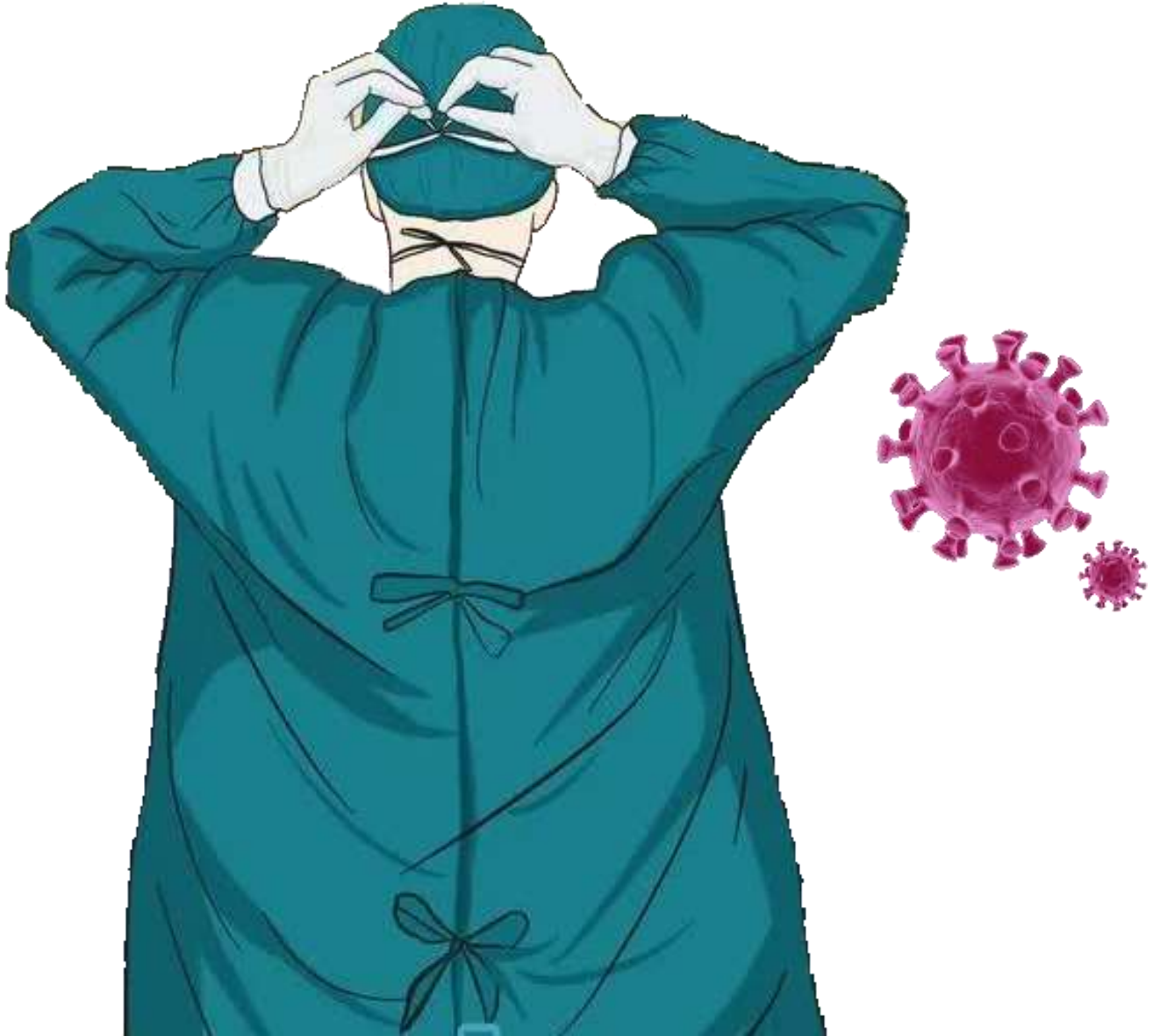
Novel Bio Clean Material for Air Purification and Disinfection Systems in Indoor Environments in COVID-19 Pandemic

By

Haiyong Li

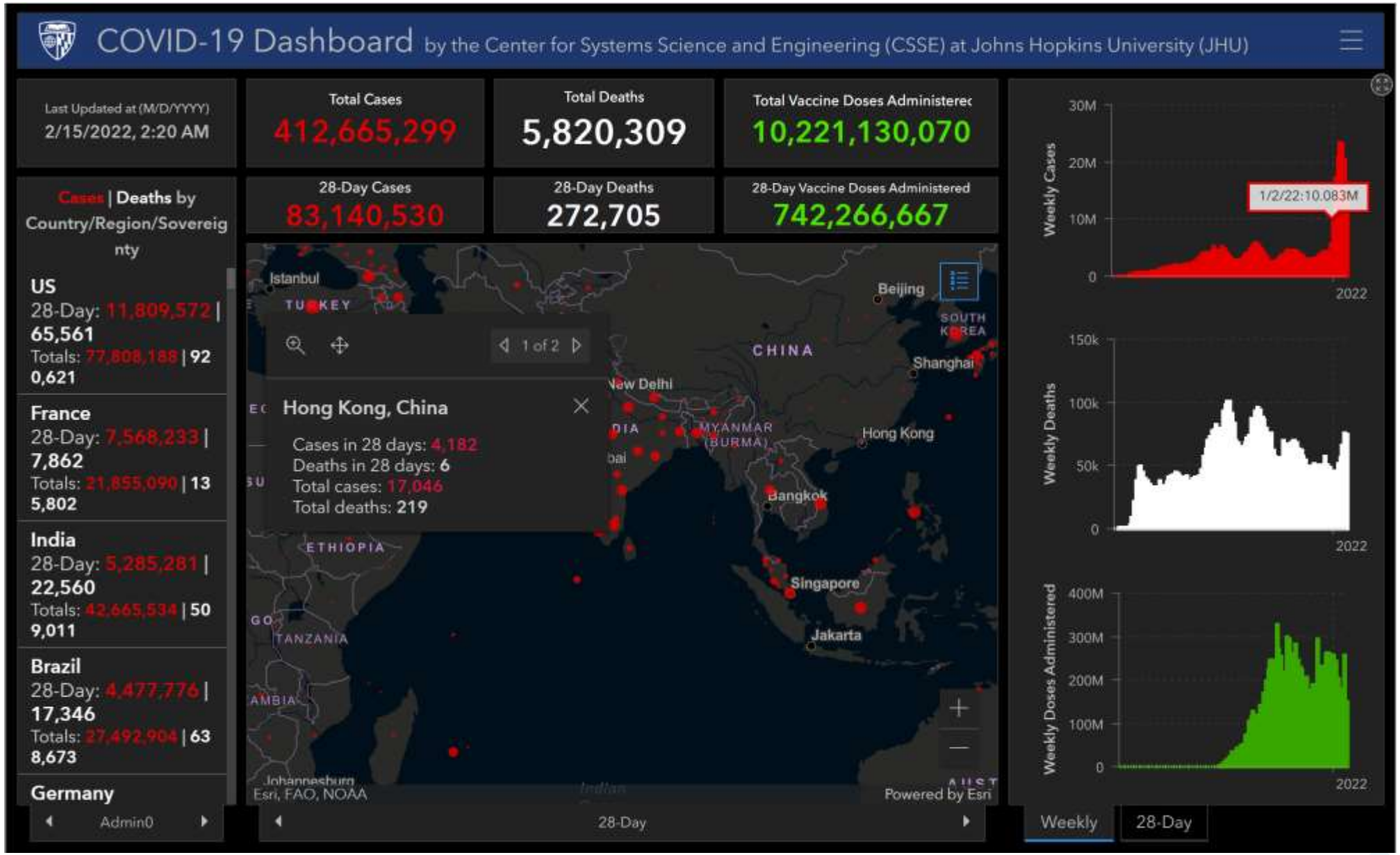
Shenzhen Kangfeng Environment Science & Technology Development Co., Ltd

Kangfeng Respiratory Safety Guard



COVID-19

Pandemic


COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)
Last Updated at (M/D/YYYY)
2/15/2022, 2:20 AM
Total Cases
412,665,299
Total Deaths
5,820,309
Total Vaccine Doses Administered
10,221,130,070
28-Day Cases
83,140,530
28-Day Deaths
272,705
28-Day Vaccine Doses Administered
742,266,667
Cases | Deaths by Country/Region/Sovereignty
US
28-Day: 11,809,572 | 65,561
Totals: 77,808,188 | 920,621
France
28-Day: 7,568,233 | 7,862
Totals: 21,855,090 | 135,802
India
28-Day: 5,285,281 | 22,560
Totals: 42,665,534 | 509,011
Brazil
28-Day: 4,477,776 | 17,346
Totals: 27,492,904 | 638,673
Germany
Admin0
Istanbul
TURKEY
Beijing
SOUTH KOREA
CHINA
Shanghai
New Delhi
MYANMAR (BURMA)
Hong Kong
Bangkok
Singapore
Jakarta
ETHIOPIA
TANZANIA
Johannesburg
1 of 2
Hong Kong, China
Cases in 28 days: 4,182
Deaths in 28 days: 6
Total cases: 17,046
Total deaths: 219
Esri, FAO, NOAA
Powered by Esri
28-Day
Weekly Cases
30M
20M
10M
0
1/2/22:10.083M
2022
Weekly Deaths
150k
100k
50k
0
2022
Weekly Doses Administered
400M
300M
200M
100M
0
2022
Weekly
28-Day


COVID-19
Safer at Home
Leave home only for essential work or necessities
Practice good hygiene: cover coughs and sneezes, don't touch your face, and wash hands often
Work remotely whenever possible
Physical distancing of at least 6 feet
Use cloth face coverings when in public
Disinfect frequently used items and touched surfaces often

Novel Bio Clean Material—AOP-KF®solid alkali

A large amount of hydroxyl radicals, oxygen radicals, peroxy radicals and other active particles are generated during reaction process

Fast reaction speed, the reaction rate constant is10^6～10^{10}L/(mol·s), 7 magnitude higher than Ozone

AOP-KF® solid alkali only effective on bacteria and virus, it is non toxic towards animals, plants etc.

*SGS tests shows “AOP-KF solid alkali does not produce any harmful material”

Principle: AOP-KF® solid alkali induces in-situ regeneration of hydroxyl radicals (·OH), which slows the physical adsorption of water (crystal water) on the surface of the carrier (mesoporous material) without heating or light. In addition to the ionized hydrolysis of OH, there is also non-ionized (radical) hydrolysis of chemically adsorbed water (OH). The latter is not significant under normal circumstances, but will greatly increase when the substrate reacts with it or is physically or chemically catalyzed. Accelerate, so that a large number of active particles such as OH are produced. ·0H oxidation potential is high (2.80ev), and the chemical reaction rate constant is 106～1010 L/(mol·s), which is 7 orders of magnitude higher than ozone, so the pollutant removal efficiency is high.

Inventor

Li Guopei
Chairman & Chief Scientist

- Deputy Director of Space Microbiology Data Center,Standing member of the Professional Committee of Space Microbiology and Infection of the Chinese Research Hospital Association;Interdisciplinary expert
- Former Deputy Director of Hangzhou Institute of Mechanical Science
- Presided over many major projects and won many awards
- Published multiple papers and held multiple patents

Li Guoqiao
Director & Co-founder

- Chief professor, doctoral supervisor, and former vice president of Guangzhou University of Chinese Medicine.
- Former director of Qinghao Research Center.
- Member of the Standing Committee of the Tropical Diseases and Parasitology Branch of the Chinese Medical Association.
- Master of clinical research on artemisinin drugs.

Chen Tangyi
Director & Co-founder

- Member of the Environmental Protection Leading Group of the Chinese Academy of Sciences.
- Former director of the Changchun Institute of Applied Chemistry, Chinese Academy of Sciences.
- The first director of Shenzhen Municipal Environmental Protection Bureau.
- Former director of the Planning and Budget Review Working Committee of the Standing Committee of the Shenzhen Municipal People's Congress, and former member of the Shenzhen Municipal Government's Science Advisory Committee.

AOP-KF® solid alkali-comparison with other technologies

Disinfection technology	Mechanism of action	Pros and cons
AOP-KF® solid alkali	**Using its strong oxidizing property, it destroys the micro-enzyme system, oxidizes and decomposes toxic substances such as formaldehyde.**	**Advantages: active sterilization, low dosage, fast action, non-toxic, harmless, no residue, no secondary pollution, 360-degree sterilization and disinfection without dead ends; a small amount of atomic oxygen released can also play a role in fresh air.**
Plasma	The plasma matrix is used to form a high-voltage electrostatic field to decompose and destroy the negatively charged bacteria, so as to achieve the purpose of sterilization.	Disadvantages: It must be cleaned regularly, otherwise the efficiency will be significantly reduced; because of the high-voltage discharge, toxic ozone will be generated.
Ozone	The oxidizing property of ozone is used to achieve the effect of sterilization and disinfection, which is active sterilization.	Advantages: rapid purification effect, broad-spectrum sterilization. Disadvantages: Strict requirements for ozone concentration, difficult to control, and people and machines cannot be in the same room.
Ultraviolet rays	The oxidizing property of ozone is used to achieve the effect of sterilization and disinfection, which is active sterilization.	Advantages: convenience, no pollution to the environment, no residual toxic substances. Disadvantages: The effect is inversely proportional to the distance and area, only the surface of the object can be sterilized, which is harmful to the human body, and cannot be shared by humans and machines.
Photocatalyst	The oxidizing property of ozone is used to achieve the effect of sterilization and disinfection, which is active sterilization.	Disadvantages: Nano particles have a strong penetrating power to cells, and inhalation of the human body is likely to cause great harm. At present, some scientists have proposed to use nanotechnology with caution.
Negative ion	Using DC high voltage to generate high corona, release a large number of electrons at high speed, together with oxygen molecules in the air, form negative ions and diffuse outward.	Advantages: Negative ions are good for human health, can enhance disease resistance, promote metabolism, improve human sleep and so on. Disadvantages: Negative ions last for a short time in the air, cannot be sterilized, do not decompose harmful substances, and are ineffective against peculiar smells.
Activated carbon	It is a commonly used air purification material, which uses the porous structure of bamboo charcoal to adsorb traces of toxic gases in the air.	Advantages: easy to use Disadvantages: Passive physical adsorption is mainly used, and the adsorption capacity for long-distance pollutants is weak, and the adsorption capacity is limited, which is easy to cause secondary pollution.

Conditions for Dynamic Sterilization

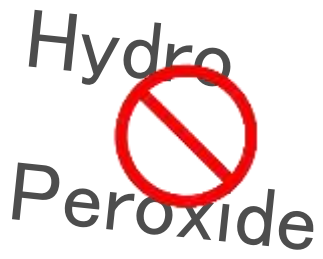
Continuous Filling, No Dead Corner

Low Concentration, Harmless

High Efficiency, No Drug Resistence

Does Not Affect Environment

Easy to Use/Maintain, Long Life

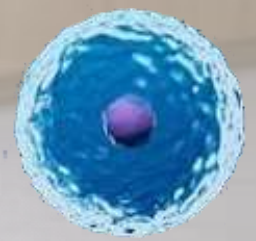


「Passive Disinfection」

When air flows through purification module, the carried pathogenic microorganisms are oxidized and eliminated 。

Oxidative intermediates come into play ：

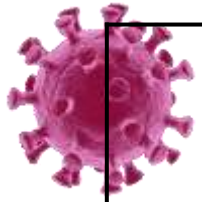
Hydroxyl free radicals



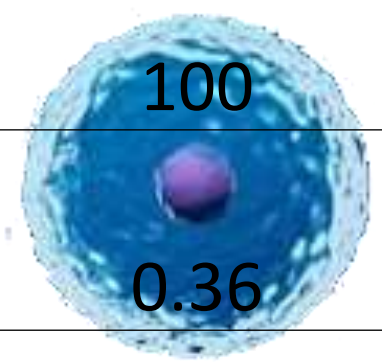
「Active Disinfection」

A small amount of chlorine dioxide is released into the air. The concentration of chlorine dioxide can be kept constant below 0.03ppm, which is within the safe range of 0.1ppm specified by the World Health Organization WHO and the US EPA.

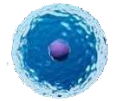
Does it work towards Covid?



	Diameter (nm)	Radius(nm)	Volume (nm3)
Covid-19	100	50	523598.7667
ClO2	0.36	0.18	0.024429024
Ratio	278	278	**21,433,471**



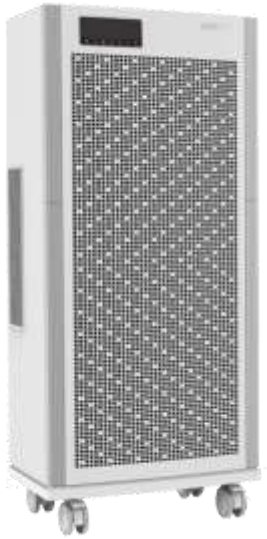
A soccer field is roughly 10,000 square meter. A soccer takes roughly 0.05 square meter.



Experiment video

Toast comparison video

Based on AOP-KF® solid alkali--medical products



YKJ2000F-A01

H1N1 influenza virus removal rate
15 minutes>99.99% (30m3)

YKJ450F-BG01

Type	YKJ2000F-A01
Field test (natural bacteria elimination rate)	60min 99.92%
Sterilization rate (Staphylococcus aureus)	15min >99.99%
Sterilization rate (Aspergillus niger)	30min >99.96%
Virus removal rate	15min >99.99% A/PR8/34 (Influenza A H1N1 virus)
PM0.1	8min >99.99%
PM2.5CADR	1998.7 m^3/h
Particle purification energy efficiency	6.67 $m^3/(w·h)$
Formaldehyde CADR	431.1 m^3/h
Toluene CADR	123.8 m^3/h

Wall-mounted air disinfection and purification machine YKJ450F-BG01			
Field test (Death rate of natural bacteria)	60min 95.34%	Sterilization rate (Staphylococcus albicans)	60min 99.99%
Particulate CADR	431.3 m^3/h	Formaldehyde CADR	72.7 m^3/h
Product Size	1120×138×215 mm	Rated input power	45w
product weight	11kg	Noise	≤46 dB
Power nature	AC220V 50Hz		

Medical Air Disinfection Purifer——Comparison

VS

VS

KangFeng：YKJ2000F-A01

A world known brand

A well-known domestic brand

Tech	AOP-KF® Solid Alkali+Low Temp Plasma	Originated from International Space Station and Mir Space Station	High efficiency filtration and photoion
Sterilization	15min>99.99%(30m³ test chamber)	60min>99.99%(20m³ test chamber)	60min>99.99% (30m3 experiment cabin) Guangdong Microbial Analysis and Testing Center
Size	1620*640*430mm	1940*910*570mm（3.4X）	800*520*1940mm
Power	300W	540W（3.6X）	380W
Weight	105kg	140kg（2.3X）	No public data

Medical Projects

- Shanghai First People's Hospital
- Shanghai Ruijin Hospital
- The First Affiliated Hospital of Kunming Medical University
- Peking University Shenzhen Hospital
- Congdu International Life and Health Management Center
- Wuhan University People's Hospital
- The Fifth Affiliated Hospital of Sun Yat-sen University
- Union Hospital, Tongji Medical College, Huazhong University of Science and Technology
- Shanghai Bund Community Health Service Center
- Zhuhai People's Hospital
- Ganmei International Hospital, Kunming First People's Hospital
- Shanghai Tongren Hospital
- Wuhan University People's Hospital
- The First Hospital of Shanxi Medical University
- Lhasa Armed Police General Hospital, Tibet
- The First Affiliated Hospital of Nanchang University
- The Eighth People's Hospital of Guangzhou
- Xiangyang First People's Hospital
- Guangzhou Hospital of Integrated Traditional Chinese and Western Medicine

AOP-KF® solid alkali--household products

Efficiently remove aldehydes, and at the same time reduce the occurrence and cross-infection of respiratory tract infections in vulnerable populations such as the elderly and children.

Formaldehyde with a concentration of 1mg/m³ (10 times exceeding the standard)

5 minutes → drop to 0 (30m3)

H1N1 influenza virus removal rate

20 minutes>99.99% (30m3)

Staphylococcus albicans removal rate

30 minutes>99.99% (30m3)

kangfeng1hao pro

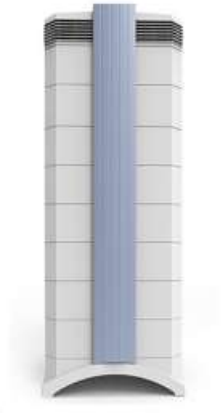
kangfeng1hao

kangfengTake a deep breath

kangfengleju

Comparison of AOP-KF® solid alkali technology at home and abroad-household products

VS



VS

	kangfeng：KJ900F-H01	**A well-known brand in the world HealthPro GCX**	**Pro XL, a world famous brand**
technology	**High efficiency filtration + AOP-KF® solid alkali**	H11 high efficiency + impregnated alumina and high-quality activated carbon	HEPASilent high efficiency + activated carbon
Particulate CADR	**871.9m³/h**	482.1**m³/h**	>800**m³/h**
Formaldehyde CADR	**2000m³/h**	421.6**m³/h**	369**m³/h**
H1N1 influenza virus removal rate	**20min>99.99%(30m³)**	——	——
Sterilization rate (Staphylococcus albicans)	**30min>99.99%(30m³)**	**60min**>99.9%	**60min**>99.99%
size	**378*375*775mm**	410*380*1020mm	504*240*1130mm
power	**85W**	135W	120W
equipment weight	**15kg**	28**kg**	32kg
price	**8998 ¥/set**	26,400 ¥/set	25,800 ¥/set

Household Projects

- Shenzhen Audit Bureau
- Shenzhen Longgang Financial Investment Holdings Co., Ltd.
- Shenzhen Longgang District Industrial Investment Service Group Limited company
- Shanwei Municipal Ecological Environment Bureau Shenshan Administration
- China People's Health Insurance Co., Ltd. Shenzhen branch
- China Pacific Property Insurance Co., Ltd. Shenzhen branch
- Shenzhen Chunsongyuan Education Management Co., Ltd.
- School of Public Health, Sun Yat-sen University
- School of Life Sciences, Shenzhen University
- The Experimental School of the High School Affiliated to Peking University
- Hitachi (China Research and Development Co., Ltd.)
- Ziru Apartment
- Guangzhou Zhongrun Industrial Co., Ltd.
- Vanke Boyu Apartment
- Shenzhen Bay Mansion
- Blue Horizon Hotel Jinan
- Jinbaolai Hotel Macau
- Poly Hotel Guangzhou
- Shenzhen Kylinhui Seafood Hotpot Restaurant
- Shenzhen Donghai New Life Catering Culture Management Limited company
- Colorful Life Group Co., Ltd.
- Shenzhen Silico Co., Ltd.
- Da'ansheng Green Home Furnishing (Guangdong) Co., Ltd.
- Shenzhen Delsheng Technology Development Co., Ltd.
- Huawei Technologies Co., Ltd

AOP-KF ®Solid alkali-mask test report

▲Can be reused for **7 days**

▲Relieve rhinitis, bronchitis, asthma and other respiratory diseases

SGS

Test Report No. HKHC2001000553HC Date :Jan.31, 2020 Page 2 of 3

Test Requested, Test Method and Test Results

The analyses were performed with reference to:

Assessment of Antibacterial Finishes on Textile Material (AATCC 100-2012)

Test bacteria: *Staphylococcus aureus* (ATCC 6538)

Tested Specimen	Bacterial count (colony forming unit, CFU per ml) over contact period		Result: % of reduction of bacteria	Specified requirement	Comment
	0 hour	24 hours			
As received	1.60×10^5	<100	>99.94	Minimum 99 %	Pass
Untreated control sample	1.28×10^5	2.59×10^7	/	/	/

Test bacteria: *Klebsiella pneumoniae* (ATCC 4352)

Tested Specimen	Bacterial count (colony forming unit, CFU per ml) over contact period		Result: % of reduction of bacteria	Specified requirement	Comment
	0 hour	24 hours			
As received	1.20×10^5	<100	>99.92	Minimum 99 %	Pass
Untreated control sample	1.04×10^5	3.15×10^6	/	/	/

检 验 报 告

Table 6: Colony Forming Units (CFU) present on interior and exterior of AOP-KF face mask over a period of 7 days.

DAY	AOP-KF Inside Mask (EXHALED)- CFU/ 25CM²	AOP-KF Outside Mask (INHALED)- CFU/ 25CM²
1	<1	<1
2	<1	<1
3	<1	<1
4	<1	<1
5	<1	<1
6	<1	<1
7	<1	<1

▲South Africa sterility test report

▲Particulate matter filtration efficiency **KN95≥95%**

▲The filtration efficiency of Staphylococcus aureus bacteria is **99.12%**

▲Klebsiella pneumoniae removal>**99.92%**

Cytotoxicity level 1
Skin irritation score 0
Sensitization: (No sensitization)

AOP-KF ®Solid Alkaline Cloth—Test Report

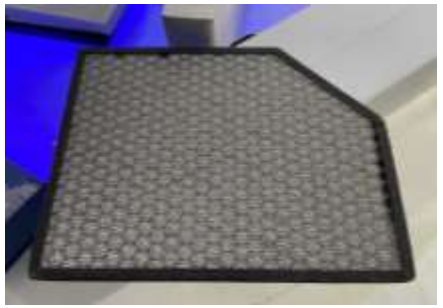
SARS-CoV-2 elimination rate **99.31%**

Testing standard: ISO 18184:2019

Respiratory syncytial virus inactivation rate **99.27%**

H1N1 inactivation rate **99.35%**

Application in the automotive industry (AOP-KF solid alkali technology)



In the new car, the original air filter is replaced by a filter of AOP-KF solid alkali.

The detected formaldehyde concentration has changed from 0.13-0.15 ppm to 0.

Based on AOP-KF ® solid alkali-portable disinfection machine travel application

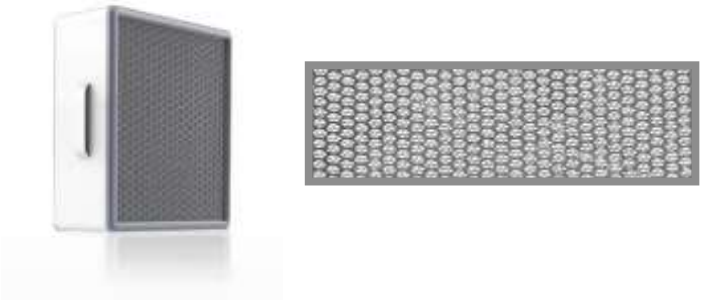
Based on AOP-KF® solid alkali disinfection and purification equipment

设备参数	
电源	220V50Hz
输入功率	200W
噪声	≤50dB(A)
处理风量	1300m³/h
除菌率（60分钟）	99.99%，可快速去除甲型流感病毒、霉菌及细菌
颗粒物洁净空气量(CADR)	>600 m³/h
甲醛洁净空气量(CADR)	>120 m³/h
熔断器规格	AC250、2A
外形尺寸	1780×560×290
产品重量	58kg
产品主要成分	预过滤器、HEPA过滤器、紫外光、负离子、ADP固体碱反应器等组成

Floor cabinet machine

Large wind cabinet machine

Ceiling ceiling machine



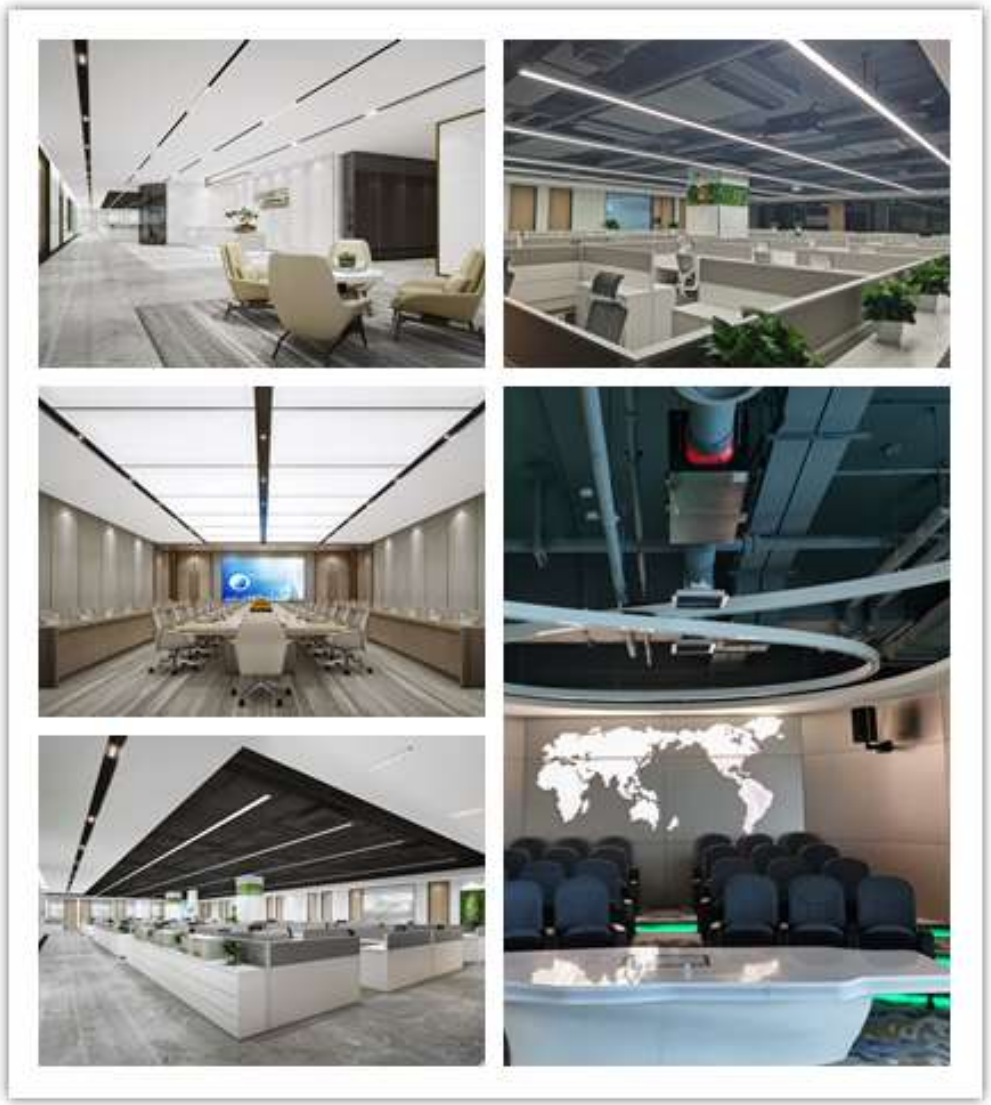
Air conditioning reaction section

Application Cases of Fighting the Epidemic

Covid Test Vehicle

Live photos

One Belt One Road Environmental Technology Exchange and Transfer Center (Shenzhen)



Kangfeng from internal construction, energy efficiency management, efficient use of resources, adhering to the concept of "green, low-carbon", taking the highest standard of indoor environment in Northern Europe as our goal, and building the Belt and Road Environmental Technology Exchange and Transfer Center (Shenzhen) into a nationwide The first "Respiratory Health and Safety Demonstration Base". With the help of this national platform, we will showcase and promote our China's clean technology to countries all over the world.

Results

Test Substance	Air Quality Standards	After Kangfeng Purification
Formaldehyde	≤0.1mg/m³	≤0.03mg/m³
PM2.5	≤75ug/m³	≤15ug/m³
Bacteria	≤2500cfu/m³	≤150cfu/m³

Solve the problem of cross-infection of respiratory infectious diseases in the public environment, and fundamentally eliminate the possibility of large-scale respiratory disease outbreaks, such as influenza and tuberculosis.

Specify exclusive epidemic prevention unit

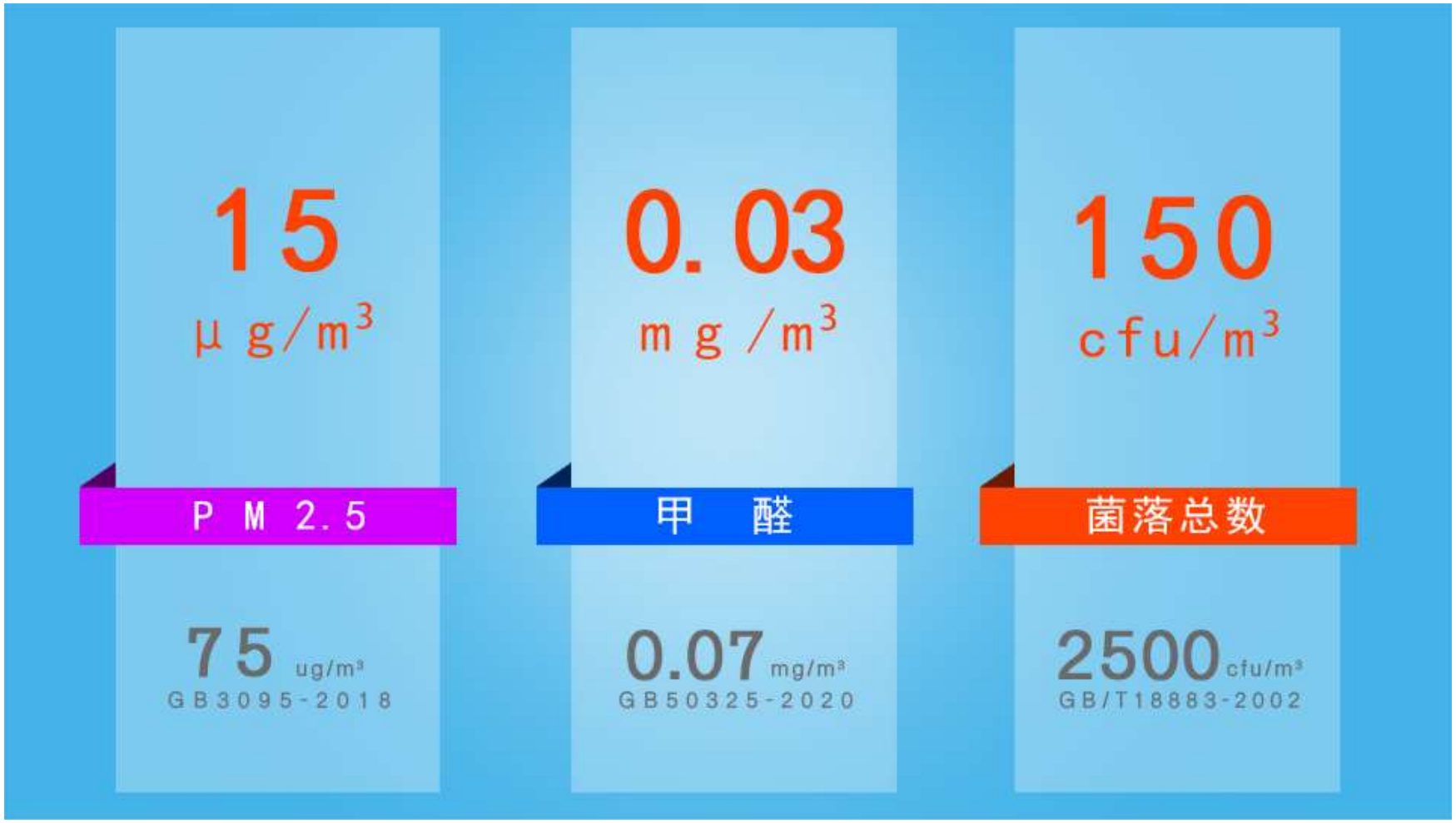
Canton Fair exclusive Epidemic prevention support units

Science and technology Winter Olympics achievements exhibition is exclusive Epidemic prevention support units

2022 Beijing Winter Olympics venues (ice altar)

The 2022 Beijing Winter Olympics has a total construction area of 33,220 square meters, and the main building is 30.15 meters high. The stadium includes two standard ice rinks, two on-land training venues, as well as supporting functions such as scientific research, medical, rehabilitation rooms, athletes' dormitories and restaurants.

Target Air Quality



Project Phase I

Dec. 2020

1 Floor of Standard ice rink air purification

floor cabinet machine

Project Phase II

Jun. 2021

Conference room on floor 2 & dining room for air purification

1 Floor of standard ice rink air quality visualization system

Air floor apartment room (33)

Air floor apartment room (33)

6 Apartment apartment (34)

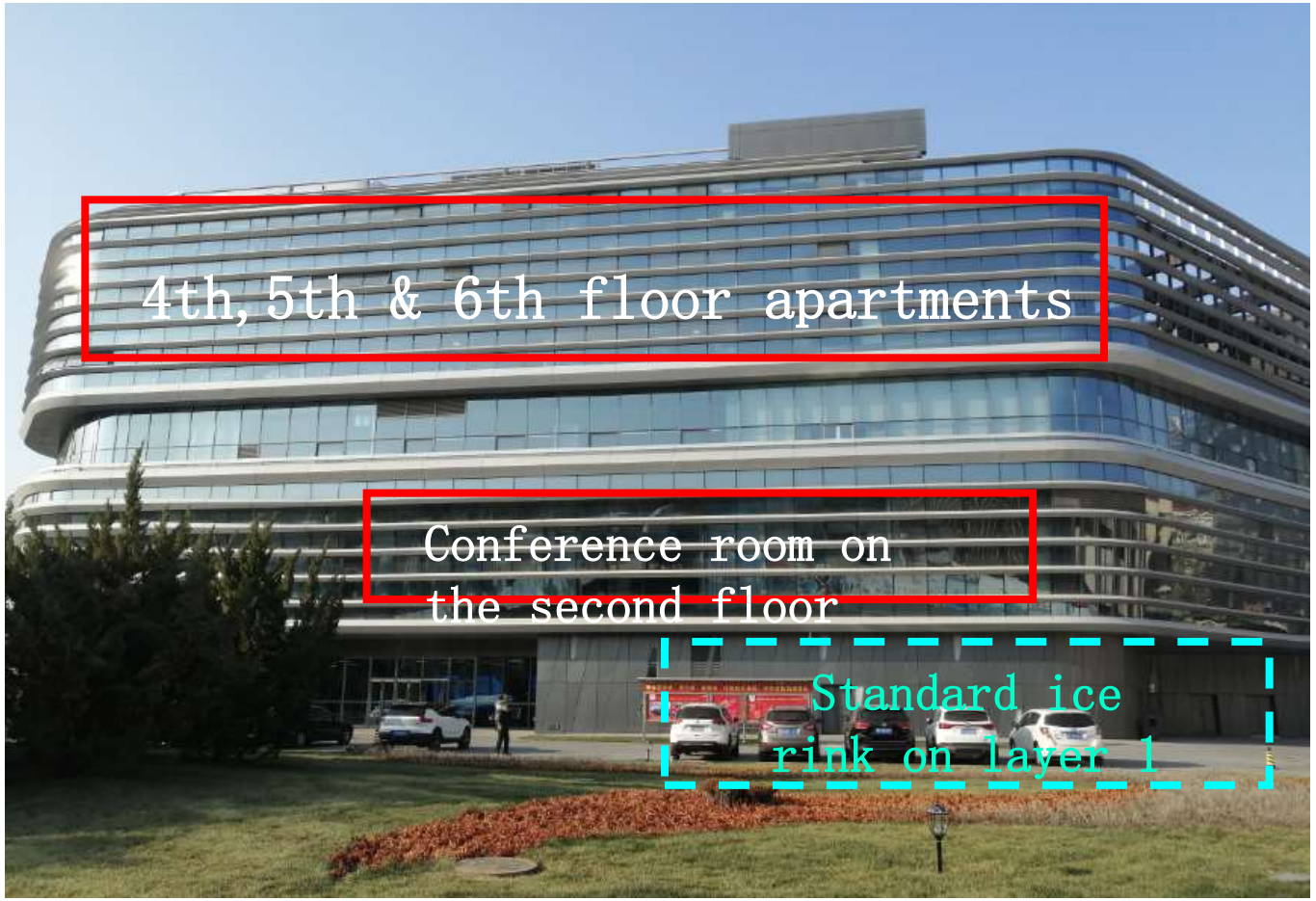
Air cleaner

Visualization system

fresh air machine

Install solid base net

2022 Beijing Winter Olympics



1 Floor of Standard ice rink air purification

1 Floor of standard ice rink air quality visualization system

Conference room on floor 2 & dining room for air purification

Air floor apartment room (33)

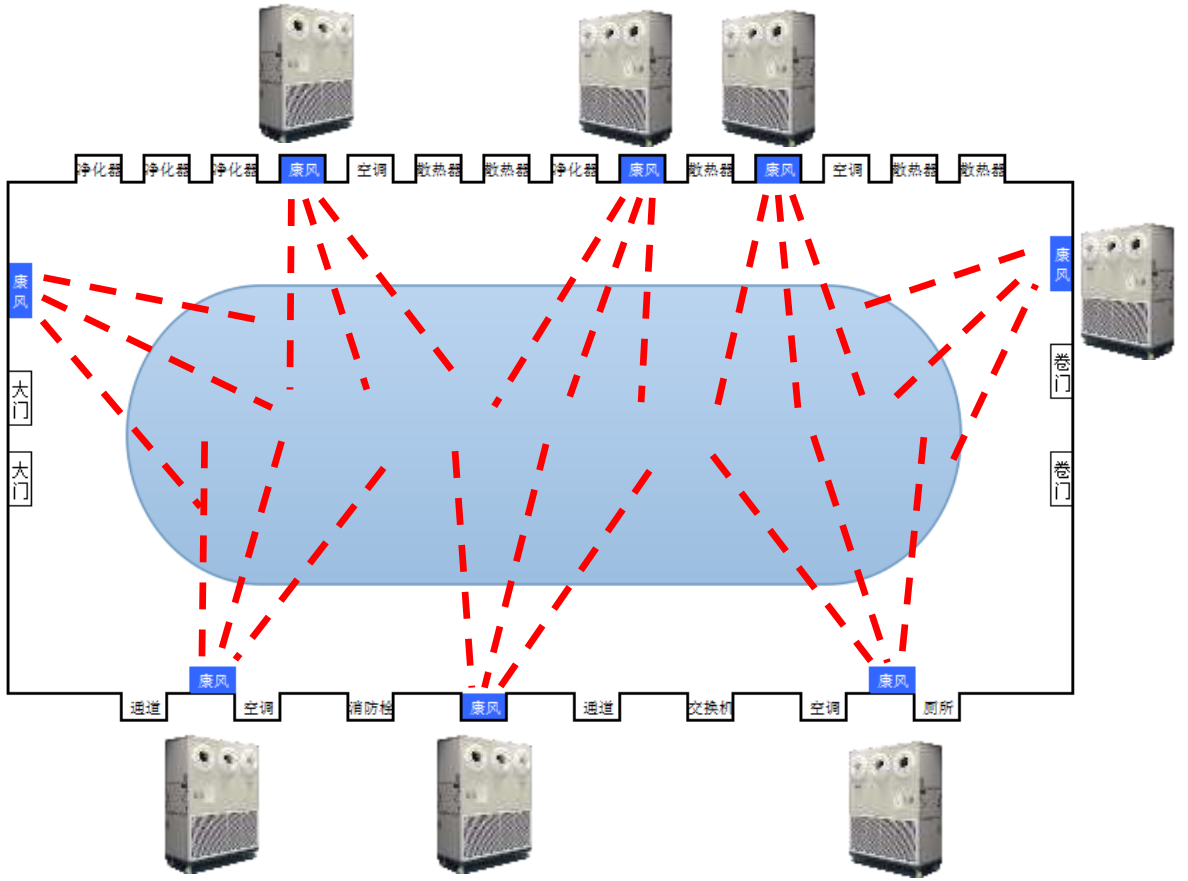
Air floor apartment room (33)

6 Apartment apartment (34)

2022 Beijing Winter Olympics

The area of 3,000 square meters is 15 meters high

Maximum single space in the "ice altar" - -the first layer of the standard ice rink



In 2020, COVID-19 ravaged the world, and crowds and cross-infection have become the biggest threat to public health security.

The project aims to create the highest level of super-large indoor space air quality level in the world, remove the pathogenic microorganisms in the air, and block the cross-infection route of respiratory infectious diseases. The application of this technology has cross-era significance.

2022 Beijing Winter Olympics

3 items of pollution data

TVOC

PM 2.5

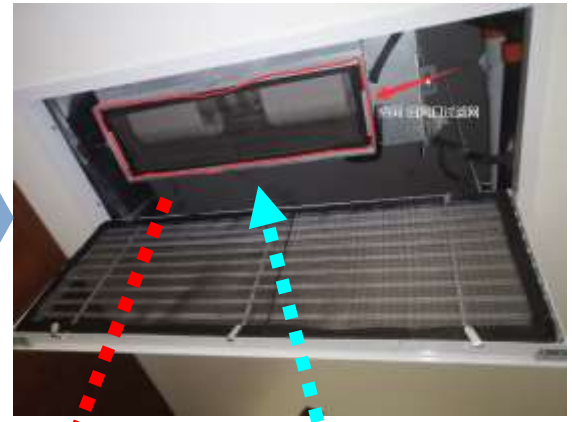
formaldehyde

other data

CO_2

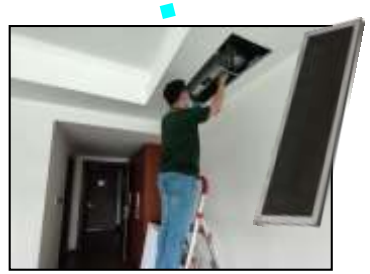
humidity

temperature



take down
Room return air outlet
Nylon filter net

fit on
Conwind solid base net

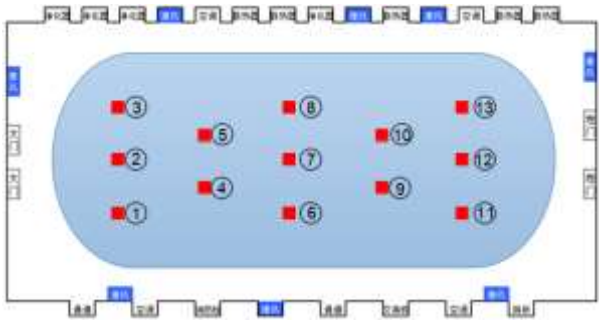


Three tests for the total number of bacteria (the third-party test of Beijing spectral)

	设备进场前 2020.12.26	设备运行1日 2020.12.28 14:00~16:30 动态|上班时段现场70人	设备运行1日 2020.12.28 18:00~20:30 下班时段现场3人	设备运行3日 2020.12.30 18:00~20:30 下班时段现场3人
细菌总数（cfu/m³）	均值283	均值22（去除率92.2%）	均值17（去除率94.0%）	均值13（去除率95.4%）
甲醛（mg/m³）	均值0.031	均值0.020	均值0.016	均值0.014
PM10（mg/m³）	均值0.045	均值0.021	均值0.015	均值0.003

The total number of bacteria, the equipment has reached the class I environment level of the hospital after operation

- The equipment operates for 1 day, under dynamic environment (about 70 people on site, dynamic in and out), and 13 detection points average 22cfu (colonies) / m³
- The equipment operated for 1 day, under static environment (3 number on site), and 13 detection points reached 17cfu (colonies) / m³
- The equipment operates for 3 days. In static environment (3 people on site), 13 detection points average 13cfu (colonies) / m³



Chlorine dioxide concentration test (the third-party test of Beijing Sinochem Institute)

二氧化氯浓度（mg/m3）	空气消毒净化机 5号 风口	空气消毒净化机 7号 风口
	0.011	0.014
	设备风口 平均值：0.013	

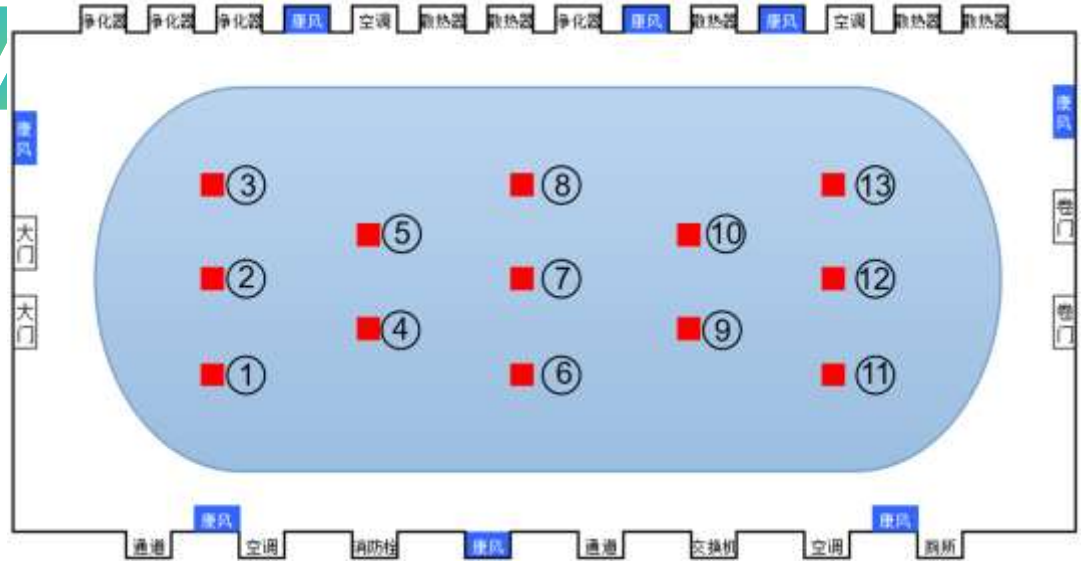
点位5	点位7	点位9
0.008	0.012	0.010
场地中间点位 平均值：0.010		

Effectiveness & Security

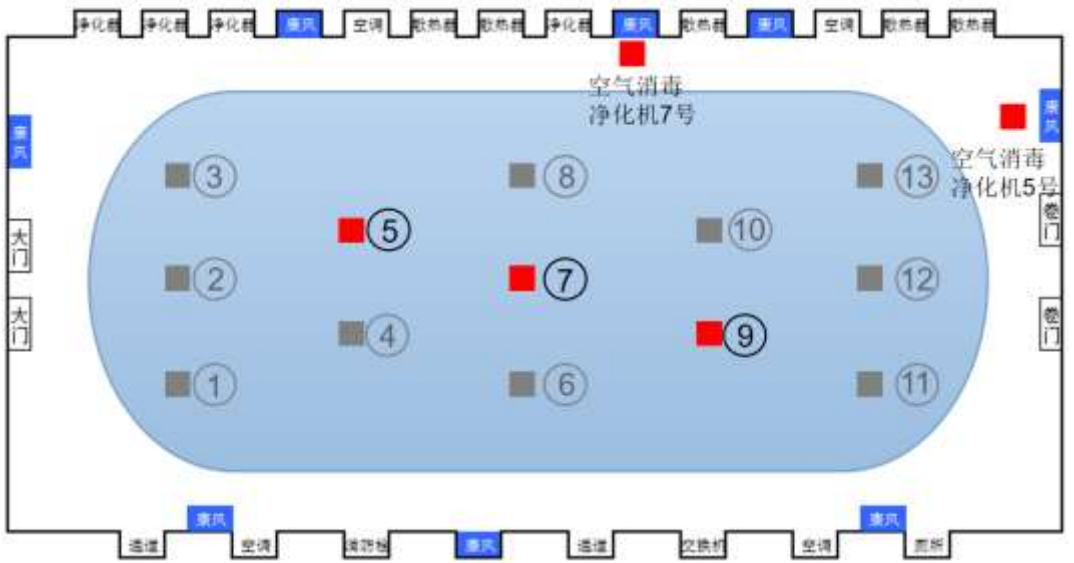
The mean chlorine dioxide concentration actually detected in the venue was 0.010mg / m^3, or 1/30 of the safety limit of 0.3mg/m^3.

At such concentrations, as verified from the test results, the AOP-KF® solid base, while effectively in disinfection and sterilization.

Be able to ensure no toxic side effects.



采样日期	采样情况	菌落总数 cfu/m³	颗粒物 mg/m³	甲醛 mg/m³
2020.12.26	设备进场前 10人	283	0.046	0.031
2020.12.28 设备运行1日	14:00~16:30 70人	22	0.021	0.02
	18:00~20:30 3人	18	0.015	0.016
2020.12.30 设备运行3日	18:00~20:30 3人	14	0.003	0.014
2021.01.29 设备运行1个月	15:00~17:30 60人	28	0.007	0.015
		23 (3.3米高)	/	/
	18:00~20:30 3人	104	0.005	0.03
2021.03.30 设备运行3个月	15:00~17:00 70人	112	0.027	0.03
	18:00~20:30 6人	145	0.024	0.029
2021.06.10 设备运行6个月	10:00~12:00 70人	47	0.021	0.042



采样日期	净化机 5 号	净化机 7 号	点位⑤	点位⑦	点位⑨	平均值
2020.12.30 设备运行 3 日	0.011	0.014	0.008	0.012	0.010	0.0110
2021.01.29 设备运行 1 个月	0.009	0.011	0.007	0.010	0.011	0.0096
	/	/	0.003 (3.3 米高)	0.003 (3.3 米高)	0.004 (3.3 米高)	0.0033
2021.03.30 设备运行 3 个月	0.007	0.010	0.009	0.006	0.011	0.0086
2021.06.10 设备运行 6 个月	0.010	0.008	0.012	0.009	0.007	0.0092

The Capital Gymnasium, the Athletes' Apartment

More than 60 national short-track speed skaters are ready to move in the First Sports Athletes Apartment.

The 2nd and 3rd floors of the apartment have just been renovated, and the interior taste is big.

For the health of athletes, the air purification equipments of Shenzhen Kangfeng environment is used to control the decoration pollution.

The air quality of the air purification equipment can meet the highest standard of the hospital class I environment and the indoor environment in northern Europe.

Chinese ice and snow athletes travel protection

China Ice and Snow partners

The Chinese figure skating team -- masks and gloves

The world's first Functional mask that can kill the novel coronavirus

Travel escort

Broad application scenarios

Home

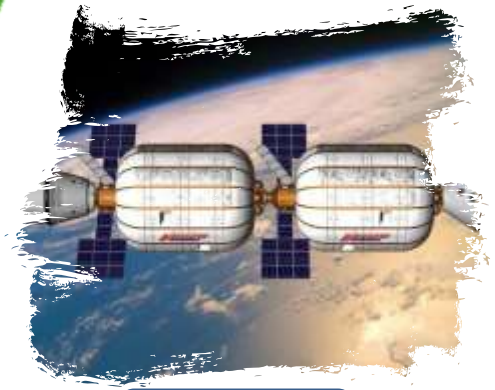
Business

School

hospital

Confinement Center

Nursing home



Space station

Pet shop

Farm

Public places

Kangfeng Respiratory Safety Guard