CERTIFIED according to ISO 22195 (mod.)

Quality Labs
BIOMATERIAL TESTING

CERTIFICATE

on the antimicrobial properties of

Lock 3 VGL 15 / VGFL 510

of the company

Varcotec GmbH
Curiestr. 2
70563 Stuttgart, Germany

has been successfully tested versus

Staphylococcus aureus DSM 799

as **a n t i m i c r o b i a l**

≥ 99.99% germ reduction

according to ISO 22196 (modified)

In contrast to the standard method with the test bacteria on a covered and therefore permanently moist surface, the test was carried out dry at room temperature and under the influence of visible light.

The antibacterial effect is clearly related to the photocatalytic effect of the coating tested.

For details, see Test Report No. 3641

The bearer of this certificate is entitled to affix the following seal to parts or surfaces made from the tested material

Nuremberg, Germany, May 18th, 2020

Managing Director

Laboratory Director

QualityLabs BT GmbH, Neumeyerstraße 46a, 90411 Nuremberg, Germany

Test report
ISO 22196 (mod.)

Measurement of antibacterial activity on surfaces

Lock 3 gloss varnish VGJTIFL 510
printed specimens MM Graphia Scheetfed
versus *Staphylococcus aureus* ATCC® 6538™

Test report according to ISO 22196 (mod.) and SOP 035

Client:	Varcotec GmbH
Address:	Curiestraße 2 70563 Stuttgart Germany
Application number:	3OT-VAR-20-009
Sample description:	Printed sheets from MM Graphia containing Lock 3 VGJTIFL 510 (carton 270 g/m²)
Type of test sample:	Sample inspection
Preparation of the test samples by:	MM Graphia
Samples received/prepared on:	August 10th, 2020 (+ photosensitizer) September 25th, 2020 (- photosensitizer)
Test strain:	*Staphylococcus aureus* ATCC® 6538™
Test laboratory:	TriOptoTec GmbH Department of Microbiology
Adresse:	Am BioPark 13 93053 Regensburg
No. of pages in report:	4

Report on findings to the client:	**Place and date of preparation:**	Regensburg, October 09th, 2020
	Recipient:	Varcotec GmbH

Laboratory Director:

Dr. Anja Eichner, CScO TriOptoTec GmbH

Approved:

Xaver Auer, CEO TriOptoTec GmbH

Declaration on quality assurance

This investigation was performed and supervised according to the standard operating procedure "ISO 22196 (mod) according to SOP 035" by TriOptoTec GmbH.

Archiving

A copy of the test report, a protocol of the measurement as well as the accompanying correspondence and business records are archived by TriOptoTec GmbH for at least 10 years.

Test description

The antibacterial activity of test samples is determined in accordance with a modified version of the norm ISO 22196 ("Measurement of anti-bacterial activity on plastics and other non-porous surfaces").

The test specimen is inoculated with a 50 µL bacterial spot and incubated at 37°C for 60 min in the dark until the liquid is visibly dry.
After drying, the test specimen is exposed homogeneously to blue light (λ = 405 nm) for 10 min. The irradiation applied corresponds to 150 times the intensity of standard office lighting (OSRAM Cool White 840). [1] After irradiation, the bacteria were removed from the surface of the test specimen. After serial dilution and incubation at 37 °C on culture medium for 24 h, the survival of was determined by counting the number of colony forming units (CFU).

[1] Time-lapse experiment

Table 1: Assessment of antibacterial activity

Germ reduction in log_{10} scales	Antibacterial activity in %
1 log_{10} reduction	90 % reduction
2 log_{10} reduction	99 % reduction
3 log_{10} reduction	99,9 % reduction
4 log_{10} reduction	99,99 % reduction
5 log_{10} reduction	99,999 % reduction
6 log_{10} reduction	99,9999 % reduction

Table 2: Test results are shown as mean value of the results of three independent experiments ± standard deviation in log_{10} scales and as reduction in percent.

#	Sample Name	Reduction [%]	log_{10} reduction ± SD
1	Sample **without photocatalyst** and **without light (reference)** **VGF 500-45**	-	-
2	Sample **with photocatalyst** and **without light** **Lock 3**	-	0.1 ± 0.4
3	Sample **with photocatalyst** and **with light** **Lock 3**	**99.75 %**	**2.6 ± 1.3**

Test strain: *Staphylococcus aureus* ATCC® 6538™

No. of independent experiments: 4

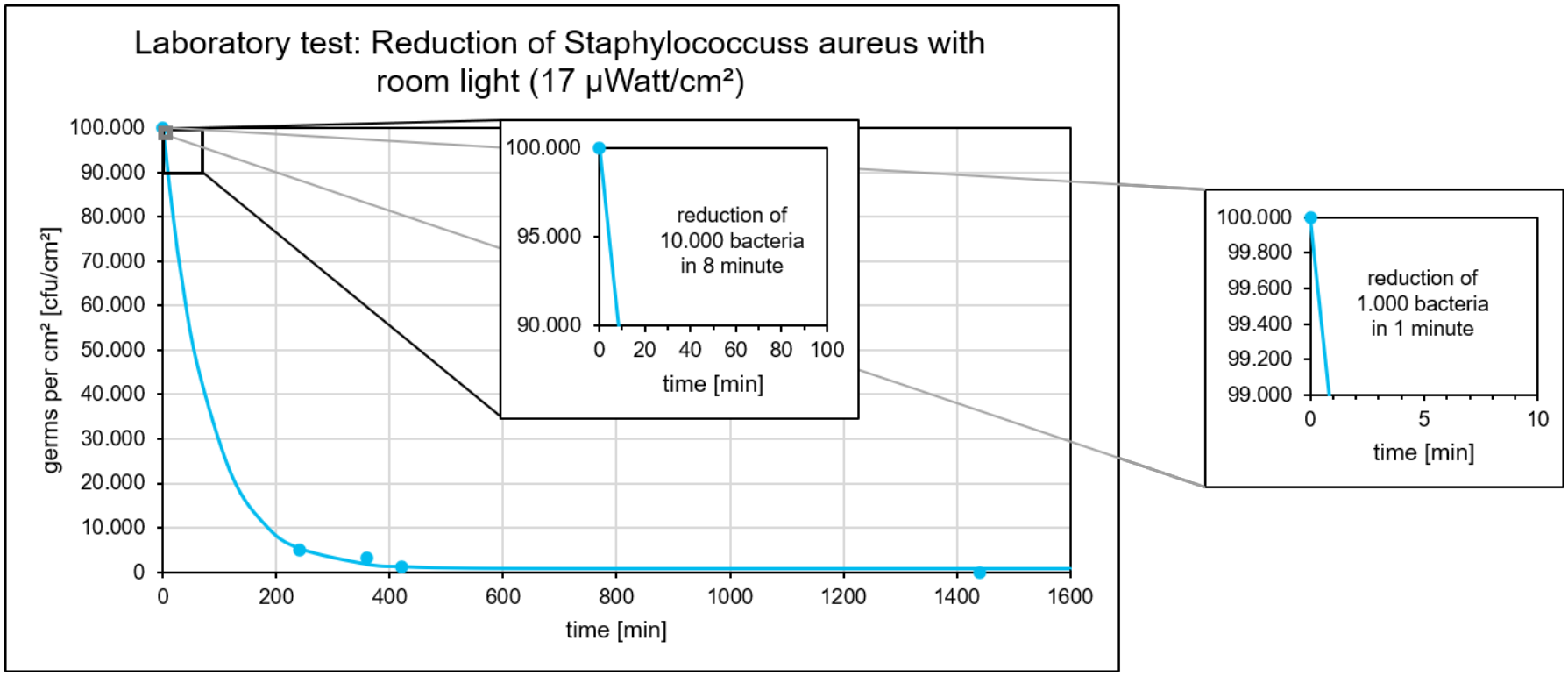
Initials of the editor: AE

Measurement finished on: September 30th, 2020

Comments on test samples: none

Varcotec
perfect varnish solution

Calculation of reduction rates of germs by Lock 3 at room light



Test setting und calculation: The coating was applied on a glass slide. For microbiological laboratory tests germ loads of 100.000 germs per cm2 are used (artificial; escalation setting).The test was conducted by **ambient light** intensity of **17 µW/cm2** (measured using **bright office light**, average value **600 Lux**). For this test the representative germ ***Staphylococcus aureus*** was selected. After 240, 360, 420 and 1440 minutes the germ reduction was determined. The measuring points were mathematically fitted through **exponential reduction**. The germ reduction rate depends on light intensity, the germ used, the number of germs and the contamination on the coating. The germ reduction rate was calculated using the first 1.000 bacteria killed. **Within 1 minute 1.000 bacteria** and **in 8 minutes 10.000 bacteria were killed**. Real occurring germ loads do not exceed 1.000 germs per cm2 as found in literature. This is also comparable to our own experiences from our field study.

Source: Dyphox Mr. Dr. Späth 03.09.2020

DYPHOX Am BioPark 13 93053 Regensburg

Varcotec GmbH
z.Hd. Hrn. Frings
Curiestraße 2
D- 70563 STUTTGART

26 August 2020

Dear Mr. Frings,

the products of TriOptoTec GmbH, which are marketed under the brand Dyphox®, are based on the process of photodynamics: a photophysical process of energy conversion. The photodynamic catalyst (= special dye) is activated by visible light. This energy is then transferred to the oxygen in the air ("precursor"). This produces the antimicrobial agent singlet oxygen. It destroys microorganisms in a chemical process by oxidation of cellular components such as membrane lipids and proteins ("Mode of Action").

All Dyphox® additives, which are incorporated into coating systems, and thus also the coatings themselves, contain the same catalyst "PN-B". The dosage is individually adjusted to the requirements for efficacy of the customer.

We have collected extensive data on the antiviral efficacy of our product DYPHOX Universal 510-R and on our photocatalyst “PN-B” in aqueous suspension. Enveloped and non-enveloped viruses can be killed with high efficacy (Table 1 and 2).

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Table 1: Evidence of the antiviral efficacy of the Dyphox® photocatalyst "PN-B" in aqueous suspension. Tests were carried out according to a modified version of DIN EN 14476 by Eurovir Hygiene-Labor GmbH.

Virus strain	enveloped / non-enveloped	Antiviral efficacy (reduction in log_{10})
Influenza A Virus (H1N1)	enveloped	> 3,3
TGEV-Coronavirus	enveloped	> 4,6
Adenovirus, Type 5	non-enveloped	> 5,5

Table 2: Evidence of the antiviral efficacy of the DYPHOX Universal 510-R coating. Tests were carried out as modified version of a quantitative carrier test in accordance with the RKI guideline (1995) by Eurovir Hygiene-Labor GmbH.

Virus strain	enveloped / non-enveloped	Antiviral efficacy (reduction in log_{10})
Influenza A Virus (H1N1)	enveloped	> 3,8
TGEV-Coronavirus	enveloped	> 5,5
Adenovirus, Type 5	non-enveloped	Ca. 2,0

The antibacterial efficacy of Dyphox®-additive systems can be reproducibly confirmed in various coating systems from different manufacturers, including wall paints, 1K acrylate water-based coatings, 2K polyurethane coatings and SolGel systems (Table 3).

Table 3: Evidence of the antibacterial efficacy of various products containing Dyphox® additives. Tests were carried out by QualityLabs BT according to a modified version of ISO 22196.

Product	Test strain	Gram positive / Gram negative	Antibacterial efficacy
Wall paint Relius AntiBac Pro	*S. aureus*	Gram positive	> 4,0
Varnish Haering AntiBak Aktiv	*S. aureus*	Gram positive	> 4,0
Printing Varnish Varcotec Lock 3 VGL15	*S. aureus*	Gram positive	> 4,0
DYPHOX Universal 510-R	*S. aureus*	Gram positive	> 4,0
DYPHOX Universal 510-R	*E. faecium*	Gram positive	> 4,0
DYPHOX Universal 510-R	*A. baumannii*	Gram negative	> 4,0

The present test results and the comparison of the data allow us to conclude an antiviral effect of Dyphox® additive-containing printing varnish systems.

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Summary / Conclusion:

- The same photocatalyst ("PN-B") is used for all Dyphox® containing products.
- The "mode of action" and the biocidal agent are the same for all products.
- The same antibacterial efficacy is given for the Dyphox® containing systems: wall paint, printing varnish, varnish and SolGel.
- As the antimicrobial efficacy is evident with different coating systems, it seems to be independent of the binding agent in the matrix.
- Based on available data, we expect an antiviral effect for Dyphox®-containing 1K water-based printing varnishes.

26.08.2020
Date

Dr. Andreas Späth
CTO

26/08/2020
Date

Dr. Theresa Frank
Microbiology

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DYPHOX Antimicrobial. Safe. Long-lasting.

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Regensburg,
12. November 2020

TriOptoTec GmbH
Am Biopark 13 • 93053 Regensburg

Varcotec GmbH
Mr. Frings
Curiestraße 2
D-70563 Stuttgart

Dear Sir or Madam,

the company Varcotec uses the Dyphox technology in its water based varnish Lock 3. Based on the process of photodynamics, bacteria and viruses are permanently eliminated with oxygen and visible light / artificial light. Photodynamics is a photophysical process of energy conversion.

The photodynamic Dyphox catalyst (= special dye) is activated by visible light. This energy is then transferred to the oxygen in the air (precursor) and generates the antimicrobial agent singlet oxygen.

Singlet oxygen destroys microorganisms such as bacteria and viruses in a subsequent chemical process by means of oxidation. No resistances are induced in the process.

The unique function of the technology is patented and its effectiveness against bacteria and viruses is confirmed by several studies and certificates. (e.g. certificate for the Dyphox® universal coating showing effectiveness against the influenza virus H1N1 and against TGEV, **a representative of the coronavirus family**).

The coronavirus family includes several viruses such as SARS-CoV-1 and MERS-CoV. Also the novel SARS-CoV-2 virus, which causes the disease **COVID-19**, is assigned to the coronavirus family.

The **Lock 3 water based varnish** from Varcotec are equipped with the same photodynamic catalyst from Dyphox®, which is also used in the product Dyphox® Universal from TriOptoTec GmbH. The effectiveness of the Dyphox® photocatalyst against bacteria and viruses has been confirmed by external tests. It has also been proven to kill viruses of the coronavirus family.

A separate Varcotec virus certificate from the coronavirus family is currently being prepared and is expected to be issued by an independent institute later this year.

We are looking forward to an exciting cooperation with this worldwide unique technology to close hygiene gaps and to interrupt possible infection chains.

Maximum attention is guaranteed for products finished with the antimicrobial water based varnish Lock 3.

November 12th 2020
Date

Xaver Auer
CEO

November 12th 2020
Date

Dr. Andreas Späth
CTO