Antimicrobial Coating Technology

Singapore Asahi Chemical & Solder Ind. Pte Ltd

Asahi Lifecare Technology

December 2021

ASAHI LIFECARE TECHNOLOGY

Table of Contents

Development Background For AHC

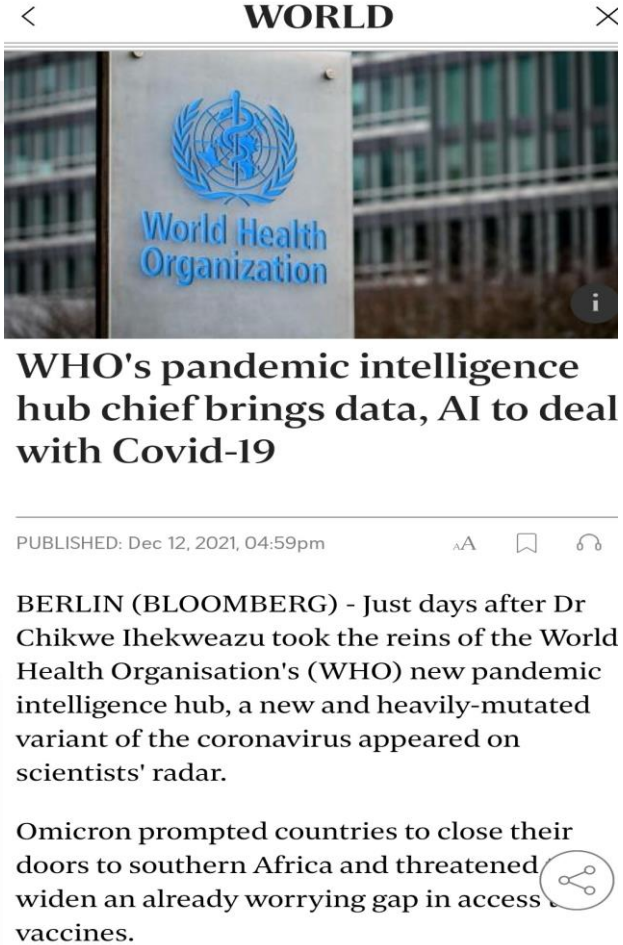
December 2021

ASAHI LIFECARE TECHNOLOGY

Mankind has faced, and will continue to face infectious diseases of different scales

DISEASE	R-NAUGHT VALUE	TRANSMISSION RATE	LETHALITY	TOTAL CASES	DEATH TOLL
SARS	2-5	77%	<1.0%	8,000	774
2018 INFLUENZA	<1.5	45%	<1.0%	50-million	250,000 to 500,000
CORONAVIRUS	4.7-6.6	83%	16%	???	???
1918 FLU	2-3	65%	>10%	500-million	>50-million
EBOLA 2014	2.0	90%	43%	28,000	12,000

VIRUS	YEAR IDENTIFIED	CASES	DEATHS	FATALITY RATE	NUMBER OF COUNTRIES
Marberg	1967	466	373	80%	11
Ebola*	1976	33,577	13,562	40.40%	9
Hendra	1994	7	4	57%	1
H5N1 Bird Flu	1997	861	455	52.80%	18
Nipah	1998	513	398	77.60%	2
SARS	2002	8,096	774	9.60%	29
H1N1**	2009	1,632,258	284,500	17.40%	214
MERS***	2012	2,494	858	34.40%	28
H7N9 Bird Flu	2013	1,568	616	39.30%	3

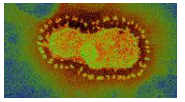


Common Hospital Acquired Infections(HAIs)

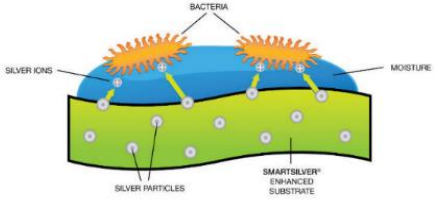
Respiratory Tract Infection (Infection of Lung Tissue)	Surgical site Infections (SSIs) (Patients undergoing surgical procedure develop surgical site infection)
Gram negatives Escherichia coli Klebsiella pneumoniae Enterobacter spp Pseudomonas aeruginosa **Gram Positives** Staphylococcus aureus MRSA Streptococcus pneumoniae	Streptococcus Staphylococcus aureus Coagulase-negative staphylococcus Enterococcus spp
Sepsis/Bacteremia (Presence of bacteria in bloodstream)	**Urinary Tract Infections (UTIs) (Infection involving any part of urinary system eg urethra, bladder, ureters, kidneys)**
Staphylococcus aureus Group A Streptococcus Streptococcus pneumoniae Enterococcus spp Pseudomonas aeruginosa	Escherichia coli(~75%) Klebsiella pneumoniae Proteus mirabilis Staphylococcus saprophyticus

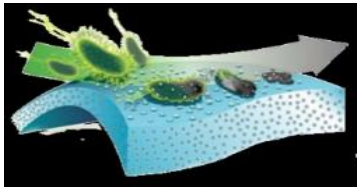
Transmission of Infectious Diseases is via skin contact with contaminated surfaces

Wash our hand often is recommended but difficult to be practiced



Anti-microbial coating on common areas will kill bacteria and virus and reduce the transmission rate of infectious deceases





Additional layers of protection are needed to protect the most vulnerable

Childcare centre worker among 548 new Covid-19 cases in Singapore

MON, MAY 25, 2020 - 5:50 AM

One of three Singaporeans confirmed to have Covid-19 on Sunday was a childcare centre worker. The 33-year-old woman worked at Iman Childcare (Tampines) and was one of 548 novel coronavirus cases confirmed by the Health Ministry (MOH), bringing the total count to 31,616. PHOTO: SCREENGRAB FROM GOOGLE MAPS

Singapore

ONE of three Singaporeans confirmed to have Covid-19 on Sunday was a childcare centre worker. The 33-year-old woman worked at Iman Childcare (Tampines) and was one of 548 novel coronavirus cases confirmed by the Health Ministry (MOH), bringing the total count to 31,616.

BREAKING NEWS

12:05 PM Union lauds Biden action on slaughter speeds industry calls safe

11:59 AM Las Vegas plans to reopen schools as suicide fears grow

11:56 AM Britain to help other countries track down coronavirus variants

11:47 AM Listen-in social network Clubhouse readies for the masses

11:41 AM Apple's hardware chief leaves post for unnamed new project

RECOMMENDED FOR YOU

Stocks to watch: Suntec Reit, ARA Logos, Keppel Reit, MLT, Parkway Life Reit

'This is not normal': Wall Street grows wary of stock bubbles

Isetan could pay dearly for dragging its heels on sale of Wisma Atria space

MFS SINGAPORE LOG IN

HFMD cases surge to near-record high

Epidemic fuelled in part by parents who send sick kids to childcare centres

1 of 2 Assistant teacher Kalaichelvi Shanmugam, 49, checking a child's temperature and looking out for blisters before allowing her to enter a childcare centre in Tampines yesterday. Singapore could be heading for one of its worst hand, foot and mouth disease (HFMD) outbreaks, with infections hitting near-record numbers over the past few months. The number of infections so far – 18,241 – is the second highest for the first 21 weeks of a year. Symptoms of HFMD include fever, ulcers in the mouth, blisters on the hands and feet, poor appetite and lethargy. ST PHOTO: LIM YAOHUI

AHC Anti-microbial Coating Technology

December 2021

Asahi Coating Technology Overview

- Suitable* for Glass, Textile, Polymer, Metals

*Different substrates have different adhesion and curing time, and surface pre-treatment before coating

- Matrix + Additives + Diluent
- Specially formulated matrix for tunable concentration and functions
- Silver based additives: antimicrobial function

- Suitable for spraying, dipping, brushing
- Thermal and Ambient cure suitable

- ✓ 99.99% anti-bacterial efficacy against *E.coli* (ATCC 8739), *S.aureus* (ATCC 6538P), MRSA and others.
- ✓ >99.99% against EV-A71 virus, H1N1
- ✓ >99.99% Murine Coronavirus
- ✓ >99.9% OC43 surrogate to Sars-Cov2

- ✓ Non-cytotoxic (*in-vitro*)
- ✓ Non-skin irritation/ sensitization (according to ISO10993-10)
- ✓ Food Contact (FDA Part 175.300)

- ✓ Hydrophobic (Easy-clean/ stain-repellent)
- ✓ Transparent

NEA Approved List of Antimicrobical Coating Solution against COVID-19

National Environment Agency

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ıfecting surface coating products against COVID-19 virus

List of household disinfectants and self-disinfecting surface coating products against COVID-19 virus

Revised on 13 December 2021
First released on 04 February 2020

For general precautionary cleaning, detergent and water are adequate. For disinfection of areas that are very likely to be contaminated with COVID-19 virus (e.g. bedroom of a person confirmed to have a COVID-19 virus infection), general household products that contain the appropriate concentrations of active ingredients can be used.

The suitable active ingredients and their effective concentrations are listed in Table 1. The table also provides guidance on the effective contact times (which are different among the various A.I.s) required by the A.I.s to act on a contaminated surface, in order to be effective against coronaviruses. In addition to the use of cleaning agents, other treatments effective against coronaviruses include steam and heat treatment. As the COVID-19 virus is new, limited studies have been published on the virus. This assessment is thus based on published scientific studies on coronaviruses, a group to which the COVID-19 virus belongs.

Table 2. List of Self-Disinfecting Surface Coating Products Effective Against Coronaviruses

S/N	Product Name	Application method	Durability and efficacy data	Efficacy class
1	Nanoshield	Film Peel and stick onto surfaces	**Yes,** >3.6-log reduction of SARS-CoV-2 within 15 min, after a simulated cleaning with 90 wipes of ethanol or detergent.	Class A
2	AirTumTec Pro (Not commercially available off-the-shelf)	Spray Coating is applied by manufacturer	**Yes,** 2.67-log reduction of hCoV-229E within 15 min, after 2,000 cycles of abrasion according to ASTM D4060 Test material: Ceramic	Class A
3	airDefender Anti-Microbial Surface Coating Solution	Spray Coating to be applied by user according to direction of use	**Yes,** 0.8-log reduction of human coronavirus-229E within 65 min and 2.9-log reduction within 170 min, after a simulated cleaning with 100 wipes of ethanol. Test material: Stainless steel	Class C
4	Antimicrobial Coating Solution AHC23 (Not commercially available off-the-shelf)	Solution Coating is applied by manufacturer or appointed distributor	**Yes,** 5-log reduction of murine coronavirus-MHV within 15 min, after a simulated cleaning with 1000 wipes of ethanol. Test material: Polycarbonate film	Class A

Asahi AHC23 listed as one of the 3 with CLASS A Efficacy

Key Differences Between Disinfectant and Antimicrobial coating

Disinfectant

- Ability to kill instantly
- Not sustainable
- Continuous application to get the best effect.

Antimicrobial Coating

- Formation of durable and transparent coating onto surfaces
- Protective coating on existing surface
- Continuously inactivate bacteria and viruses
- Withstand cleaning without losing efficacy
- Absence of toxic effects on treated surface

Product and Application Video (Youtube links)

AHC7 Product Video

Nostalgia Hotel Project Video

Safety Tests

December 2021

Cytotoxicity Test Report

<u>Degree of cytotoxicity <2</u>, as per ISO ISO 10993-5:2009 Biological evaluation of medical devices Part 5: Tests for in vitro cytotoxicity

Conclusion:
The result of analysis showed that the sample tested was considered to have no cytotoxic effect

TEST REPORT: 7191189329-CHM18-02-RC
09 JUL 2018

PSB Singapore

RESULTS

Test Commencement Date : 18 Jun 2018
Test Completion date : 22 Jun 2018
Sample Description : Air cure [redacted]

Extracts of Sample and Controls	Description	Degree	Reactivity
<u>Triplicates</u> Sample extract # 1	Not more than 20% of the cells are round, loosely attached, and without intracytoplasmic granules or show changes in morphology; occasional lysed cells are present; only slight growth inhibition observable	1	Slight
Sample extract # 2	Not more than 20% of the cells are round, loosely attached, and without intracytoplasmic granules or show changes in morphology; occasional lysed cells are present; only slight growth inhibition observable	1	Slight
Sample extract # 3	Not more than 20% of the cells are round, loosely attached, and without intracytoplasmic granules or show changes in morphology; occasional lysed cells are present; only slight growth inhibition observable	1	Slight
Negative Control extract (HDPE Material) #1	Discrete intracytoplasmic granules; no cell lysis.	0	None
Negative Control extract (HDPE Material) #2	Discrete intracytoplasmic granules; no cell lysis.	0	None
Negative Control extract (HDPE Material) #3	Discrete intracytoplasmic granules; no cell lysis.	0	None
Positive Control (Zinc Sulphate Solution, 800 mg/L) #1	Complete destruction of the cell layers.	4	Severe
Positive Control (Zinc Sulphate Solution, 800 mg/L) #2	Complete destruction of the cell layers.	4	Severe
Positive Control (Zinc Sulphate Solution, 800 mg/L) #3	Complete destruction of the cell layers.	4	Severe
Reagent blank control #1	Discrete intracytoplasmic granules; no cell lysis.	0	None
Reagent blank control #2	Discrete intracytoplasmic granules; no cell lysis.	0	None
Reagent blank control #3	Discrete intracytoplasmic granules; no cell lysis.	0	None

<u>Remarks</u> :

The results of analysis showed that the sample "Air cure [redacted] tested was considered to have no cytotoxic effect.

Skin Irritation Test

<u>Primary irritation is negligible (index <0.4)</u>, as per ISO 10993-10:2013 Biological evaluation of medical devices Part 10: Tests for irritation and skin sensitization

GLP STUDY REPORT: 7191206474-01-00
28 JUN 2019

PSB Singapore

8. TEST RESULTS

8.1 <u>ERYTHEMA / ESCHAR (E) AND OEDEMA (O) FORMATION OF EACH ANIMAL AT EACH OBSERVATION TIMEPOINT</u>

Animal ID	Application site	1 hr after exposure E/O	24 hrs after exposure E/O	48 hrs after exposure E/O	72 hrs after exposure E/O	Sum of all scores at 24, 48 and 72hrs E+O
7191206474-01-00-1	Site 2 (Test)	0/0	0/0	0/0	0/0	0
	Site 6 (Test)	0/0	0/0	0/0	0/0	
	Site 3 (Negative control)	0/0	0/0	0/0	0/0	0
	Site 5 (Negative control)	0/0	0/0	0/0	0/0	
7191206474-01-00-2	Site 2 (Test)	0/0	0/0	0/0	0/0	0
	Site 6 (Test)	0/0	0/0	0/0	0/0	
	Site 3 (Negative control)	0/0	0/0	0/0	0/0	0
	Site 5 (Negative control)	0/0	0/0	0/0	0/0	
7191206474-01-00-3	Site 2 (Test)	0/0	0/0	0/0	0/0	0
	Site 6 (Test)	0/0	0/0	0/0	0/0	
	Site 3 (Negative control)	0/0	0/0	0/0	0/0	0
	Site 5 (Negative control)	0/0	0/0	0/0	0/0	

GLP STUDY REPORT: 7191206474-01-00
28 JUN 2019

PSB Singapore

8.2 <u>PRIMARY IRRITATION SCORE (PIS) AND PRIMARY IRRITATION INDEX (PII)</u>

Animal ID	PIS_{test} (Sum of all scores of 2 test sites / 6)	$PIS_{negative\ control}$ (Sum of all scores of 2 negative control sites / 6)	PIS (PIS_{test} – $PIS_{negative\ control}$)	PII (Sum of PISs of individual animals / 3)
7191206474-01-00-1	0	0	0	0
7191206474-01-00-2	0	0	0	
7191206474-01-00-3	0	0	0	

8.3 <u>OBSERVATION OF OTHER ADVERSE EFFECTS</u>

No other adverse effect was observed in all the test animals during the observation period.

9. HISTORICAL DATA FOR POSITIVE CONTROL

The periodical positive control (20% (w/v) sodium dodecyl sulfate in water) was conducted in GLP study 7191197747-02-00. These historical data were adopted from GLP study 7191197747-02-00 conducted on 31 Dec 2018 to 11 Jan 2019 as follows:

Animal ID	$PIS_{positive\ control}$ (Sum of all scores of positive control site / 3)	$PIS_{negative\ control}$ (Sum of all scores of negative control site / 3)	PIS ($PIS_{positive\ control}$ - $PIS_{negative\ control}$)	PII (Sum of PISs of individual animals / 3)
7191197747-02-00-01	3.33	0	3.33	3.22
7191197747-02-00-02	3.33	0	3.33	
7191197747-02-00-03	3.00	0	3.00	

The skin irritation response category of the positive control is moderate (2 to 4.9).

11. CONCLUSION

Based on the above results, using direct contact method, the skin irritation response category of the test item – AHP-1 k ppm Ag Ac, Lot No: 01 is negligible (PII = 0, less than 0.4).

Skin Sensitization Test Report

<u>No skin sensitization</u>, as per ISO 10993-10:2013 Biological evaluation of medical devices Part 10: Tests for irritation and skin sensitization

11. CONCLUSION

Based on the above results, using direct contact of the test item - AHP 1K, Lot No: NA moistened with 0.9% NaCl saline, no skin sensitization was produced in guinea pigs when closed-patch method was conducted.

GLP STUDY REPORT: 7191209960-03-00
04 SEP 2019

8. TEST RESULTS

8.1 <u>SKIN REACTIONS AT THE CHALLENGE AREA OF EACH ANIMAL</u>

8.1.1 The grades of each animal in test group and negative control group

Group	Animal ID	Grade at 24 hrs after removal of the challenge patch at the challenge area of test item	Grade at 48 hrs after removal of the challenge patch at the challenge area of test item
Test	7191209960-03-00-T-1	0	0
	7191209960-03-00-T-2	0	0
	7191209960-03-00-T-3	0	0
	7191209960-03-00-T-4	0	0
	7191209960-03-00-T-5	0	0
	7191209960-03-00-T-6	0	0
	7191209960-03-00-T-7	0	0
	7191209960-03-00-T-8	0	0
	7191209960-03-00-T-9	0	0
	7191209960-03-00-T-10	0	0
Negative control	7191209960-03-00-NC-1	0	0
	7191209960-03-00-NC-2	0	0
	7191209960-03-00-NC-3	0	0
	7191209960-03-00-NC-4	0	0
	7191209960-03-00-NC-5	0	0

Note: 0 = No visible change

8.2 <u>OBSERVATION OF OTHER ADVERSE EFFECTS</u>

No other adverse effect was observed on all animals during the observation period.

Food Contact Test

intertek
Total Quality. Assured.

TEST REPORT

Number: BKKH21000677

Test conducted:

Conclusion:

Tested sample	Standard	Result
Submitted samples	U.S.21 CFR F.D.A. regulation Part 175.300 clause (c)(4) on Coating intended for repeated use and employed as a component of a non-container	Pass

****

Test result:

Test for F.D.A. regulation on resinous and polymeric coating(S)
With reference to the U.S. 21 CFR Food and Drug administration part 175.300, clause (c)(4).

I. Condition of Contact in Actual Use :
Room Temperature Filled and Stored (no thermal treatment in the container)

II. Result

Test items	Result (mg/in^2)	Fixed Limit (mg/in^2)
(A) Total Non-volatile soluble Extractive in Water	0.04	18
(B) Total Non-volatile soluble Extractive in Heptane	0.66	18
(C) Total Non-volatile soluble Extractive in 8% Alcohol	0.02	18

Remark : mg/in^2 = Milligram per square inch
(S) = Test item has been tested by subcontractor approved by Intertek.

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Anti-bacterial Test Report

December 2021

Coated PET film with Antimicrobial activity value,
tested as per JIS Z 2801: Antibacterial Products -- Test For Antibacterial Activity And Efficacy

TEST REPORT: 7191263493-CHM21-01-RC
05 JUL 2021

PSB Singapore

RESULTS (cont'd)

Test microorganism (Bacterial cells inoculated per test piece)	Average of the number of viable cells of test microorganism per test piece		Value of Antibacterial Activity (Criteria : Not less than 2.0)
Klebsiella pneumoniae (ATCC 4352)	0 hour	24 hours	
Uncoated Sample (Control)	120 000	34 000	-
AHC23B coated on Polycarbonate Film Batch no. AMS240521	-	Less than 10	More than 3.54

Test microorganism (Bacterial cells inoculated per test piece)	Average of the number of viable cells of test microorganism per test piece		Value of Antibacterial Activity (Criteria : Not less than 2.0)
Methicillin-resistant *Staphylococcus aureus* (MRSA) (NCTC 12493)	0 hour	24 hours	
Uncoated Sample (Control)	140 000	29 000	-
AHC23B coated on Polycarbonate Film Batch no. AMS240521	-	Less than 10	More than 3.47

TEST REPORT: 7191263493-CHM21-01-RC
05 JUL 2021

PSB Singapore

RESULTS

Test microorganism (Bacterial cells inoculated per test piece)	Average of the number of viable cells of test microorganism per test piece		Value of Antibacterial Activity (Criteria : Not less than 2.0)
Staphylococcus aureus (ATCC 6538P)	0 hour	24 hours	
Uncoated Sample (Control)	150 000	23 000	-
AHC23B coated on Polycarbonate Film Batch no. AMS240521	-	Less than 10	More than 3.36

Test microorganism (Bacterial cells inoculated per test piece)	Average of the number of viable cells of test microorganism per test piece		Value of Antibacterial Activity (Criteria : Not less than 2.0)
Escherichia coli (ATCC 8739)	0 hour	24 hours	
Uncoated Sample (Control)	140 000	94 000	-
AHC23B coated on Polycarbonate Film Batch no. AMS240521	-	Less than 10	More than 3.97

Conclusion: AHC based antimicrobial coating has exhibited at least 99.9% reduction on both gram-positive and gram-negative bacteria such as Staphylcoccus, MRSA, E-Coli, Kiensiella pneumonia, etc

ASAHI LIFECARE TECHNOLOGY

Anti-Virus Test Report

December 2021

Anti Viral Test Report using AHC coating

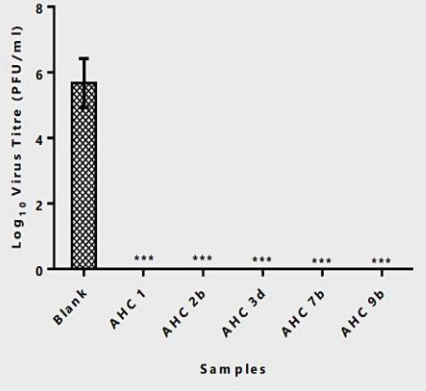
Conclusion:
AHC has showed complete inhibition on influenza A virus or H1N1

RESULTS:

Table 1: Average total virus titre of blank, and anti-microbial treated glass-slides.

Blank Sample 1	Blank Sample 2	Blank Sample 3	Average
4.82×10^5 PFU/ml	5.97×10^5 PFU/ml	6.24×10^5 PFU/ml	5.68×10^5 PFU/ml
AHC 1 Sample 1	**AHC 1 Sample 2**	**AHC 1 Sample 3**	**Average**
0	0	0	0
AHC 2b Sample 1	**AHC 2b Sample 2**	**AHC 2b Sample 3**	**Average**
0	0	0	0
AHC 3d Sample 1	**AHC 3d Sample 2**	**AHC 3d Sample 3**	**Average**
0	0	0	0
AHC 7b Sample 1	**AHC 7b Sample 2**	**AHC 7b Sample 3**	**Average**
0	0	0	0
AHC 9b Sample 1	**AHC 9b Sample 2**	**AHC 9b Sample 3**	**Average**
0	0	0	0

Figure 1: According to the results shown below,. all the samples treated with anti-microbial agents (AHC 1, AHC 2b, AHC 3d, AHC 7b, AHC 9b) showed complete inhibition influenza A virus.



Anti Viral Test Report using AHC coating

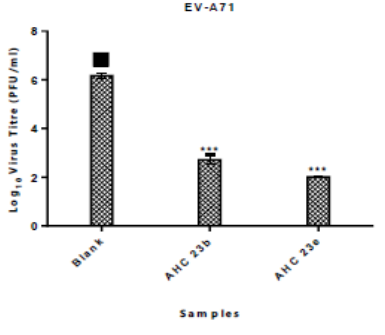
Conclusion:
AHC has exhibited at least 99.9% reduction on EV-A71

RESULTS

Table 1: Average total virus titre of control glass-slides and antimicrobial treated glass-slides

Non-treated Sample 1	Non-treated Sample 2	Non-treated Sample 3	Average
1.4×10^6 PFU/ml	1.2×10^6 PFU/ml	2×10^6 PFU/ml	1.53×10^6 PFU/ml
AHC 23b Treated Sample 1	**AHC 23b Treated Sample 2**	**AHC 23b Treated Sample 3**	**Average**
9×10^2 PFU/ml	4×10^2 PFU/ml	4×10^2 PFU/ml	5.67×10^2 PFU/ml
AHC 23e Treated Sample	**AHC 23e Treated Sample**	**AHC 23e Treated Sample**	**Average**
1.1×10^2 PFU/ml	1×10^2 PFU/ml	1×10^2 PFU/ml	1.03×10^2 PFU/ml

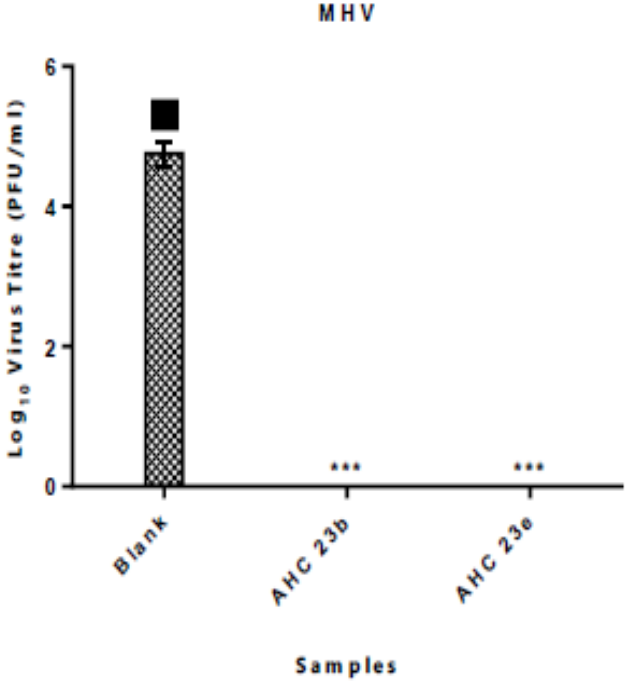
Figure 1: According to the results shown below, a 3.5-logs and 4.17-logs inhibition was observed for AHC 23b and AHC23e, respectively, upon treatment comparing to the blank (control). The asterisk indicates *p values <0.05, **p values of <0.01 and ***p values <0.001 by 1-way ANOVA with post-dunnett test using GraphPad Prism version 5.00 for Windows, GraphPad Software. Asterisks indicate statistically significant results relative to control group (■).



CONCLUSION:

Based on the data obtained, upon 24h contact time, for both AHC 23b and AHC 23e, inhibition was observed on upon treatment with comparing to the non-treated (control).

Anti Viral Test Report using AHC coating



CONCLUSION:

Based on the data obtained, upon 24h contact time, a complete inhibition of murine-hepatitis virus (MHV) was observed on upon treatment with comparing to the non-treated (control).

Anti Viral Test Report using AHC coating

Conclusion:
AHC has exhibited at least 99.9% reduction on OC43 virus (Surrogate to Sars-Cov2(Covid-19) virus)

TEST REPORT

Virucidal efficacy test of AHC23E

according to ISO 21702 Measurement of Antiviral Activity on Plastics and Other Non-Porous Surfaces

Report Number:	TNSG-C-0025/AHC23/0721-DWE-01-2
Report Date:	22 Sep 2021
Sponsor:	Asahi LifeCare Technology, 47 Pandan Road, Singapore 609288
Names of Test Articles:	AHC23E Anti Microbial Coating on PC film
Test Article Size:	50 x 50 mm flat surface
Lot Date:	24 May 2021
Test Article Received:	7 Jun 2021
Test Time Period:	16 Jun to 17 Sep 2021

Summary

The virucidal product, AHC23E, weas quantitatively evaluated for virucidal activity on polycarbonate film.

This test was conducted according to ISO 21702:2019, with test method based on incubation of viral inoculum (Human Coronavirus OC43) in contact with treated and untreated test specimens. A contact point of 24 hours was selected with inoculum drying risk being managed carefully. Following exposure to the contact point, the inoculated virus was recovered, with concentration of infective virus determined.

Antiviral performance was determined by comparison of recovered virus between treated and untreated material, after the 24-hour incubation. Antiviral performance is reported as both the Log10 and % Reduction relative to the untreated control sample.

The following antiviral efficacy results were quantified:

Inoculum: Human Coronavirus (Betacoronavirus 1, OC43 strain)			
Test Specimen		**Interval**	**Result**
Treated	**AHC23E coated on polycarbonate film**		
	Virus Concentration	0 min	5.8 Log_{10} $TCID_{50}$ / cm^2
	Percent Reduction = 99.9%	24 hours	2.8 $_{Log\ 10}$ Reduction
Control	**Positive (Untreated) Control**		
	Virus concentration	0 hr	6.3 Log_{10} $TCID_{50}$ / cm^2
	Virus concentration	24 hours	6 Log_{10} $TCID_{50}$ / cm^2

Gaurava Mishra
Country Head

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Washability Test

December 2021

Methodology

Adopted from ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings

- Check WCA & other properties of sample before test
- Soak the 3M sponge sufficiently with tap water
- Place the wet sponge and holder at one end of the panel so that its long axis is parallel to the length of the sample
- Turn on pump to add water or Ethanol 70% while the equipment run
- Allow the sponge to travel specific number of cycles
- Check WCA & other properties of sample after specific number of cycles
- Test pieces were sent for Mueller Hinston Agar (MHA) Plate Testing using E-Coli BL21 in accordance to JIS Z 2801:2010 “Antibacterial products-Test for antibacterial activity and efficacy”
- Incubation period – 24 hours

Speed: 37±1 cycle/min

Load: Dry sponge + holder = 1kg

Bacterial Efficacy based Percent reduction after 24 Hours Contact with water as cleaning media

Sample condition:
- Sprayed 2 pass at 5cm distance – about 1 micron thickness
- Contact period: 24hours
- Incubation period: 24 hours

Test Pieces	CFU	Value of antibacterial activity (Log_{10} reduction)	Value of antibacterial activity (Percent reduction)
Initial inoculated cells	129×10^4	-	-
Blank Control	80×10^6	-	-
AHC23 @ 0 wash	**37×10^4**	**2.33**	**99.54**
AHC23 after 5K washes with water as media	**23×10^5**	**1.54**	**97.15**
AHC23 after 10K washes with water as media	**189×10^5**	**0.62**	**76.31**

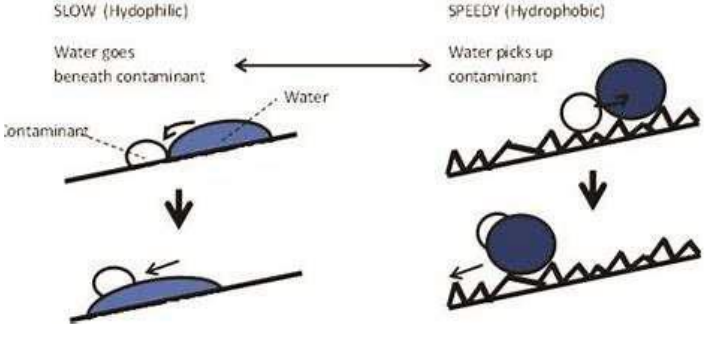
Bacterial Efficacy based Percent reduction after 24 Hours Contact with 70% Ethanol/30% Water as cleaning media

Sample condition:
- Sprayed 2 pass at 5cm distance – about 1 micron thickness
- Contact period: 24hours
- Incubation period: 24 hours

Test Pieces	CFU	Value of antibacterial activity (Log_{10} reduction)	Value of antibacterial activity (Percent reduction)
Initial inoculated cells	109 x 10^5	-	-
Blank Film Control	26 x 10^6	-	-
AHC23 after 500 wipes with 70% Ethanol	1680	4.19	99.99
AHC23 after 1000 wipes with 70% Ethanol	2740	3.98	99.99

Hydrophibicity Effect of coated surface after Water or 70% Ethanol/30% water washes

Number of washes with water	0 Washes	5K Washes	10K Washes
Water Contact Angle after Wash	**114.0**	**101.1**	**101.6**
Number of washes with 70%Ethanol/30% Water	**0 Washes**	**500 Washes**	**1K Washes**
Water Contact Angle after Wash	**113.5**	**110.8**	**111.2**



Note: Degree of water beading greater than 65° is considered hydrophobic and is considered super hydrophobic if greater than 110°

Anti-Bacterial and Anti Viral Varying Contact Time Testing

December 2021

JIS Z 2801:2010 “Antibacterial products-Test for antibacterial activity and efficacy”

Method of Test

This test determines the potential of the test agent to disinfect hard, non-porous surfaces contaminated with *Escherichia coli*. The value of antibacterial activity obtained by the testing methods of this Standard shall not be less than 2.0 for the antibacterial efficacy.

AHC23b coated samples were used in this experiment. *MRSA* was added onto each samples and covered with sterile covered glass. The test inoculum was left on the samples **for varying contact time – 0.5hr, 2hr & 24hr**. After incubation, the number of colonies in a serially diluted petri dish in was counted.

Materials used

Test microorganism: Methicillin-resistant Staphylococcus aureus (*MRSA; NCTC12493)*

Agar: Mueller Hinton agar (MHA)

Samples: AHC23b coated onto polymeric substrate

Contact time: 0.5, 2 and 24Hrs

Contact time Testing by TUV-SUD

TEST REPORT: 7191267836-CHM21-01-RC

Date: 10 SEP 2021 Tel: +65 69736171

Client's Ref: - Email: Randy.CHIN@tuvsud.com

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

PSB Singapore

Add value. Inspire trust.

SUBJECT

Antibacterial Activity Evaluation

CLIENT

Asahi Lifecare Technology
47 Pandan Road
Singapore 609288

Attn: Chew Kai Hwa

SAMPLE SUBMISSION DATE / TEST DATE

12 Aug 2021 / 18 Aug 2021

DESCRIPTION OF SAMPLE

One coated sample was submitted by the above company, as follows:

Product Description	AHC23B Coating Solution
Batch no.	AMS100821

METHOD OF TEST

The evaluation of antibacterial activity was conducted based on:

JIS Z 2801:2010/A1:2012
"Antibacterial products – Test for antibacterial activity and efficacy".

Test microorganism(s) used :

Methicillin-resistant *Staphylococcus aureus* (MRSA) (NCTC 12493)

Size of Coated Sample: 5 cm x 5 cm
Size of Uncoated Sample: 5 cm x 5 cm
Size of film: 4 cm x 4 cm polyethylene film
Volume of test inoculum : 0.2 ml

TÜV SÜD PSB

Laboratory:
TÜV SÜD PSB Pte. Ltd.
15 International Business Park
TÜV SÜD @ IBP
Singapore 609937

Phone : +65 6778 7777
E-mail: info.sg@tuvsud.com
https://www.tuvsud.com/sg
Co. Reg : 199002557R

Regional Head Office:
TÜV SÜD Asia Pacific Pte. Ltd.
15 International Business Park
TÜV SÜD @ IBP
Singapore 609937

PSB Singapore

RESULTS

Test microorganism (Bacterial cells inoculated per test piece)		Average of the number of viable cells of test microorganism per test piece	Value of Antibacterial Activity
Methicillin-resistant *Staphylococcus aureus* (MRSA) (NCTC 12493)			
Uncoated Sample (Control)	0 hour	110 000	-
	30 mins	170 000	
	2 hours	190 000	
	24 hours	190 000	
AHC23B Coating Solution Batch no.: AMS100821	0 hour	-	-
	30 mins	Less than 10	More than 4.23
	2 hours	Less than 10	More than 4.27
	24 hours	Less than 10	More than 4.28

Conclusion: AHC23b coated surface exhibited anti-bacteria efficacy of >99.99% within 30 mins of contact time

ISO 21072:2019 – Measurement of antiviral activity on plastics and other non-porous surface

Testing Method and Conditions

- Control and sample were cut into 20 mm × 20 mm pieces.
- Prior to testing, the samples were sterilized by UV for 15 min.
- 3 control samples and 3 test samples were required. 3 control and 3 test samples were inoculated with 0.2 mL of MHV at a concentration of approximately 107 PFU/mL.
- Incubated for a contact time of 15min at room temperature. A cover slide is added onto the virus droplet to prevent evaporation and ensure maximum contact with the test surface.
- At the required time interval, a neutralizing broth, soya casein lecithin polysorbate broth was added.
- Following the neutralization, 20 mL of DMEM was added to the controls and samples to wash out the virus. With appropriate dilutions, the infectivity titre was enumerated using NCTC 1469 cells through the plaque assay.
- The antiviral activity is calculated by comparison of the antiviral test material to the control.

Material Used

- Virus Used : Maurine Hepatitis Coronavirus (MHV)
- Test Sample: Polymeric substrate coated with AHC23 antimicrobial solution
- Control: Polymeric substrate without any antimicrobial coating
- Contact Time 15 mins

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Institute of Bioengineering and Bioimaging
IBB

Results

Contact time: 15min, room temperature			
Control: Uncoated surface	**Infectivity titre (PFU/sample)**	**Average**	
1	820000		
2	820000	767000	
3	660000		
Test sample	**Infectivity titre (PFU/sample)**	**Antiviral activity (%)**	**Limits of detection**
1	0	99.999	5 log
2	0	99.999	5 log
3	0	99.999	5 log

$|S_n - S_t| \leq 0.5$

$|S_n - S_u| \leq 0.5$

where $S_n = 2.1$, $S_t = 2.4$ and $S_u = 1.9$

The test result are valid as the both of the conditions above are met.

Remarks

The test fabric showed an overall reduction of **99.999%** when tested against MHV with a 15min contact time. The limit of detection is 5 log reduction. The neutralizing buffer did not cause any toxicity to the host cells.

Test report prepared by:

Dr. Jeremy Tan
Senior Research Scientist
IBB

Test report approved by:

Dr. Yang Yi Yan
Covering Executive Director
IBB

Conclusion: AHC23 coated surface exhibit anti-virus efficacy of >99.99% within 15 mins of contact time

NEA Approved List of Antimicrobical Coating Solution against COVID-19

Published and updated as of
13 December 2021

S/N	Product Name	Application method	Durability and efficacy data	Efficacy class
1	Nanoshield	Film Peel and stick onto surfaces	**Yes**, >3.6-log reduction of SARS-CoV-2 within 15 min, after a simulated cleaning with 90 wipes of ethanol or detergent.	Class A
2	AirTumTec Pro (Not commercially available off-the-shelf)	Spray Coating is applied by manufacturer	**Yes,** 2.67-log reduction of hCoV-229E within 15 min, after 2,000 cycles of abrasion according to ASTM D4060 Test material: Ceramic	Class A
3	airDefender Anti-Microbial Surface Coating Solution	Spray Coating to be applied by user according to direction of use	**Yes**, 0.8-log reduction of human coronavirus-229E within 65 min and 2.9-log reduction within 170 min, after a simulated cleaning with 100 wipes of ethanol. Test material: Stainless steel	Class C
4	Asahi Lifecare Antimicrobial Coating Solution AHC23B (Not commercially available off-the-shelf)	Solution Coating is applied by manufacturer or appointed distributor	**Yes,** 5-log reduction of murine coronavirus-MHV within 15 min, after a simulated cleaning with 1000 wipes of ethanol. Test material: Polycarbonate film	Class A

A total of 52 products have been evaluated based on data provided by suppliers, in accordance with the criteria as stated in the Technical Guidance on the Testing of Self-Disinfecting Surface Coatings against SARS-CoV-2.

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In summary

Bacteria Tested under JIS Z2801:2010/A1:2012 Staphylococcus aureus (ATCC6538P) Escherichia Coli (ATCC8739) Bacillus subtilis (ATCC6633) Methicillin-Resistant Staphylococcus aureus (NCTC12493) Streptococcus pyogenes (ATCC19615) Kiebsiella pneumoniae (ATCC4352) Pseudomonas aeruginosa (ATCC15442)	**Viruses Tested Under ISO21702** EV A71 (Hand Foot Mouth Disease (HFMD)) H1N1 (Influenza A) MHV (Maurine Hepatitis Virus) OC43 (Human Coronavirus and surrogate to Sars-Cov2)
Bacteria Tested Under ASTM E2180-07 on Polymeric or Hydrophobic Material based on 10X wash cycle Staphylococcus aerues (ATCC6538) Kiebsiella pneumonia (ATCC4352)	**Washability Test ASTM D4824 followed by ASTME2180-07** Escherichia Coli (ATCC8739)
BACTERIA Tested Under JIS Z2801:2010/A1:2012 For Contact Time 30mins, 2 hours and 24 hours Methicillin-Resistant Staphylococcus aureus (NCTC12493)	**Virus Tested Under ISO21702 For Contact Time 15mins** MHV (Maurine Hepatitis Virus)
Test Done Under ISO 10993-5:2009, ISO 10993-10:2003 Cytotoxicity Test Acute Dermal Irritation Test Skin Sensitization Test	**U.S.21 CFR FDA Regulation Part 175.3000 Clause (c)(4) Food Contact Test** Pass
AHC Based Antimicrobial Coating could attained >99.9% Efficacy on both bacteria and Viruses and proven to be safe on the surface coated.	

Examples of AHC End-Users

December 2021

The Mills International

- Anti-microbial carpets & flooring alternatives for exhibition halls
- Created a new line of product: EXPOflor

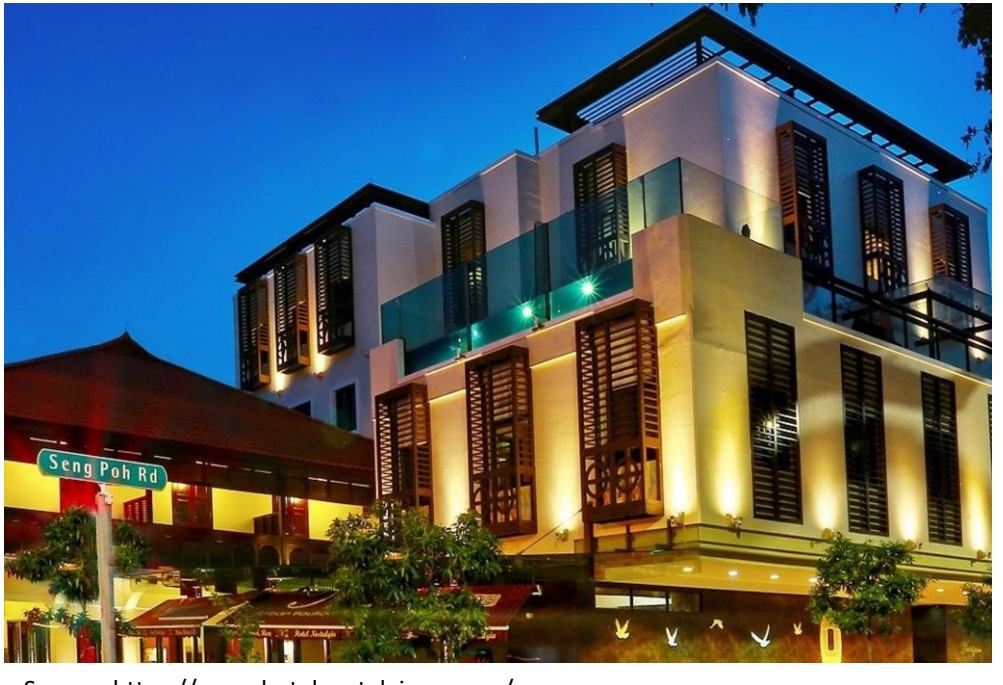
Source: https://expoflor.com.sg/

Source: https://expoflor.com.sg/

Nostalgia Hotel Singapore

- Boutique Hotel situated at Tiong Bahru
- Coated AHC7 for their hotel room, including curtains, carpet, bathroom
- Other high touch areas coated includes phone, remote control, switches and doorknobs

Source: https://www.hotelnostalgia.com.sg/



Source: https://www.hotelnostalgia.com.sg/

ASAHI LIFECARE TECHNOLOGY

PicoX
Simplify Infection Risk™

Air Robot Purifier

- Air Purifier Robot
- Circulating the air in the environment by cleaning the air by going through HEPA filter
- HEPA filter is coated with Asahi Lifecare's Antimicrobial solution making changing of filter safer

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Coating on Operational Ambulance

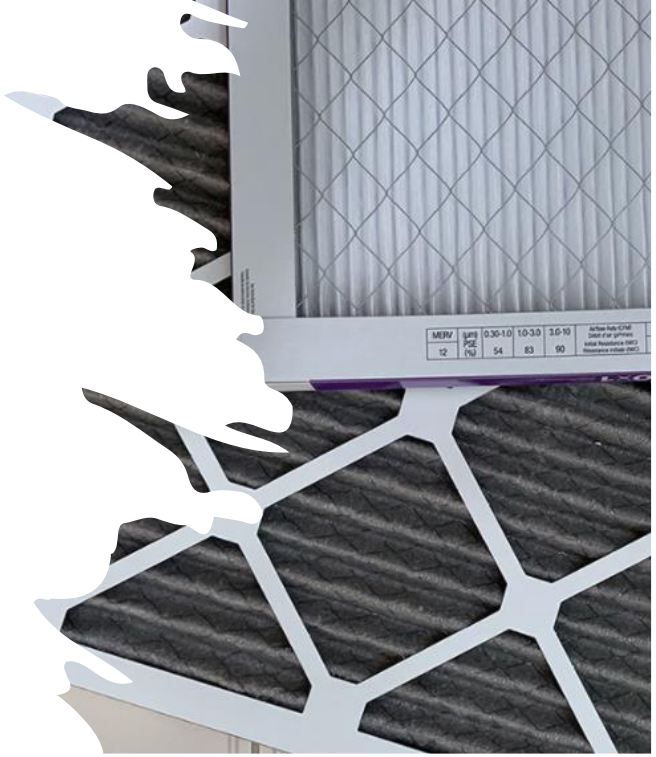
1. Ambulance External Backdoor Handle
2. Ambulance Internal backdoor Handle
3. Driver's steering wheel and Seat
4. Oxygen Knob (inside of Ambulance)
5. Yellow Bar Handle
6. Ambulance Seats

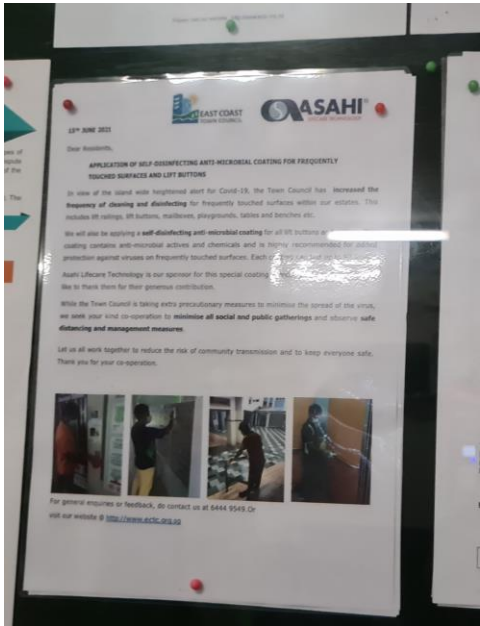
Coating on Elderly Home

December 2021

Others

- East Coast GRC – All the lifts and touchable area
- All Saints Elderly Home
- Methodist Church
- Bethel Child care Centre
- Keppel Tower
- Filters Manufacturer
- Carl Zeiss Office/Lab
- Car grooming services.





December 2021

Thank you

KH Chew

Technical cum R&D Director