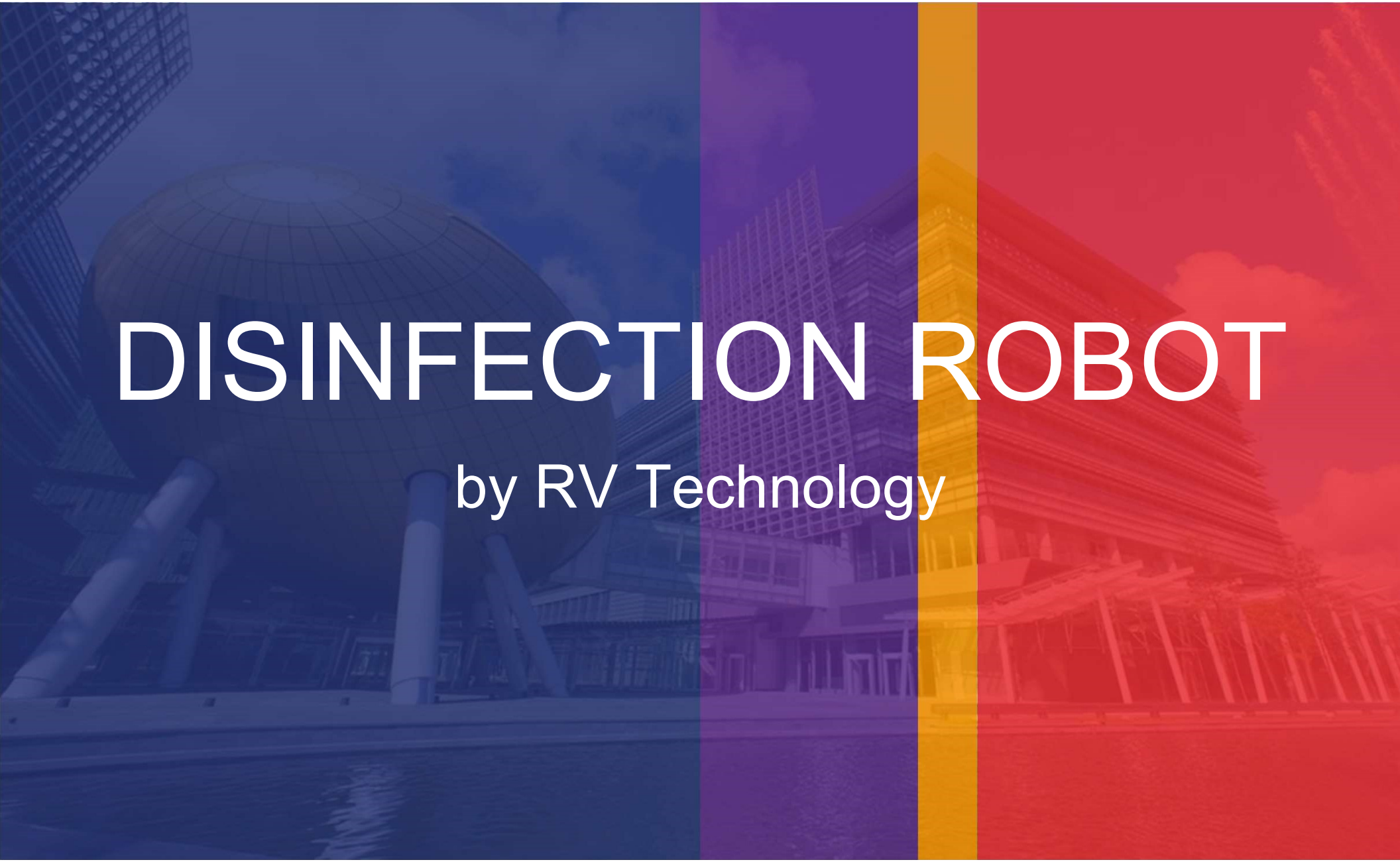
Robots for Indoor Disinfection

by RV automation Technology

27th Apr 2020

RV Technology



DISINFECTION ROBOT

by RV Technology

SUMMARY

Technology

Robots for Indoor Disinfection
(REF : W-0241)

This project aims to develop a robot for indoor area disinfection, in order to maintain environmental hygiene and minimize cleaning staff's exposure to viruses and germs. The subject robot shall be able to perform both manual and automatic remote control for indoor disinfection tasks (e.g. spraying of disinfectants) such as in office environment, sports complex and quarantine areas.

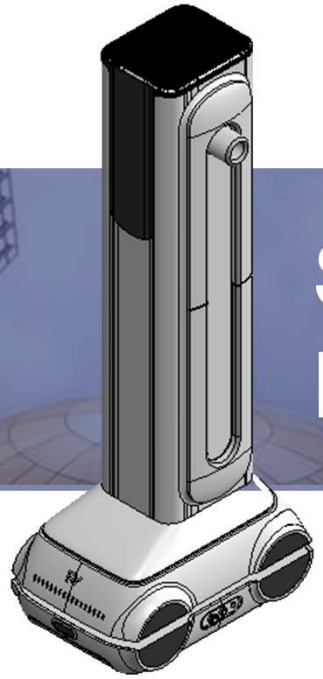
PROJECT EXPECTED OUTCOME

RV Technology

A robotic system shall be designed, developed, constructed, tested and commissioned with appropriate types of disinfection operation and battery-driven chassis with processing units including obstacle avoidance, navigation and indoor positioning.

DISINFECTION ROBOTS

Technology



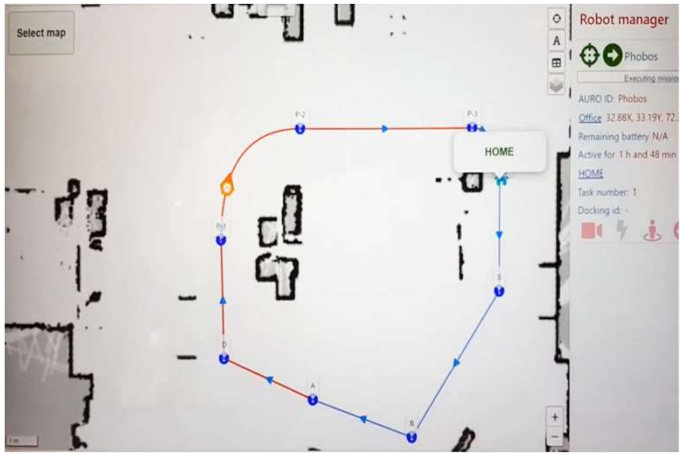
Spray Disinfection Robot

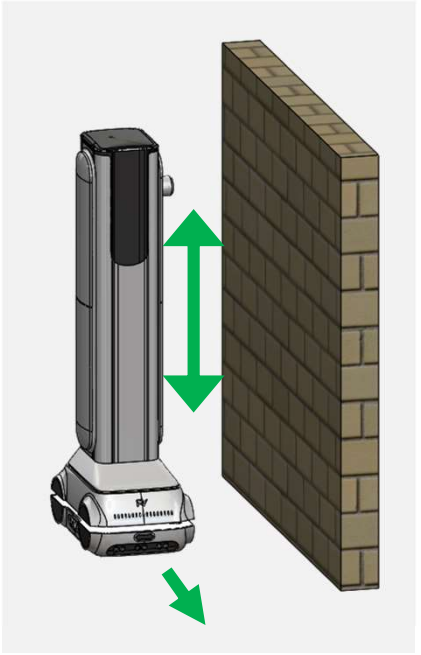
Fogging Disinfection Robot

SPRAY DISINFECTION ROBOT

RV Technology

- Autonomous Navigation
- SteraMist® BIT™ Disinfection
- Direct Spray
- Spray at different height, different location
- 5 seconds per square foot for disinfection
- Reaches surfaces and areas that regular disinfectants cannot reach





FOGGING DISINFECTION ROBOT

RV Technology

- Autonomous Navigation
- SteraMist® BIT™ Disinfection
- Effective whole room treatment in under 45 minutes
- Six-Log Kill (99.9999%) on Clostridium difficile spores
- Kills pathogenic bacteria and Deodorizes by killing odor causing bacteria
- Precise measurement of H^2O^2 disbursement.

PRODUCT VIDEOS

Technology

Disinfection Robot

RV Technology

DISINFECTION TECHNOLOGIES

BINARY IONIZATION TECHNOLOGY® (BIT™)

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY®

RV Technology

TOMI SteraMist Binary Ionization Technology (BIT) was invented under a grant in association with the **Defense Advanced Research Projects Agency (DARPA)** of the U.S. Department of Defense in response to the 2001 weaponized Anthrax spores' attacks (Amerithrax).

DARPA

SteraMist's disinfection technology utilizes **ionized Hydrogen Peroxide (iHP)** mist/fog spray to **achieve a six-log (99.9999%)** or greater kill and is regarded as the "gold standard" of sterilization in the disinfection industry.

Its state-of-the-art technology is capable of providing **disinfection protection from coronavirus**, existing and emerging pathogens, mutating resistant bacteria, bacteria spore, viruses, fungi and spores. SteraMist has now been implemented in all corners of the globe as multiple registrations are secured both in US and internationally; including independent validation and registration with the European Union (EU), Ministry of Health Israel, China CDC, Taiwan, South Africa, among many others.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FDA REGISTERED

Canada Health Canada

MINISTRY OF HEALTH

USDA

CDC

THE COLD PLASMA ARC

Technology

- Allows a Kill on Contact – using **ONLY 7.8%** hydrogen peroxide-based solution which breaks the H202 bond- creating Reactive Oxygen Species (ROS), composed mostly of Hydroxyl Radicals.
- **Six-Log Kill Achieved** – NOT by a high concentration of H2O2, but by **the power in the ion of the Hydroxyl Radicals**
- A charged droplet is activated immediately after the solution passes the arc - a **SMALL CHARGED MICRON** and a fog that disperses like a **GAS** throughout an area, touching all surfaces, and completing this task without the need of additional equipment (i.e. fans or blowers).

EPA REGISTERED: SOLUTION AND EQUIPMENT

RV Technology

- The **first EPA registered solution + equipment combination** that provides the unique technology of Hydrogen Peroxide Ionization for Hospital-Healthcare Disinfecting.
- Kills bacteria which may reduce the risk of exposure to bacteria on treated surfaces.
- Intended for use in all Hospital-Healthcare, Life Science, Commercial and Food use sites and facilities.
- A visual mist that moves like gas.
- Does not contaminate the environment with any toxic by-products.
- Does not cause blistering of paint and is Silver Ion free.
- This product's sole active ingredient is hydrogen peroxide.
- Quick drying time – no wipe, no rinse, no residue.

For use as a **Healthcare-Hospital Disinfectant** and **General Use, Multiple Use Disinfectant**

EPA REGISTERED
EPA Reg. #90150-2

Binary Ionization Technology® (BIT™) Solution
(Alternate Brand Names:
SteraMist™ BIT™ Solution
Binary Ionization Technology (BIT™) Plus
Binary Ionization Technology
BIT™
BIT™ Solution Ready-To-Use Hydrogen Peroxide
SteraMist™ BIT™)

{Begin Optional Front Panel Claims}

ACCEPTED
Jul 27, 2017
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 90150-2

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY®

STAND OUT IN MARKET

RV Technology

Kills within seconds
(Other dwell time ranges 5 to 30 mins)

6-Log kill
99.9999% on all Pathogens
(A majority of other EPA registered 99.9 to 99.99)

No Residue
No wipe
No rinse
Quick drying time

No Harmful
Effects to Health of Personnel

Non-corrosive
to 39 commonly found materials
including metals, plastics, rubbers

Environmental friendly, only **oxygen** and **water** leaves

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OTHER STERILIZING METHODS

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Ultraviolet (UV)

- Only 20-30 percent effective
- Line of sight only
- Decomposes plastics
- Room treatment limitation to height of device
- Large storage footprint
- Expensive lamp replacement
- Potential OSHA claims from exposure
- Units are heavy and may need multiple units
- Not registered by the EPA
- Efficacy not tested by Regulatory bodies

Other Hydrogen Peroxide Methods

- High levels of hydrogen peroxide
- Leaves residue
- Long application, injection and dwell time
- Room changes required, i.e. HVAC turn off
- Not compatible with iron and other metals because of its reactivity and its long exposure time
- Very high level of 800 PPM for efficacy of disinfection
- Blisters paint
- Pits stainless steel

Electrostatic Sprayers

- Efficacy claims are based solely on the disinfectant EPA label - not when applied with an Electrostatic Sprayer
- - Wet time is needed for efficacy, sometimes not known
- - Labels include several contact times, depending on the types of microorganisms that the product has demonstrated efficacy against
- - Large particle sizes <40 microns
- - Corrosive
- - No studies showing electrostatic spraying with disinfectants reduces HAIs

Spray and Wipe

- Relies on surface coverage with cleaner, leading to many untreated areas
- Cross contamination
- Requires longer application times
- Physical labor often limits application capability and restricts the cleaner to a single area at a time
- Leaves behind residue
- Wet contact times are not followed
- Application relies on personnel
- Corrosive

TOMI™ ENVIRONMENTAL SOLUTIONS | STERAMIST® POWERED BY BINARY IONIZATION TECHNOLOGY®

REGISTRATIONS AND INTELLECTUAL PROPERTY

Technology

Registered in all 50 U.S. States, Health Canada and over 20 countries worldwide
(registrations include China CDC, Taiwan FDA and the Minister of Health of Israel)

SteraMist by TOMI was the **first ever registered EPA technology and solution**

32 granted patents
and 19 applications worldwide

EPA registered as a hospital and general use disinfectant. FDA registered as a medical device

Used by professional cleaners, over 50 Hospital EVS departments, Forensic Remediators and BSL-4 Biosafety experts

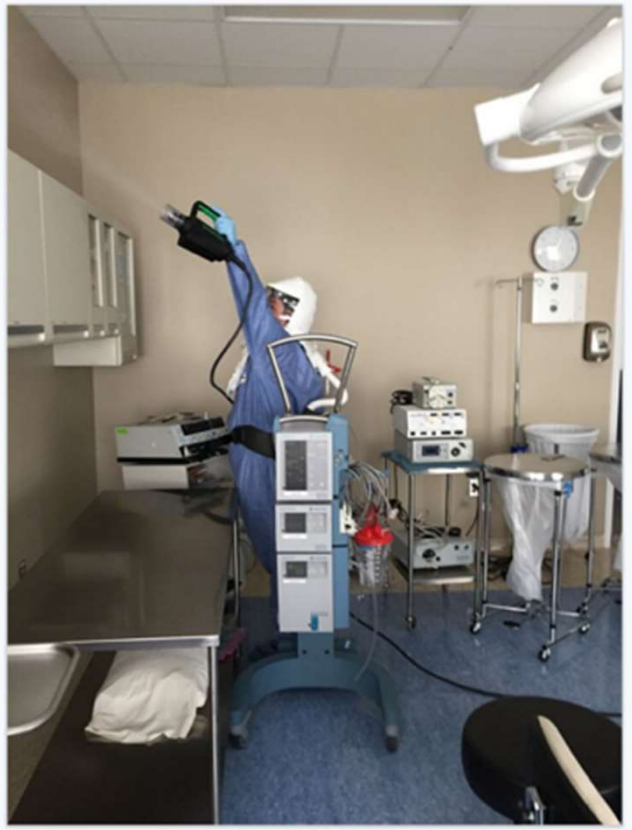
36 granted trademarks worldwide
and awaiting approval on an additional 41 registered marks

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY

NO HARMFUL EFFECTS TO HEALTH OF PERSONNEL

RV Technology

- SteraMist® BIT™ is **exclusive of toxic chemicals** that are highly corrosive and hazardous. Contains **NO harmful silver ions.**
- Intensive preparation is not required and if exposed, there are **no long-lasting harmful effects** to the health of personnel, Cal OSHA requires that all eyes and mucus membranes must be protected.
- SteraMist® BIT™ has **no off gassing leaves** the environment with **only oxygen and water (humidity).**
- **Does not damage** delicate medical instrument, laboratory equipment, sensitive electronics in ambulances or avionics in infectious disease transport aircraft.



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COMPARISON TO OTHER COMPETITORS

RV Technology

Hydrogen Peroxide Use

only uses **50-150 ppm** to get over a **6-log kill**

Others 35% H_2O_2, must use **400-600 ppm** levels to achieve kill.

Timing of Treatment

Under **45 minutes** – no need to shut down for long time periods.

Others takes hours or even **10 hours**

Shipping and Storage

Shipped via air – **NO SPEICAL** consideration

Others can only shipped by sea & rail and needs stored in **explosive cabinets**

Precondition -ing Process

DOES NOT require preconditioning to an area- **not affected** by humidity

Others needs room conditions to be altered before and after treatment

Sensitive Equipment

Superior compatibility **doesn't damage** delicate equipment

Others **corrodes equipment** and off gasses for days.

DISINFECTANT DATA

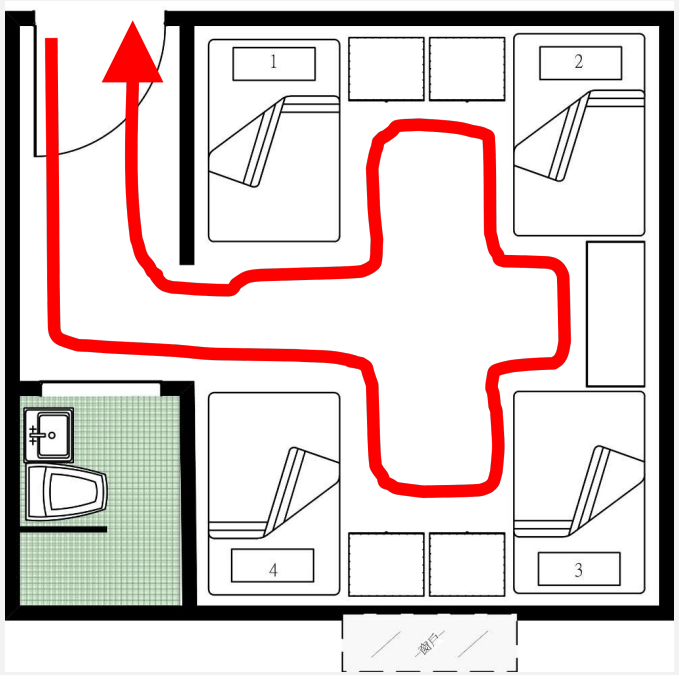
Technology

To achieve a six-log (99.9999%) Kill

Spray Distance	600-1000	mm
Area	1	sq. ft
Duration	5	sec
Usage	25	ml per min
SKU Cost	1520	HK$ per gallon
Unit Cost	0.4016	HK$ per ml

SCENARIO 1

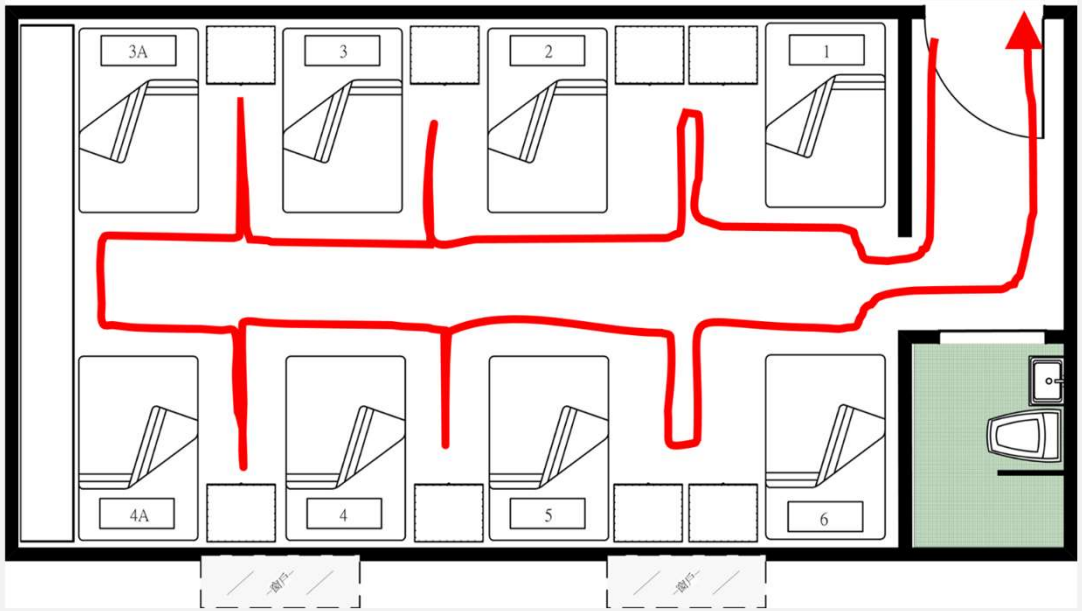
Room Size	22.5	sq.m
Total Route	19500	mm
Time	487.5	sec
Volume	406	ml
Total Cost	163	HK$



SCENARIO 2

Technology

Room Size	37.5	sq.m
Total Route	37500	mm
Time	937.5	sec
Volume	781	ml
Total Cost	314	HK$



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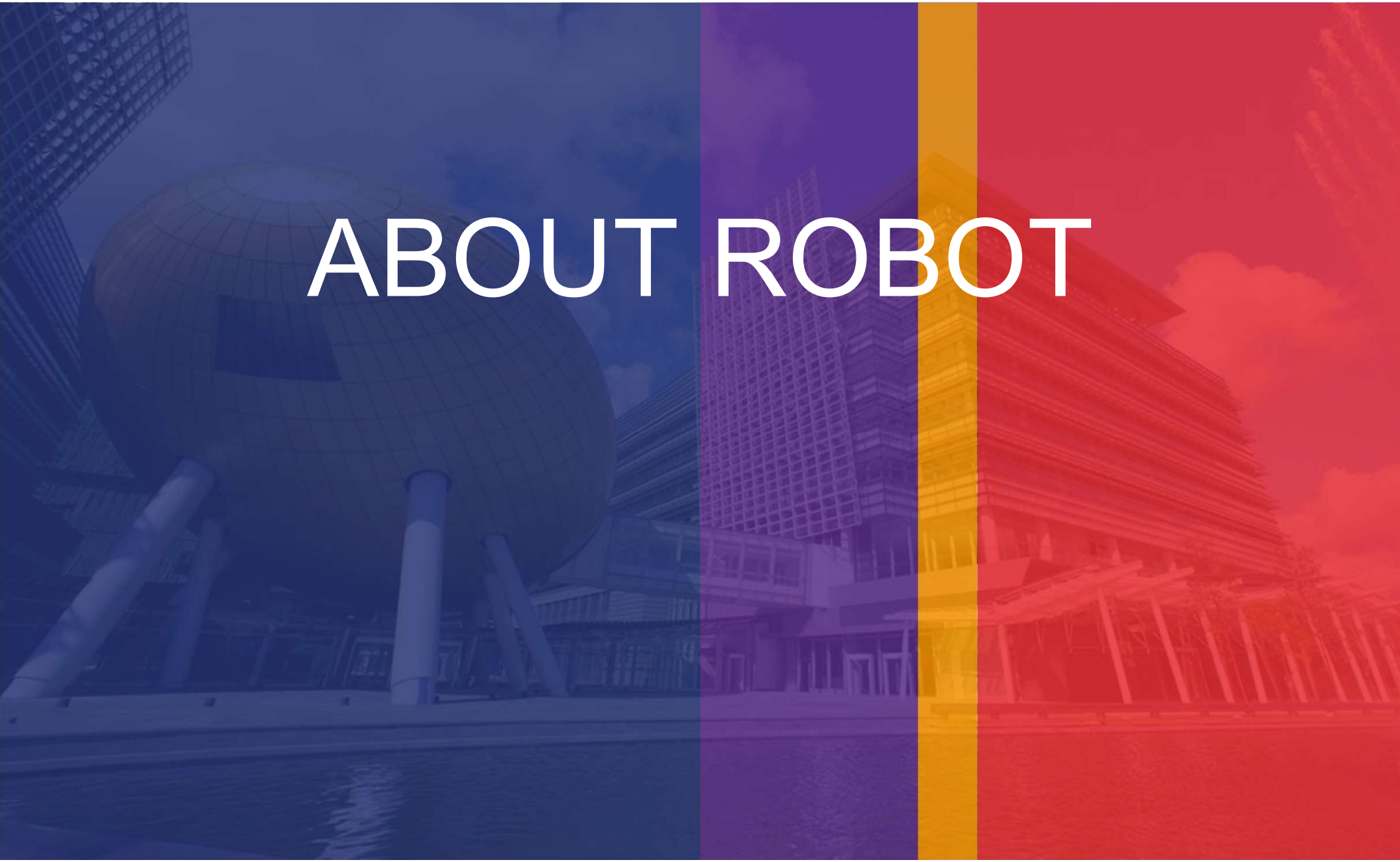
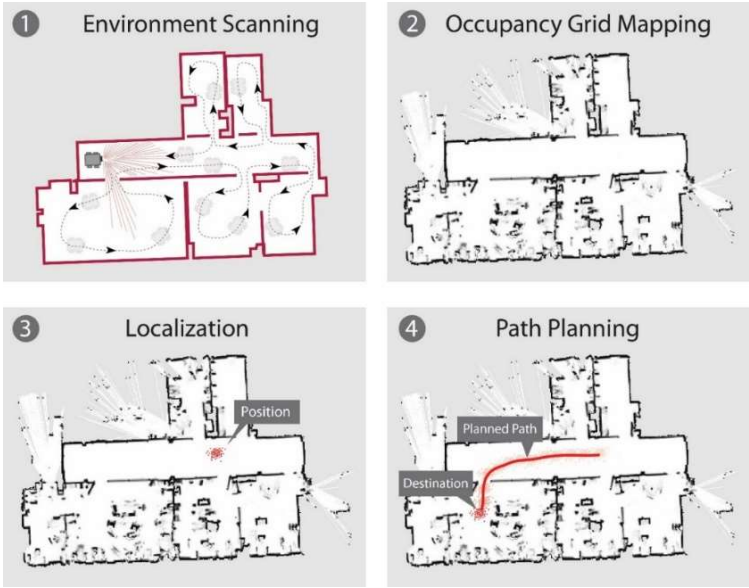


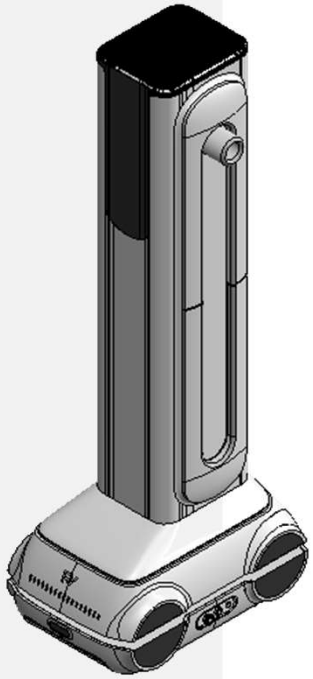
ABOUT ROBOT

AUTONOMOUS ROBOTS

Technology

- Autonomous Navigation
- Auto Storage and Retrieval Gripper
- Simultaneous Localization and Mapping (SLAM)
- LiDAR Sensor
  - Navigation Sensor
  - Safety Sensor
- 2D/3D Vision Sensor
- Two-wheel Differential Drive





ROBOT VS HUMAN

RV Technology

Special Decontamination Equipment 'SteraMist™' is Mobilized to Control COVID-19 in Daegu-Kyungbuk Province.

Money-Today Daily
Reported by Bo Kyung, Hong. 2020. 03. 09.
GDscience Co., Ltd. announced that the latest sterilization equipment, 'SteraMist™', exclusively supplied by TOMI Environmental Solutions, Inc., was mobilized for the protection of Kyungpook National University and ROK Daegu Hospital related to Corona19

SteraMist™ is a product commercialized by TOMI Environmental Solutions, Inc., which was developed as a defense equipment for chemical and biological warfare such as anthrax and nerve gas at DARPA, a research institute under the US Department of Defense.
In Korea, GDscience supplied SteraMist™ to the Korea Armed Force CBR Defense Command, which is a specialized team for the protection of life and death. It was used in special areas such as hospital negative pressure isolation rooms, operating rooms, and pharmaceutical sterile rooms. According to a statement issued by President Moon Jae-in on the 2nd of this month, "Utilize the full national resources to support Daegu-Gyeongbuk area", military personnel and chemical vehicles are being used in the military one after another. In particular, the special sterilization equipment, SteraMist™, which is owned by the ROK Armed Force CBR Defense, was used to protect the Kyungpook National University and the ROK Army Daegu Hospital, which were selected as the first priority area under the cooperation of Daegu City and Army 2 Operation Command.
The mechanism by which reactive oxygen species produced by plasma treatment of 7.8% low hydrogen peroxide by applying the world's first active ionization method (IHP) contact with microorganisms such as molds, bacteria, and viruses to destroy and destruction of cells down to 6 log kill (99.9999%).
In particular, it is convenient for sterilization regardless of humidity or temperature in a relatively short time. It is environmentally friendly and does not affect other sensitive devices or materials sensitive to corrosion.
An official of GDscience, the exclusive supplier of SteraMist™, said, "At the time of the outbreak of MERS CoV (Middle East Respiratory Syndrome), which occurred in Saudi Arabia and has been on the rise in Korea in 2015, the official termination of the pandemic was announced after the decontamination by SteraMist™. In the Ebola crisis in Africa, it was designated as the official decontamination equipment to eradicate Ebola from all over the world. "

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY

Technology

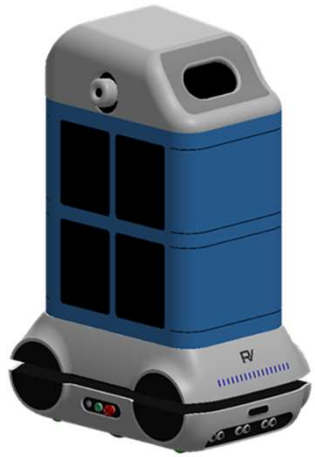
THANK YOU

Disinfection Robot – (RV standard version)

Applications	
Autonomous mobile platform	Autonomous navigation in the indoor environment;
Drive Train	
Drive wheels	2 green non-marking Polyurethane
Passive casters	2 front, 2 rear
Suspension	Passive suspension design
Steering	Differential (self-rotation is possible)
Dimensions	
Length	866mm
Width	535mm
Height	1200mm (Customerization)
Ground clearance	30mm
Weight (without load)	< 80kg
Payload	
Robot payload	100kg
Speed & Performance	
Running time	7 hours or 15 km
Maximum speed	1.5 m/s
Turning Radius	800mm
Positioning accuracy	+/-50 mm of position
Power	
Battery	LiFePo4, 48v 20ah,
Charger	Input: 100-230 Vac, 50-60Hz / Output: 54.5V
Charging mode	Manual/Auto charging (Option)
Communication	
Wifi	2.4 GHz : IEEE 802.11 b/g/n; 5 GHz : IEEE 802.11 a/n/ac
PC interface	USB, Ethernet, HDMI
Sensor	
Laser scanner (front and back)	360° & 25 meters scanning range

Top Module	
SteraMist System	SteraMist Surface Unit
	H2O2 monitoring system
Holder	
Applicator holder	Allow nozzle to spray in different angle (detail design needed)
Installed software (single-robot mode)	
Navigation – mode	Empowered by the waypoint setup feature on the map, the robot will navigate to the waypoints autonomously. The Robot was installed with collision avoidance feature with obstacles during the navigation. Integrate waypoint with applicator setting

Disinfection Robot
1 disinfection applicator



THE STERAMIST ADVANTAGE

RV Technology

- Effective broad-spectrum surface and air decontaminant.
- Effective against bacterial spores and gram-negative bacteria, including multiple drug resistant organisms (MDROs).
- Effective against viruses including swine, bird flu and mold.
- Suitable for frequent/daily use.
- Easily incorporated into current procedures and protocols.
- Fast cycle times – quick turn room turnover.
- Non-corrosive, leaves no residue, proven materials compatibility, does not damage medical equipment or computers.
- Superior efficacy.
- Rapid response worldwide.
- Cost effective pricing.

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY

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RV Technology

SteraMist serves a broad spectrum of commercial clients including, but not limited to hospitals, clinics, nursing homes, research laboratories, cruise ships, commercial offices, hotels, restaurants, schools, residential, pharmaceutical manufacture and food industry etc. In the US healthcare sector SteraMist is being used by over 50+ hospitals. In Hong Kong SteraMist is under trial use at Queen Mary Hospital. In Singapore Changi General Hospital and other servicing companies are using SteraMist. There is strong demand to deploy SteraMist's highly effective disinfection technology to combat coronavirus pandemic around the globe.

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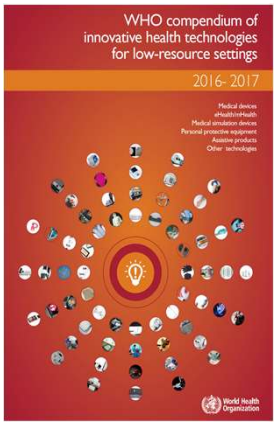
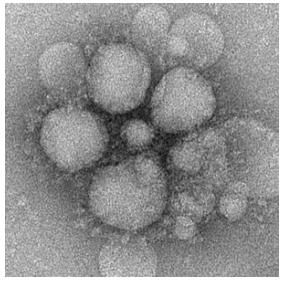
Seoul Metro



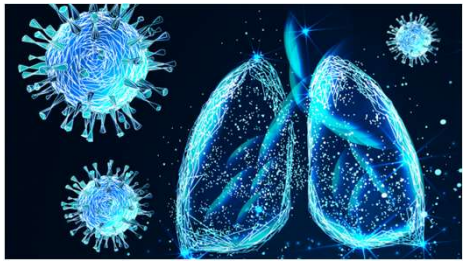
SteraMist disinfection equipment and BIT Solutions have a sound proven track record in combating infectious diseases outbreaks. It was previously deployed during both EBOLA in West Africa and MERS in the Kingdom of Saudi Arabia and South Korea. Recently it was deployed in decontaminating coronavirus affected premises at National University of Singapore and York hotel room in UK.

The State of Israel Ministry of Health has adopted SteraMist in its emergency protocol for handling coronavirus and other infectious diseases patients. South Korea has adopted SteraMist to decontaminate its metro system in Seoul.

In 2016-17 SteraMist was thoroughly tested by an independent panel of experts and subsequently included in the World Health Organization (WHO) compendium of innovative health technologies.



MERS - CoV



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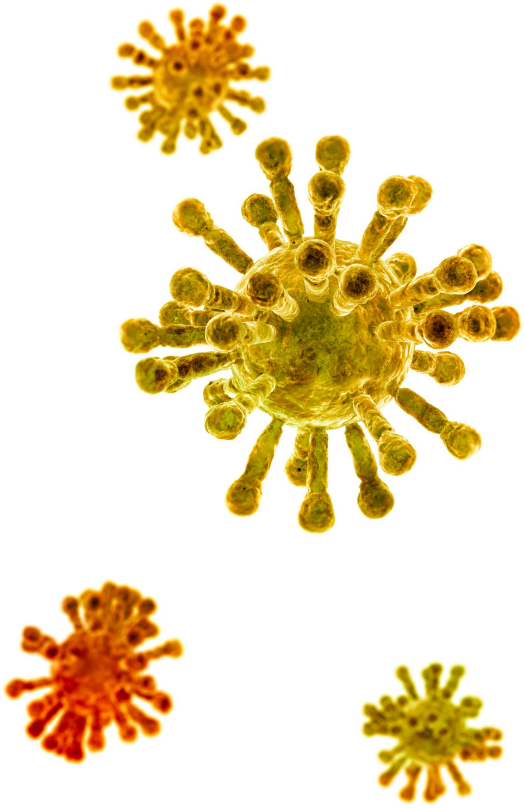

Coronavirus (Covid-19)

SteraMist disinfection equipment can be deployed quickly and effectively to decontaminate all infected premises. It is a highly flexible tool that ensures complete sterilization for controlling viral duplications in the air and on all surfaces.

SteraMist's environmentally friendly technology is easy to set up and operate. SteraMist kills dangerous pathogens swiftly and leaves no residual on disinfected surfaces other than water vapor and air.

SteraMist technology achieves the highest standard requirement for sterilizing all healthcare facilities including hospital ward, biosafety cabinet, operating room, medical device and sensitive electronic equipment etc.

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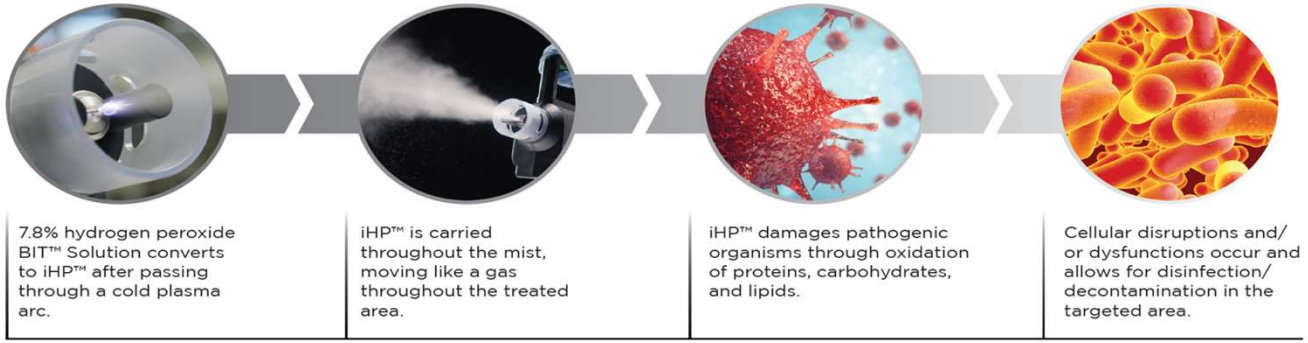
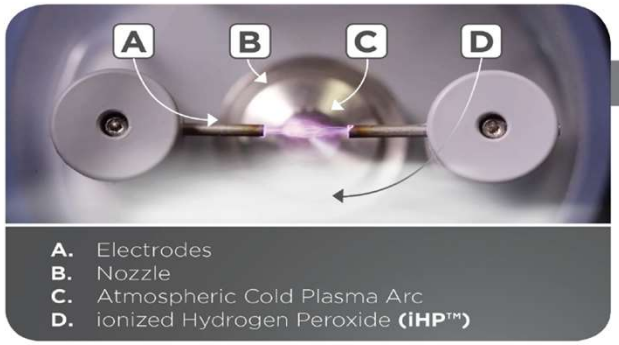
THE IHP™ (IONIZED HYDROGEN PEROXIDE) PROCESS

Technology





HOW STERAMIST® WORKS:

The atmospheric cold plasma arc converts the H_2O_2 molecules into iHP™. As one of the most powerful oxidizing agents in nature, the iHP™ kills the pathogens achieving high efficacy and leaves behind only oxygen and humidity in treated spaces.

Destroys proteins, carbohydrates and lipids on contact (via oxidation) which results in killing bacteria, bacteria spores, mold spores including the inactivation of viruses.

Reacts with chemical agents by breaking their double bond and neutralizing them via oxidation. The same is true with weaponized biological agents as they are neutralized via oxidation.

The by-products of ionized hydrogen peroxide (oxygen and water in the form of humidity) are far safer to handle than those left by conventional methods.

The iHP™ (ionized Hydrogen Peroxide) Process

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