data termine method test /	Ends test method	10/09/2020
Revisione 1 / Updated 1		25/09/2020
Revisione 2 / Updated 2		30/11/2020

Identificazione del campione / Identification of the sample :	MATERIALE CERAMICO:
Denominazione / Name of the product	Serie Advance, linea Royal Stone – Gold. /
Dimensioni./ Dimensions (measures)	CERAMIC MATERIAL:
	<i>Advance series, Royal Stone – Gold line.</i>
	Campione trattato: / Sample treated:
	5 x 5 cm spessore / thickness 0,8 cm
	Campione non trattato: / Untreated sample:
	5 x 5 cm spessore / thickness 0,8 cm

Ditta produttrice / Manufacturer.(Committente / Customer)....	GRUPPO ITALCER - Reggio Emilia
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Campionamento dei provini/ Sampling of specimens.....	Eseguito dal committente /
	Performed by the customer
Data del campionamento / Date sampling	03/09/2020

Fase preliminare: / Preliminary phase	Trattamento in autoclave a 121°C per 15 min.
modalità di disinfezione dei campioni (pre-test) /	<i>Autoclave treatment at 121 ° C for 15 min.</i>
sample disinfection methods (pre-test).....	

Stoccaggio dei provini / Storage conditions	Temperatura ambiente / Room temperature
Caratteristiche Cover o film di copertura: /	Film in polypropylene 4 x 4 cm – spessore
Characteristics Cover or covering film	0,10 mm / Polypropylene film 4 x 4 cm - 0.10
	mm thick

c) Metodo test e Validazione / Test method and its validation:	
Metodo / Method	

Neutralizzante / Neutraliser	Diluzione-neutralizzazione /
	<i>Dilution-neutralization;</i>
	<i>Soybean-casein digest broth with lecithin</i>
	<i>and polysorbate 80 (SCDLP)</i>

d) Condizioni sperimentali: / Experimental conditions:	
Periodo di analisi / Period of analysis	dal 03/09/2020 al 10/09/2020
	<i>from 03/09/2020 to 10/09/2020</i>

Tempo di esposizione / Exposition time	t = 8 ore
--	-----------

Caratteristiche lampada UV / UV lamp characteristics.....	intensità UV: 0.25mW/cm ²
	lampada UV - 18 W a vapori di mercurio
	(PHILIPS PL-L. 18W/10/4P)
	UV intensity: 0.25mW / cm ²
	UV lamp - 18 W mercury vapor



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Identificazione del ceppo batterico utilizzato /	
Identification of the bacterial strain used.....	<i>Escherichia coli</i> ATCC 8739
Volume inoculo della sospensione test di E.coli /	
Inoculum volume of the E.coli test suspension	150 µl

Temperatura di incubazione batteri /	
Temperature of incubation of bacteria	35 °C ± 2 °C
(tecnica diluizione-neutralizzazione e conta in piastra in	
inclusione) / Temperature of incubation of bacteria	
(dilution-neutralization technique and pour-plate method)	

Foto campioni / samples picture.

Provini di Ceramica fotocatalitica Serie	
Advance, linea Royal Stone – Gold	
(ITALCER)	
(con trattamento) /	
Specimens of photocatalytic ceramic Serie	
Advance, linea Royal Stone – Gold	
(ITALCER)	
(with treatment)	

Provini di Ceramica non fotocatalitica STD	
(ITALCER)	
(senza trattamento)	
Non photocatalytic ceramic specimens	
STD (ITALCER)	
(without treatment)	



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e) RISULTATI DEL TEST / TEST RESULTS :

Campione / Sample: Provini Serie Advance, linea Royal Stone - Gold (ITALCER) /
Specimens Advance series, Royal Stone – Gold line (ITALCER)

Metodo analitico / Analytical method : ISO 24774: 2019 – Film adhesion method:
Attività antibatterica di provini di ceramica fotocatalitica nei confronti di E.coli ATCC 8739 /
Antibacterial activity of photocatalytic ceramic specimens against E.coli ATCC 8739

Test di laboratorio / Lab test:	Campione / Sample Serie Advance, linea Royal Stone - Gold	UM*1	Risultato / Result
N microrganismi sospensione batterica iniziale / initial bacterial suspension microorganisms		CFU*2 /ml	2,2x10 ⁶
A – Valore medio microrganismi materiale non fotocatalitico dopo inoculo / average number of viable bacteria of non-treated specimens, just after inoculation		CFU*2 /ml	1,2x10 ⁴
B_L – Valore medio microrganismi materiale non fotocatalitico dopo inoculo con irraggiamento UV / average number of viable bacteria of non-treated specimens, after UV irradiation of intensity L		CFU*2 /ml	9,8x10 ³
C_L – Valore medio microrganismi materiale fotocatalitico dopo inoculo con irraggiamento UV / average number of viable bacteria of photocatalytic treated specimens, after UV irradiation of intensity L		CFU*2 /ml	1,9x10 ²
R_L – Attività antibatterica materiale fotocatalitico con irraggiamento UV espresso in Logaritmo / photocatalyst antibacterial activity value, after irradiation at a constant intensity (L) on a photocatalytic material express in Log	R _L = Log BL/CL	Log ₁₀ *3	1,7
Riduzione (%) batterica del materiale fotocatalitico nei confronti materiale non fotocatalitico con irraggiamento UV / Bacterial (%) reduction of photocatalytic material compared to non-photocatalytic material with UV irradiation		%	98,4%
B_D – valore medio microrganismi materiale non fotocatalitico senza irraggiamento UV al buio / average number of viable bacteria of non-treated specimens, after being kept in a dark place		CFU*2 /ml	2,0x10 ⁴
C_D – valore medio microrganismi materiale fotocatalitico senza irraggiamento UV al buio/ average number of viable bacteria of photocatalytic treated specimens, after being kept in a dark place		CFU*2 /ml	8,3x10 ²
ΔR (Delta R) – Attività antibatterica materiale fotocatalitico / photocatalyst antibacterial activity value with UV irradiation	ΔR = Log (BL/CL)- Log (BD/CD)	Log ₁₀	0,25

*1 UM= Unità di Misura / Unit of Measure

*2 CFU= Unità formante colonia o cellule batteriche o batteri / Colony-forming unit or bacterial cells or bacteria

*3 LOG₁₀= Valore del Logaritmo in base 10 / Logarithm value



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f) CONCLUSIONI / CONCLUSIONS:

Il metodo test secondo le condizioni di prova specificate nella norma ISO 27447:2019 determina la sopravvivenza del ceppo batterico test (*Escherichia coli* ATCC 8739) sulla superficie di provini di materiale ceramico, denominato **Serie Advance, linea Royal Stone - Gold (ITALCER)**, sottoposto a irraggiamento con UV per 8 ore, dimostrando che la riduzione batterica è pari al **98,4%**.

È possibile concludere in base ai requisiti e metodo della ISO 27447:20019 che il materiale ceramico fotocatalitico Serie Advance, linea Royal Stone - Gold (ITALCER), presenta una significativa attività inibitoria (antimicrobica) nei confronti del ceppo batterico *Escherichia coli* dopo irraggiamento UV.

Il campione Serie Advance, linea Royal Stone - Gold, trattato ad attività fotocatalitica nei confronti del non trattato, senza irraggiamento UV e mantenuto al buio per 8 ore, rileva attività antimicrobica e presenta una riduzione antibatterica pari al 96,5%.

According to the test conditions specified in the ISO 27447: 2019 standard The test method determines the survival of the bacterial test strain (Escherichia coli ATCC 8739) on the surface of specimens of ceramic material, Advance series, Royal Stone – Gold line (ITALCER), radiated with UV rays for 8 hours, inducing bacterial reduction equal to 98,4%.

According to the requirements and method of ISO 27447: 20019 it can be concluded that the photocatalytic ceramic material Advance series, Royal Stone – Gold line (ITALCER) has a significant inhibitory (antimicrobial) activity against the bacterial strain Escherichia coli after UV irradiation.

Sample Advance series, Royal Stone – Gold line, treated with photocatalytic activity against the untreated, without UV irradiation and kept in the dark for 8 hours, has antimicrobial activity and shows a antibacterial reduction of 96,5%.

g) locality, date:

Ferrara, 10/09/2020

Revisione 1 / Updated 1: 25/09/2020

Revisione 2 / Updated 2: 30/11/2020

identified signature



(Firma / Signature) Dr.ssa Alberta Vandrini
n. AA_038993 O.N.B.)

in collaborazione con il / in collaboration with the
Consorzio Futuro in Ricerca

(in collaborazione Firma / in collaboration Signature

Prof. Pier Giorgio Balboni
Prof. cultore della materia "Microbiologia"
dell'Università di Ferrara in collaborazione con il Consorzio
Futuro in Ricerca / Professor of the subject "Microbiology"
of the University of Ferrara in collaboration with Consorzio
Futuro in Ricerca

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in collaborazione con Prof. Pier Giorgio Balboni
incarico di insegnamento come cultore della materia
"Microbiologia" dell'Università di Ferrara

Rapporto di Prova / Test report N. 010/Cfr AV2020

Data/ Date: 05/11/2020

Revisione 1 / Updated : 30/11/2020

ISO 27447:2019 (E)

Measurement of antibacterial activity on plastics and other non-porous surfaces

Metodo e requisiti modificati.

Committente / Customer: GRUPPO ITALCER Via Emilia Ovest 53/A 42048 Rubiera (Reggio Emilia)

Campione/ Sample: Serie Advance, linea Royal Stone – Gold. /

Advance series, Royal Stone - Gold line.

Introduzione / Introduction

ISO 27447:2019. Fine ceramics (advanced ceramics, advanced technical ceramics) – Test method for antibacterial activity of semiconducting photocatalytic materials.

La norma specifica un metodo di prova è generalmente applicabile ai materiali fotocatalitici e a prodotti con effetto antibatterico. La tipologia di materiali può essere di diversa caratteristica, ad esempio materiali utilizzati nei materiali da costruzione, quali ceramici fotocatalitici o semiconduttori in lamiera piana, cartone, a forma di lastra o tessuti che sono le forme di base dei materiali per varie applicazioni.

Il Metodo e i requisiti ISO 27447 riguardano il ceppo di prova, *Staphylococcus aureus*, e l'intensità della luce UV (0.25 mW/cm²).

The standard specifies a test method is generally applicable to photocatalytic materials and products with an antibacterial effect. The type of materials can be of different characteristics, for example materials used in building materials, such as photocatalytic ceramics or semiconductors in flat sheet, cardboard, sheet shape or fabrics which are the basic shapes of materials for various applications.

According ISO 27447 the method and requirements concern the test strains, such as Staphylococcus aureus, and the intensity of UV light (0.25 mW/cm²).

Sommario: / Abstract:

Questa norma internazionale specifica un metodo di prova per la determinazione dell'attività antibatterica di materiali che contengono un fotocatalizzatore o hanno pellicole fotocatalitiche sulla superficie, misurando il conteggio dei batteri sotto l'irradiazione della luce ultravioletta.

This International Standard specifies a test method for the determination of the antibacterial activity of materials that contain a photocatalyst or have photocatalytic films on the surface, by measuring the enumeration of bacteria under irradiation of ultraviolet light.



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Termini e Definizioni / Terms and Definitions

Fotocatalizzatore

sostanza che svolge molte funzioni basate su reazioni di ossidazione e riduzione sotto irradiazione ultravioletta (UV), compresa la decomposizione e la rimozione di contaminanti dell'aria e dell'acqua, deodorizzazione e azione antibatterica, autopulente e antiappannante.

Photocatalyst

substance that carries out many functions based on oxidization and reduction reactions under ultraviolet (UV) irradiation, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, self-cleaning and antifogging actions.

Antibatterico

condizione che inibisce la crescita di batteri sulla superficie di materiali o panni a superficie piana.

Antibacterial

condition inhibiting the growth of bacteria on the surface of flat surface materials or cloths.

Valore dell'attività antibatterica del fotocatalizzatore per il metodo di adesione del film

differenza tra il numero totale di batteri vitali dei materiali a superficie piana trattati fotocatalitici e dei materiali non trattati dopo l'irradiazione UV.

Photocatalyst antibacterial activity value for film adhesion method

difference between the total number of viable bacteria of photocatalytic treated flat surface materials and non- treated materials after UV irradiation.

Lampada UV fluorescente

lampada che fornisce l'irradiazione UV-A entro un intervallo di lunghezze d'onda da 300 nm a 400 nm

Fluorescent UV lamp

lamp that provides UV-A irradiation within a wavelength range of 300 nm to 400 nm

Attività antibatterica

differenza nel logaritmo della conta delle cellule vitali rilevata su un prodotto trattato con antibatterico e un prodotto non trattato dopo l'inoculazione e l'incubazione dei batteri test.

antibacterial activity

difference in the logarithm of the viable cell counts found on an antibacterial-treated product and an untreated product after inoculation with and incubation of bacteria.



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È stata valutata l'attività antimicrobica di provini di piastrelle di ceramica, trattate con una dispersione fotocatalitica effettuando il metodo secondo ISO 27447: 2019.

In accordance with the ISO 27447: 2019 method, the antimicrobial activity of ceramic tile specimens treated with a photocatalytic dispersion was evaluated.

Norma ISO applicata / ISO standard applied
Metodo e requisiti / Method and requirements

EN 27447:2019

Data ricevimento: / Receipt date:
Data inizio method test / Start of test method
Data termine method test / Ends test method
Revisione 1 / Updated 1

03/09/2020
29/10/2020
05/11/2020
30/11/2020

Identificazione del campione / Identification of the sample :
Denominazione / Name of the product
Dimensioni./ Dimensions (measures)

MATERIALE CERAMICO:
Serie Advance, linea Royal Stone – Gold. /
CERAMIC MATERIAL:
Advance series, Royal Stone – Gold line.
Campione trattato: / Sample treated:
5 x 5 cm spessore / thickness 0,8 cm
Campione non trattato: / Untreated sample:
5 x 5 cm spessore / thickness 0,8 cm

Ditta produttrice / Manufacturer.(Committente / Customer)....

GRUPPO ITALCER - Reggio Emilia

Campionamento dei provini/ Sampling of specimens.....

Eseguito dal committente /
Performed by the customer
03/09/2020

Data del campionamento / Date sampling

Fase preliminare: / Preliminary phase
modalità di disinfezione dei campioni (pre-test) /
sample disinfection methods (pre-test).....

Trattamento in autoclave a 121°C per 15 min.
Autoclave treatment at 121 ° C for 15 min.

Stoccaggio dei provini / Storage conditions

Caratteristiche Cover o film di copertura: /
Characteristics Cover or covering film

Temperatura ambiente / Room temperature
Film in polypropylene 4 x 4 cm – spessore
0,10 mm / Polypropylene film 4 x 4 cm - 0.10
mm thick

c) Metodo test e Validazione / Test method and its validation:
Metodo / Method

Neutralizzante / Neutraliser

Diluizione-neutralizzazione /
Dilution-neutralization;
Soybean-casein digest broth with lecithin
and polysorbate 80 (SCDLP)

d) Condizioni sperimentali: / Experimental conditions:
Periodo di analisi / Period of analysis

dal 29/10/2020 al 05/11/2020
from 29/10/2020 to 05/11/2020

Tempo di esposizione / Exposition time

t = 8 ore

Caratteristiche lampada UV / UV lamp characteristics.....

intensità UV: 0.25 mW/cm²
lampada UV – (PHILIPS -UV TUV)
UV intensity: 0.25 mW / cm²
UV lamp – (PHILIPS -UV TUV)



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Identificazione del ceppo batterico utilizzato /
Identification of the bacterial strain used.....
Volume inoculo della sospensione test di St. aureus /
Inoculum volume of the St.aureus test suspension

Staphylococcus aureus ATCC 6538

Temperatura di incubazione batteri /
Temperature of incubation of bacteria
(tecnica diluizione-neutralizzazione e conta in piastra in
inclusione) / Temperature of incubation of bacteria
(dilution-neutralization technique and pour-plate method)

400 µl

35 °C ± 2 °C

Foto campioni / samples picture.

Provini di Ceramica fotocatalitica Serie
Advance, linea Royal Stone – Gold
(ITALCER)
(con trattamento) /
Specimens of photocatalytic ceramic
Serie Advance, linea Royal Stone –
Gold
(ITALCER)
(with treatment)



Provini di Ceramica non fotocatalitica
STD (ITALCER)
(senza trattamento)
Non photocatalytic ceramic specimens
STD (ITALCER)
(without treatment)



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e) RISULTATI DEL TEST / TEST RESULTS :

Campione / Sample: Provini Serie Advance, linea Royal Stone - Gold (ITALCER) /
Specimens Advance series, Royal Stone – Gold line (ITALCER)

Metodo analitico / Analytical method : ISO 24774: 2019 – Film adhesion method:
Attività antibatterica di provini di ceramica fotocatalitica nei confronti di *Staphylococcus aureus* ATCC 6538
Antibacterial activity of photocatalytic ceramic specimens against *Staphylococcus aureus* ATCC 6538

Test di laboratorio / Lab test:	Campione / Sample Serie Advance, linea Royal Stone - Gold	UM*1	Risultato / Result
N microrganismi sospensione batterica iniziale / initial bacterial suspension microorganisms		CFU*2 /ml	2,2x10 ⁶
A – Valore medio microrganismi materiale non fotocatalitico dopo inoculo / average number of viable bacteria of non-treated specimens, just after inoculation		CFU*2 /ml	2,4x10 ⁵
B_L – Valore medio microrganismi materiale non fotocatalitico dopo inoculo con irraggiamento UV / average number of viable bacteria of non-treated specimens, after UV irradiation of intensity L		CFU*2 /ml	1,0x10 ⁵
C_L – Valore medio microrganismi materiale fotocatalitico dopo inoculo con irraggiamento UV / average number of viable bacteria of photocatalytic treated specimens, after UV irradiation of intensity L		CFU*2 /ml	2,3x10 ³
R_L – Attività antibatterica materiale fotocatalitico con irraggiamento UV espresso in Logaritmo / photocatalyst antibacterial activity value, after irradiation at a constant intensity (L) on a photocatalytic material express in Log	R _L = Log BL/CL	Log ₁₀ *3	1,6
Riduzione (%) batterica del materiale fotocatalitico nei confronti materiale non fotocatalitico con irraggiamento UV / Bacterial (%) reduction of photocatalytic material compared to non-photocatalytic material with UV irradiation		%	99,0%
B_D – valore medio microrganismi materiale non fotocatalitico senza irraggiamento UV al buio / average number of viable bacteria of non-treated specimens, after being kept in a dark place		CFU*2 /ml	1,0x10 ⁵
C_D – valore medio microrganismi materiale fotocatalitico senza irraggiamento UV al buio/ average number of viable bacteria of photocatalytic treated specimens, after being kept in a dark place		CFU*2 /ml	1,8x10 ⁵
ΔR (Delta R) – Attività antibatterica materiale fotocatalitico / photocatalyst antibacterial activity value with UV irradiation	ΔR = Log (BL/CL)- Log (BD/CD)	Log ₁₀	0,89
Riduzione (%) batterica del materiale fotocatalitico nei confronti materiale non fotocatalitico senza irraggiamento UV al buio / Bacterial (%) reduction of photocatalytic material compared to non-photocatalytic material without UV radiation in the dark		%	82,0%

*1 UM= Unità di Misura / Unit of Measure

*2 CFU= Unità formante colonia o cellule batteriche o batteri / Colony-forming unit or bacterial cells or bacteria

*3 LOG₁₀= Valore del Logaritmo in base 10 / Logarithm value



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f) CONCLUSIONI / CONCLUSIONS:

Il metodo test secondo le condizioni di prova specificate nella norma ISO 27447:2019 determina la sopravvivenza del ceppo batterico test (*Staphylococcus aureus* ATCC 6538) sulla superficie di provini di materiale ceramico, denominato Serie Advance, linea Royal Stone - Gold (ITALCER), sottoposto a irraggiamento con UV per 8 ore, dimostrando che la riduzione batterica è pari al 99,0%.

È possibile concludere in base ai requisiti e metodo della ISO 27447:20019 che il materiale ceramico fotocatalitico Serie Advance, linea Royal Stone - Gold (ITALCER), presenta una ottima attività antimicrobica nei confronti del ceppo batterico *Staphylococcus aureus* dopo irraggiamento UV a 0.25 mW/cm².

Il campione Serie Advance, linea Royal Stone - Gold, trattato ad attività fotocatalitica nei confronti del non trattato, senza irraggiamento UV e mantenuto al buio per 8 ore, presenta attività antimicrobica e una riduzione antibatterica pari al 82,0%.

According to the test conditions specified in the ISO 27447: 2019 standard the test method determines the survival of the bacterial test strain (Staphylococcus aureus ATCC 6538) on the surface of specimens of ceramic material, Advance series, Royal Stone – Gold line (ITALCER), radiated with UV rays for 8 hours, inducing bacterial reduction equal to 99,0%.

According to the requirements and method of ISO 27447: 20019 it can be concluded that the photocatalytic ceramic material Advance series, Royal Stone – Gold line (ITALCER), has an excellent antimicrobial activity against the bacterial strain Staphylococcus aureus after UV irradiation at 0.25 mW / cm2.

Sample Advance series, Royal Stone – Gold line (ITALCER),, treated with photocatalytic activity against the untreated, without UV irradiation and kept in the dark for 8 hours, has antimicrobial activity and shows a antibacterial reduction of 82,0%.

g) locality, date:

Ferrara, 05/11/2020

Revisione 1 / Updated 1: 30/11/2020

identified signature

(Firma / Signature) Dr.ssa Alberta Vandini
n. AA_039993 O.N.B.)

in collaborazione con il / in collaboration with the
Consorzio Futuro in Ricerca

(in collaborazione Firma / in collaboration Signature

Prof. Pier Giorgio Balboni
Prof. cultore della materia "Microbiologia"
dell'Università di Ferrara in collaborazione con il Consorzio
Futuro in Ricerca / Professor of the subject "Microbiology"
of the University of Ferrara in collaboration with Consorzio
Futuro in Ricerca

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Dipartimento di CHIMICA
Laboratorio CEA
- Chimica Energia Ambiente-

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DI TORINO
ALMA UNIVERSITAS
TAURINENSIS



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Test report

**Determination of the photocatalytic activity with the tangential flow method -
reduction of nitric oxide**

**(UNI 11484 simplified method, in accordance with CEN / TS 16980-1: 2016)
on materials - Rondine ceramica, Advance Rondine Collections 3D series**

for

Italcer S.p.A
Via Emilia Ovest 53/A
42048 Rubiera (Re)
P.Iva: 00142060359

Torino, June 8, 2020

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1. GENERAL TEST CONDITIONS

The photocatalytic NO/NO_x abatement tests were carried out using the method described in UNI 11484 (Determination of photocatalytic activity with a tangential continuous flow method - Abatement of nitric oxide - March 2013). The method follows the European Union technical specification CEN/TS 16980-1:2016 "Continuous flow methods – Part 1: Determination of NO in the air by photocatalytic materials". The tests were carried out with a simplified procedure, i.e. when the condition of stability of the concentrations measured under irradiation was reached or the maximum irradiation time was reached (according to the UNI 11484 180 minutes), the flow rate was not changed within the reactor, thus ending the test under these conditions. The irradiance was in UV 10 W m⁻² from 290 to 400 nm, e in deroga sotto irraggiamento visibile.

The determination of the NO/NO₂ content in the flow was carried out using an APNA 370 chemiluminescence detector (serial number WWSBNNW6). The measuring reactor had an internal volume of 3.6 dm³. The mixing inside the reactor was guaranteed by a compact axial fan EBMPAPST 612 JH (dimensions 60×60×32 mm) that provides a nominal flow equal to 70 m³ h⁻¹.

The irradiation took place with two different irradiation systems. In the first case, according to the indications of the UNI 11484 standard, the sample was irradiated in the UV by means of a set of two Philips PL-S 9W/2P BLB fluorescent lamps whose emission spectrum is shown in **Figure 1**. The intensity of the radiation incident on the sample was 10 W m⁻² between 290 and 400 nm.

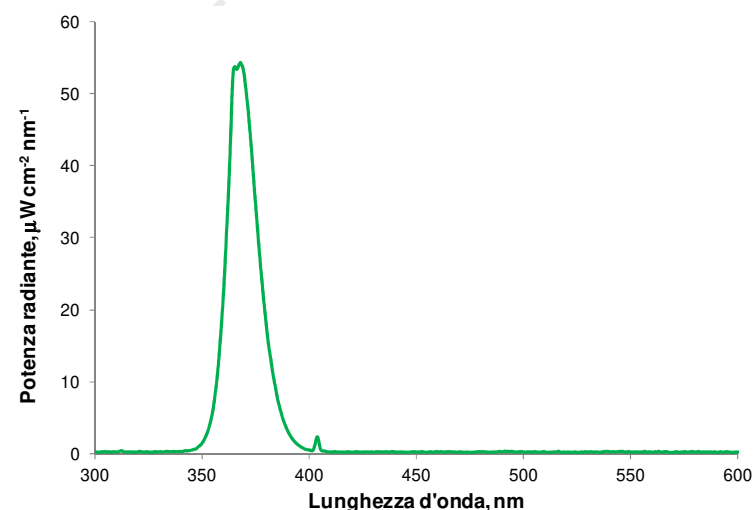


Figure 1. Emission spectrum of the Philips PL-S 9W / 2P BLB lamp. The radiant power was measured in the same position in which the sample is housed by placing the Pyrex glass cover for closing the measuring reactor between the lamp and the sample.

In the case of Visible irradiation, at variance with the standard UNI 11484, it was used a LED illuminator (6500 K color temperature), assembled at the laboratories of the Department of Chemistry of the University of Turin, devoid of UV emission. The spectrum of this source (**Figure 2**) was characterized as shown below. The irradiance on the sample surface was 250 W m⁻² between 400 and 800 nm.

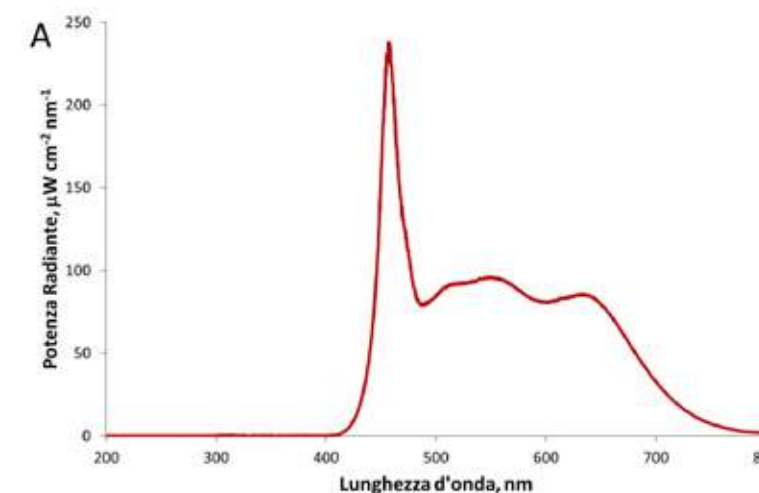


Figure 2. Emission spectrum of the LED lighting system (6500 K color temperature). The radiant power was measured in the same position in which the sample is housed by placing the Pyrex glass cover for closing the measurement reactor between the lamp and the sample.

The irradiance at the surface of the samples was evaluated spectroradiometrically with the two employed irradiation systems, through the use of an Ocean Optics USB2000 + UV-VIS spectrophotometer equipped with an optical fiber having a diameter of 400 μm and length equal to 30 cm, and a cosine corrector (Ocean Optics CC-3-UV-T, PTFE optical diffuser, spectral range 200-2500 nm, external diameter 6.35 mm, field of view 180 °). The spectroradiometer was calibrated with an Ocean Optics DH-2000-CAL Deuterium-Halogen Light Source for UV-Vis-NIR measurements, calibrated in turn in absolute irradiance by the seller (Radiometric Calibration Standard UV-NIR, calibration certificate # 2162).

2. SAMPLES

The samples (delivered directly by the client to UNITO on 21/05/2019) are 3 ceramic tiles (labeled AR, BR, CR, respectively, with dimensions 9.9 cm × 9.9 cm × 10 mm) with a potentially photoactive white paint deposited on one of the faces, whose photocatalytic properties are the subject of this document.

The tests in accordance with the UNI 11484 standard ("simplified" test) were performed on the samples as such **without any pretreatment**. The tests in accordance with the UNI 11484 standard, but with Visible radiation took place on the samples used for the test under UV radiation, but after washing with demineralized water and drying at 90 ° C.

The list of tested samples, with the respective irradiated surface area and an indication of the type of radiation used during the test, is reported in **Table 1**. The pictures of the tested samples are shown in **Figure 3**.

Table 1. Samples analyzed

Sample	Sample description	Irradiation	Test	Area, cm ²	Pretreatment
AR (UV)	Ceramic tile	UV	NO/NO _x , UNI 11484:2013	98.0	NO
BR (UV)	Ceramic tile	UV	NO/NO _x , UNI 11484:2013	98.0	NO
CR (UV)	Ceramic tile	UV	NO/NO _x , UNI 11484:2013	98.0	NO
AR(Vis)	Ceramic tile	Visible	NO/NO _x , UNI 11484:2013 (Visible)	98.0	Washing with water after test in UV
BR(Vis)	Ceramic tile	Visible	NO/NO _x , UNI 11484:2013 (Visible)	98.0	Washing with water after test in UV
CR(Vis)	Ceramic tile	Visible	NO/NO _x , UNI 11484:2013 (Visible)	98.0	Washing with water after test in UV

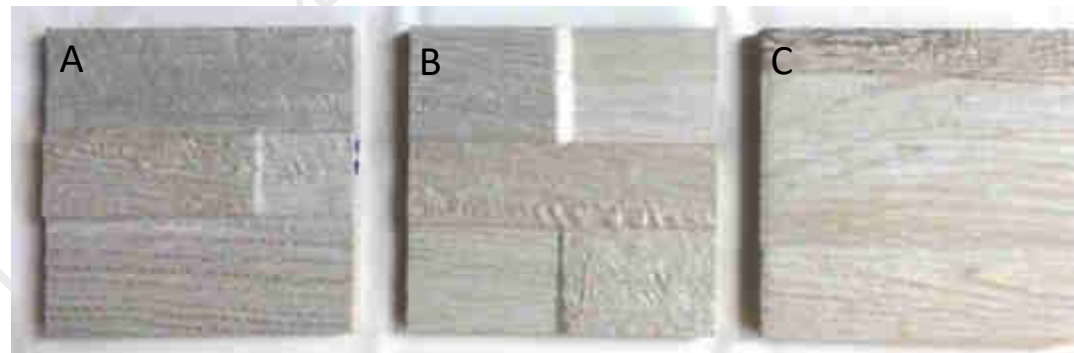


Figure 3. Pictures of the samples tested according to UNI 11484:2013: A = AR, B = BR, C = CR . The sample face reported is the irradiated one (UV and Visible irradiation) during the photocatalytic NO / NO_x abatement tests.

3. EXPERIMENTAL RESULTS AND MEASURING CONDITIONS

3.1. Sample "AR" (UNI 11484, UV)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.515$ ppmv
	$C_{NO_2}^{IN} = 0.000$ ppmv
Gas flow	$F = 1.608$ dm ³ min ⁻¹
Temperature inside the reactor	$T = 29.2$ °C
Relative humidity inside the reactor	$HR\% = 45.1$
Irradiance of the lamp to the sample surface (290-400 nm)	$I = 10$ W m ⁻²
Time elapsed between the time the UV lamp is switched on and the start of the concentration recording	31.5 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036$ ppmv $C_{NO_2}^{OUT,BUIO} = 0.016$ ppmv $C_{NO}^{OUT,LUCE} = 0.4972$ ppmv $\eta_{NO}^{foto} = 1.3$ %
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = 2.0$ % $\eta_{NO_2}^{buio} = -0.2$ %
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 4 .
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

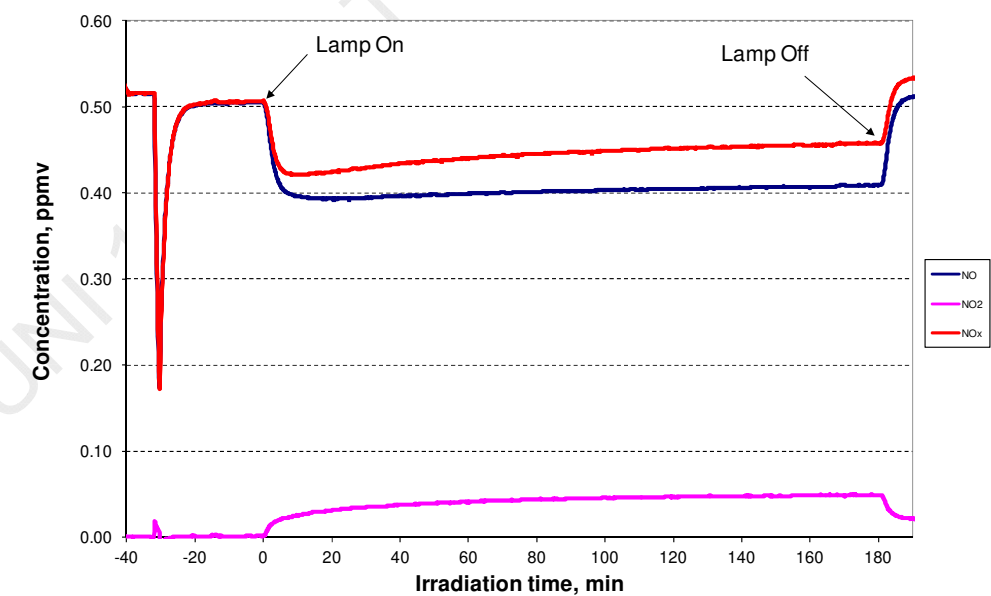


Figure 4. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on AR (UV) sample. Test dated 29-05-2020 and performed with UV irradiation in accordance with UNI 11484 (simplified).

3.2. Sample “BR” (UNI 11484, UV)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.509$ ppmv $C_{NO_2}^{IN} = -0.002$ ppmv
Gas flow	$F = 1.608$ dm ³ min ⁻¹
Temperature inside the reactor	$T = 28.4$ °C
Relative humidity inside the reactor	HR% = 44.1
Irradiance of the lamp to the sample surface (290-400 nm)	$I = 10$ W m ⁻²
Time elapsed between the time the UV lamp is switched on and the start of the concentration recording	31.5 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036$ ppmv $C_{NO_2}^{OUT,BUIO} = 0.016$ ppmv $C_{NO}^{OUT,LUCE} = 0.4972$ ppmv $\eta_{NO}^{foto} = 1.3$ %
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = -1.0$ % $\eta_{NO_2}^{buio} = 0.1$ %
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 5.
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

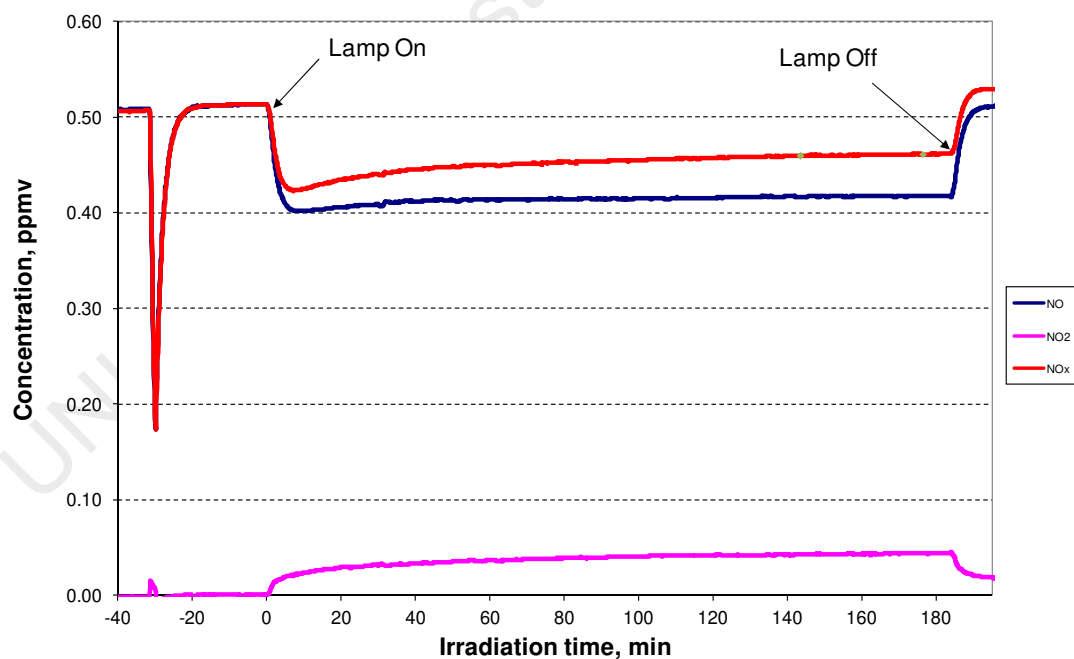


Figure 5. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on BR (UV) sample. Test dated 01/06/2020 and performed with UV irradiation in accordance with UNI 11484 (simplified).

3.3. Sample “CR” (UNI 11484, UV)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.513$ ppmv $C_{NO_2}^{IN} = 0.000$ ppmv
Gas flow	$F = 1.608$ dm ³ min ⁻¹
Temperature inside the reactor	$T = 28.7$ °C
Relative humidity inside the reactor	HR% = 43.4
Irradiance of the lamp to the sample surface (290-400 nm)	$I = 10$ W m ⁻²
Time elapsed between the time the UV lamp is switched on and the start of the concentration recording	30.5 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036$ ppmv $C_{NO_2}^{OUT,BUIO} = 0.016$ ppmv $C_{NO}^{OUT,LUCE} = 0.4972$ ppmv $\eta_{NO}^{foto} = 1.3$ %
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = 2.1$ % $\eta_{NO_2}^{buio} = 1.5$ %
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 6.
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

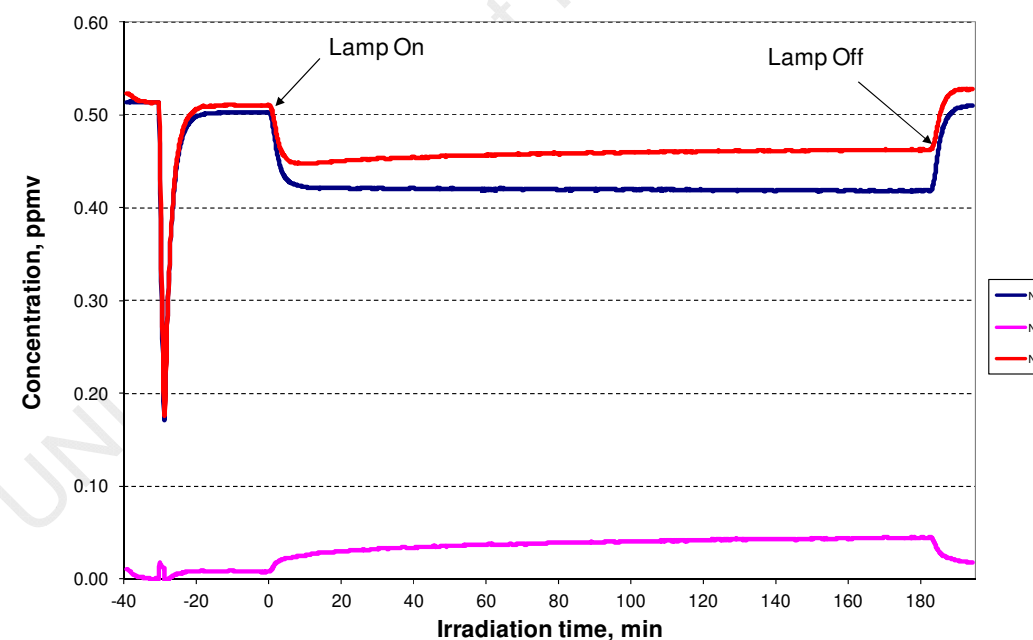


Figure 6. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on CR (UV) sample. Test dated 01/06/2020 and performed with UV irradiation in accordance with UNI 11484 (simplified).

3.4. Sample "AR" (UNI 11484, Visible)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.506$ ppmv $C_{NO_2}^{IN} = 0.001$ ppmv
Gas flow	$F = 1.608$ dm ³ min ⁻¹
Temperature inside the reactor	$T = 33.3$ °C
Relative humidity inside the reactor	$HR\% = 37.3$
Irradiance of the lamp to the sample surface (in the VISIBLE range 400-800 nm)	$I = 250$ W m ⁻²
Time elapsed between the time the VIS lamp is switched on and the start of the concentration recording	32 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036$ ppmv $C_{NO_2}^{OUT,BUIO} = 0.016$ ppmv $C_{NO}^{OUT,LUCE} = 0.4972$ ppmv $\eta_{NO}^{foto} = 1.3$ %
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = -1.5$ % $\eta_{NO_2}^{buio} = 0.4$ %
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 7 .
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

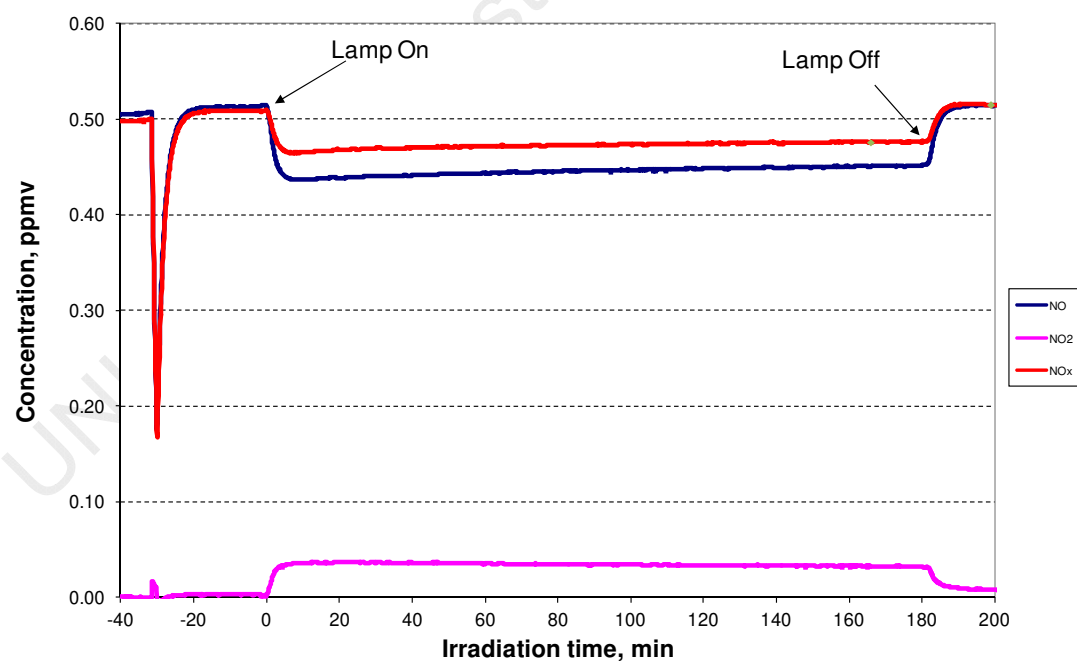


Figure 7. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on AR (Vis) sample. Test dated 03/06/2020 and performed in accordance with UNI 11484 (simplified) with VIS irradiation.

3.5. Sample "BR" (UNI 11484, Visible)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.513$ ppmv $C_{NO_2}^{IN} = 0.001$ ppmv
Gas flow	$F = 1.608$ dm ³ min ⁻¹
Temperature inside the reactor	$T = 33.4$ °C
Relative humidity inside the reactor	$HR\% = 36.6$
Irradiance of the lamp to the sample surface (in the VISIBLE range 400-800 nm)	$I = 250$ W m ⁻²
Time elapsed between the time the VIS lamp is switched on and the start of the concentration recording	45 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036$ ppmv $C_{NO_2}^{OUT,BUIO} = 0.016$ ppmv $C_{NO}^{OUT,LUCE} = 0.4972$ ppmv $\eta_{NO}^{foto} = 1.3$ %
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = -0.3$ % $\eta_{NO_2}^{buio} = -0.7$ %
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 8 .
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

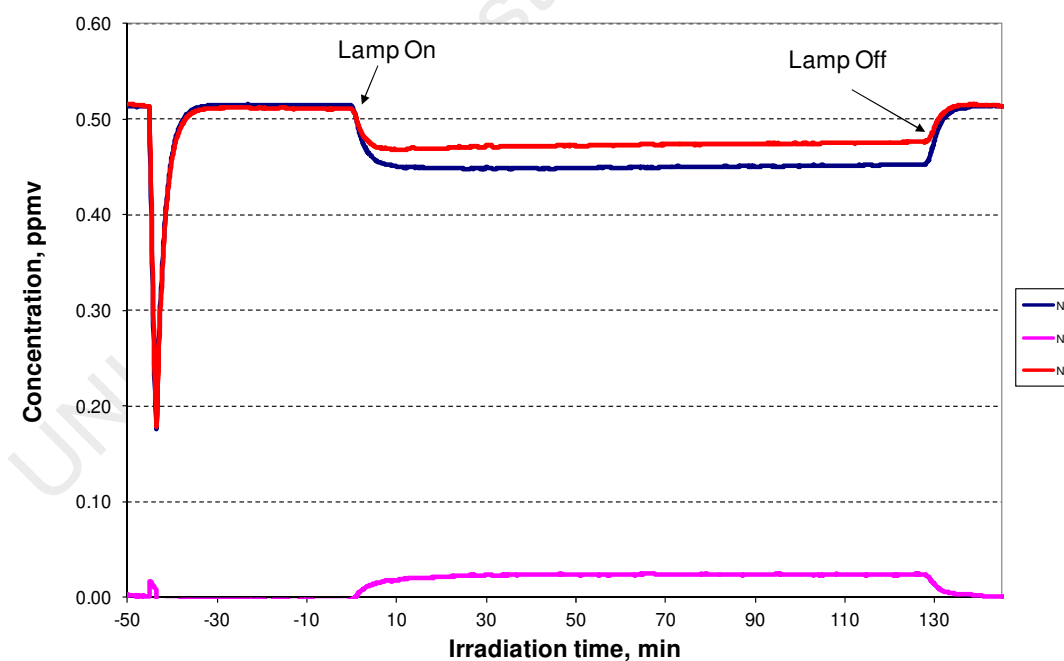


Figure 8. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on BR (Vis) sample. Test dated 03/06/2020 and performed in accordance with UNI 11484 (simplified) with VIS irradiation.

3.6. Sample "CR" (UNI 11484, Visible)

The following table shows the operating conditions used in the test and its results.

Initial concentration of nitrogen oxides before entering the reactor	$C_{NO}^{IN} = 0.506 \text{ ppmv}$
	$C_{NO_2}^{IN} = -0.001 \text{ ppmv}$
Gas flow	$F = 1.608 \text{ dm}^3 \text{ min}^{-1}$
Temperature inside the reactor	$T = 32.5 \text{ }^\circ\text{C}$
Relative humidity inside the reactor	$HR\% = 37.1$
Irradiance of the lamp to the sample surface (in the VISIBLE range 400-800 nm)	$I = 250 \text{ W m}^{-2}$
Time elapsed between the time the VIS lamp is switched on and the start of the concentration recording	31 min
Conversion in the absence of sample	$C_{NO}^{OUT,BUIO} = 0.5036 \text{ ppmv}$ $C_{NO_2}^{OUT,BUIO} = 0.016 \text{ ppmv}$ $C_{NO}^{OUT,LUCE} = 0.4972 \text{ ppmv}$ $\eta_{NO,luce}^{foto} = 1.3 \%$
Conversion in the dark in the presence of a sample	$\eta_{NO}^{buio} = -1.1 \%$ $\eta_{NO_2}^{buio} = -0.5 \%$
Conversion under radiation in the presence of a sample	The graph showing the evolution of the concentrations during the various test steps is shown in Figure 9.
Observed rate of photocatalytic degradation	See Table 2
Remarks	none

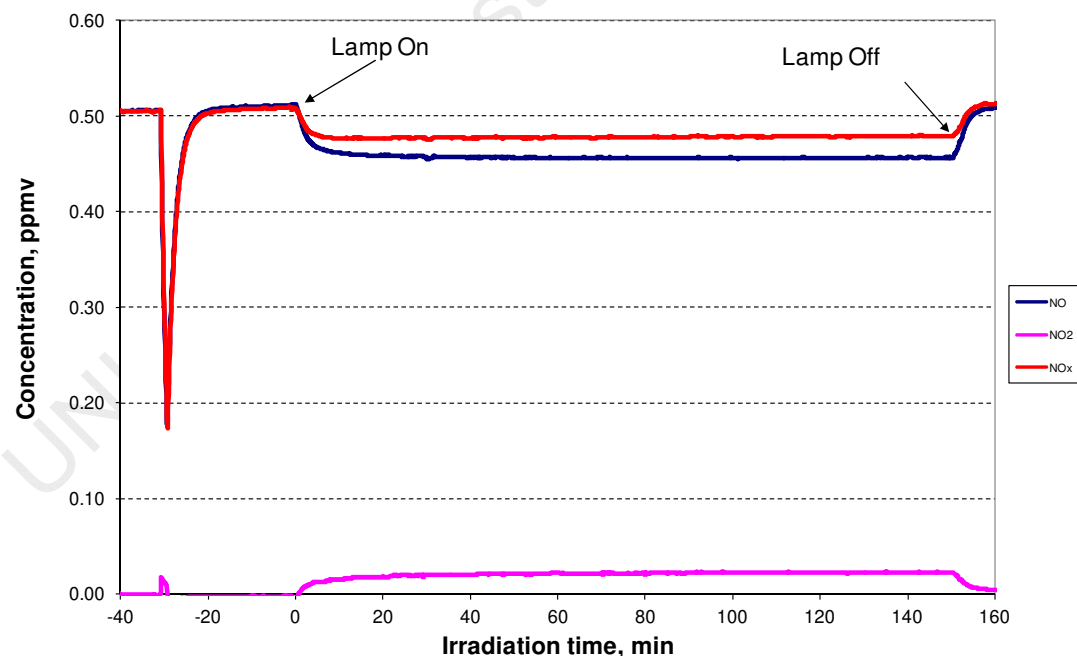


Figure 9. Concentration vs time for NO, NO₂ and NO_x during the photocatalytic test on CR (Vis) sample. Test dated 04/06/2020 and performed in accordance with UNI 11484 (simplified) with VIS irradiation.

4. SUMMARY OF RESULTS

The specimens showed a measurable NO abatement under UV and Visible irradiation. The results of measurements of the photocatalytic activity according to UNI 11484 under UV (no pretreatment) and Visible irradiation (after washing with water) of the 3 samples are summarized in Table 2 (for NO/NO_x). The conversions and rates are reported as average values calculated after 180 minutes of irradiation or when the stability of the conversion is attained in accordance with the UNI 11484.

Table 2. Measurement results. The conversions refer to the measured values after 180 minutes of irradiation










Sample	Irradiation	$\eta_{NO,i}^{totale}, \%$	$\eta_{NO_2,i}^{totale}, \%$	$r_{NO,i}^{foto}, \mu\text{g m}^{-2} \text{ h}^{-1}$	$r_{NO_2,i}^{foto}, \mu\text{g m}^{-2} \text{ h}^{-1} [j]$
AR(UV)	UV	20.7	11.2	1450	1130
BR(UV)	UV	17.9	9.3	1370	1140
CR(UV)	UV	18.5	9.9	1240	1060
AR(Vis)	Visible	10.9	4.7	820	640
BR(Vis)	Visible	11.8	7.2	830	720
CR(Vis)	Visible	9.8	5.3	720	590

[j] The photocatalytic NO_x conversion rate is expressed as μg equivalents of NO₂ converted per m² of sample in 1 hour.






Torino, June 8, 2020

Prof. Claudio Minero

Technische Daten

CARATTERISTICA TECNICA TECHNICAL PROPERTY CARACTERISTIQUE TECHNIQUE TECHNISCHE DATEN	METODO DI PROVA TESTING METHOD MÉTHODE D'ESSAI PRÜFNORMEN	VALORE PRESCRITTO DELLA NORMA REQUIRED STANDARDS VALEUR PRESCRIPTE PAR LES NORMES NORMVORGABE
 Assorbimento d'acqua Water Absorption Absorption d'eau Wasseraufnahme	UNI EN ISO 10545-3	≤ 0,5%
 Resistenza a basse/alte concentrazioni di acidi/alcali Resistenza ai prodotti chimici di uso domestico e agli additivi per piscina Resistance to low/high concentrations of alkalis and acids Resistance to household chemical products and swimming pool additives Résistance à faibles/ fortes concentrations d'acides et d'alcalis Résistance aux produits chimiques à usage domestique et aux additifs pour piscine Chemikalien beständigkeit und gegen haushaltschemikalien und badewasserzusätze	UNI EN ISO 10545-13	Classe dichiarata Classe minima B Declared class Minimum class B Classe déclarée Minimum classification B Angegebenen Klasse Mindestklasse B
 Resistenza alla flessione Bending Strength Résistance à la flexion Bruchlast	UNI EN ISO 10545-4	R ≥ 35 N / mm ² S > 700 N (spessore < 7,5 mm) S > 1300 N (spessore ≥ 7,5 mm)
 Resistenza al gelo Frost resistance Résistance au gel Frostbeständigkeit	UNI EN ISO 10545-12	Nessun campione deve presentare rotture o alterazioni apprezzabili della superficie. Samples must not show alterations on the surface. Les échantillons ne doivent pas présenter de ruptures ou d'altérations considérables sur la surface. Die Muster nussen keine Bruch oder Schäden auf dem Oberfläche presentieren.
 Durezza di Mohs Hardness in Mohs degrees Dureté de Mohs Ritzhärte nach Mohs	UNI EN 101	≥ 5° Mohs
 Resistenza alle macchie Stain resistant Résistance aux taches Fleckbeständigkeit	UNI EN ISO 10545-14	Classe > 3 Class > 3 Classe > 3 Klasse > 3
 Resistenza all'abrasione superficiale Superficial abrasion resistance Résistance à la abrasion superficielle PEI Klassifizierung	Classificazione Interna Internal Classification System	Classi di abrasione da I a V Abrasion class from I to V Classe d'abrasion de I à V Abriebklassen I bis V
 Resistenza all'abrasione profonda Deep abrasion resistance Résistance à l'abrasion profonde Tiefenverschleiß	UNI EN ISO 10545-6	≤ 175 mm ³
 Resistenza allo scivolamento (coefficiente di attrito) Slip resistance (coefficient of friction) Résistance au glissement (coefficient de friction) Rutschfestigkeit (Reibungskoeffizient)	DIN 51130 DIN 51097 B.C.R.A. Rep. CEC/81 Dcof ANSI A137.1:2012 BS 7976-2 (pendulum)	μ > 0,40 > 0,42 0-24 Scivoloso Slippery Glissant Rutschig 25-35 Scivolosità moderata Moderately slippery Glissance modérée Großer Haftreibungwert >36 Basso rischio scivolamento Low slipping risk Risque de glissement faible Sehr Großer Haftreibungwert

Technische Daten

CARATTERISTICA TECNICA TECHNICAL PROPERTY CARACTERISTIQUE TECHNIQUE TECHNISCHE DATEN	METODO DI PROVA TESTING METHOD MÉTHODE D'ESSAI PRÜFNORMEN	VALORE PRESCRITTO DELLA NORMA REQUIRED STANDARDS VALEUR PRESCRIPTE PAR LES NORMES NORMVORGABE			
		N < 7 cm	7 cm ≤ N < 15 cm	N ≥ 15 cm	
 Lunghezza e larghezza Length and width Longueur et largeur Länge und Breite		(mm)	(mm)	(mm)	(mm)
		± 0,5 (*)	± 0,9 (*)	± 0,6 (*)	± 2,0 (*)
 Spessore Thickness Épaisseur Dicke		± 0,5 (*)	± 0,5 (*)	± 0,5 (*)	± 0,5 (*)
 Rettilineità degli spigoli Straightness of sides Rectitude des bords Geradheit der kanten	ISO 10545-2	n.a. (***)	± 0,75 (***)	± 0,5 (***)	± 1,5 (***)
 Ortogonalità Squareness Rectangularité Rechtwinkligkeit		n.a. (****)	± 0,75 (****)	± 0,5 (****)	± 2,0 (****)
 Planarità Planarity Planéité de surface Ebenflächigkeit		c.c. / n.a e.c. / n.a w. / n.a	c.c. ± 0,75 e.c. ± 0,75 w. ± 0,75	c.c. ± 0,5 e.c. ± 0,5 w. ± 0,5	c.c. ± 2,0 e.c. ± 2,0 w. ± 2,0

(*) Deviazione ammissibile, in % oppure mm, della dimensione media di ogni piastrella (2 oppure 4 lati) dalla dimensione di fabbricazione (W).
(*) The permissible deviation, in % or mm, of the average size for each tile (2 or 4 sides) from work size (W).
(*) Écart admissible, en % ou en mm, de la taille moyenne de chaque carreau (2 ou 4 faces) par rapport à la dimension de fabrication (W).
(*) Zulässige Abweichung der durchschnittlichen Größe jeder Fliese in % oder mm vom Herstellungsmaß (W).

(**) Deviazione ammissibile, in % oppure mm, dello spessore medio di ogni piastrella dallo spessore riportato nella dimensione di fabbricazione (W).
(**) The permissible deviation, in % or mm, of the average thickness for each tile from the work size (W).
(**) Écart admissible, en % ou en mm, de l'épaisseur moyenne de chaque carreau indiquée dans la dimension de fabrication (W).
(**) Zulässige Abweichung der durchschnittlichen Dicke jeder Fliese in % oder mm von der in der Herstellungsabmessung (W) angegebenen Dicke.





(***) Deviazione massima ammissibile di rettilineità, in % oppure mm, in rapporto alle dimensioni di fabbricazione (W) corrispondenti.
(***) The maximum permissible deviation from straightness, in % or mm, related to the corresponding work sizes (W).
(***) Écart de rectitude maximum admissible, en % ou en mm, par rapport aux dimensions de fabrication (W) correspondantes.
(***) Maximal zulässige Geradheitsabweichung in % oder mm in Bezug auf die entsprechenden Fertigungsabmessungen (W).

(****) Deviazione massima ammissibile di ortogonalità, in % oppure mm, in rapporto alle dimensioni di fabbricazione (W) corrispondenti.
(****) The maximum permissible deviation from rectangularity, in % or mm, related to the corresponding work size (W).
(****) Écart d'orthogonalité maximum admissible, en % ou en mm, par rapport aux dimensions de fabrication (W) correspondantes.
(****) Maximal zulässige Abweichung der Orthogonalität in % oder mm in Bezug auf die entsprechenden Herstellungsabmessungen (W).

c.c. Deviazione massima ammissibile della curvatura del centro, in % oppure mm, in rapporto alla diagonale calcolata secondo le dimensioni di fabbricazione (W).
c.c. The maximum permissible deviation from centre curvature, in % or mm, related to the corresponding work sizes (W).
c.c. Écart maximum admissible de la courbure du centre, en % ou en mm, par rapport à la diagonale calculée en fonction des dimensions de fabrication (W).
c.c. Maximal zulässige Abweichung der Krümmung der Ecke in % oder mm von den Herstellungsmaßen (W).

e.c. Deviazione massima ammissibile della curvatura dello spigolo, in % oppure mm, in rapporto alle dimensioni di fabbricazione (W).
e.c. The maximum permissible deviation from edge curvature, in % or mm, related to the corresponding work sizes (W).
e.c. Écart maximum admissible de la courbure du coin, en % ou en mm, par rapport aux dimensions de fabrication (W).
e.c. Maximal zulässige Abweichung der Krümmung der Ecke in % oder mm von den Herstellungsmaßen (W).

w. Deviazione massima ammissibile dello svergolamento, in % o mm, in rapporto alla diagonale calcolata secondo le dimensioni di fabbricazione (W).
w. The maximum permissible deviation from warpage, in % or mm, related to diagonal calculated from the work size (W).
w. Écart de gauchissement maximum admissible, en % ou en mm, par rapport à la diagonale calculée en fonction des dimensions de fabrication (W).
w. Maximal zulässige Verzugsabweichung in % oder mm in Bezug auf die Diagonale, berechnet nach den Abmessungen von Herstellung (W).

VARIAZIONE CROMATICA SHADE VARIATION - VARIATIONS CHROMATIQUES - ABÄNDERUNG DER FARBENLEHRR			
			
Piastrella uniforme Tiles with uniform appearance	Piastrella con leggera variazione di tono e grafica Tiles with slight shade and graphic variation	Piastrella con discreta variazione di tono e grafica Tiles with moderate shade and graphic variation	Piastrella con notevole variazione di tono e grafica Tiles with huge variation of shade and graphic

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