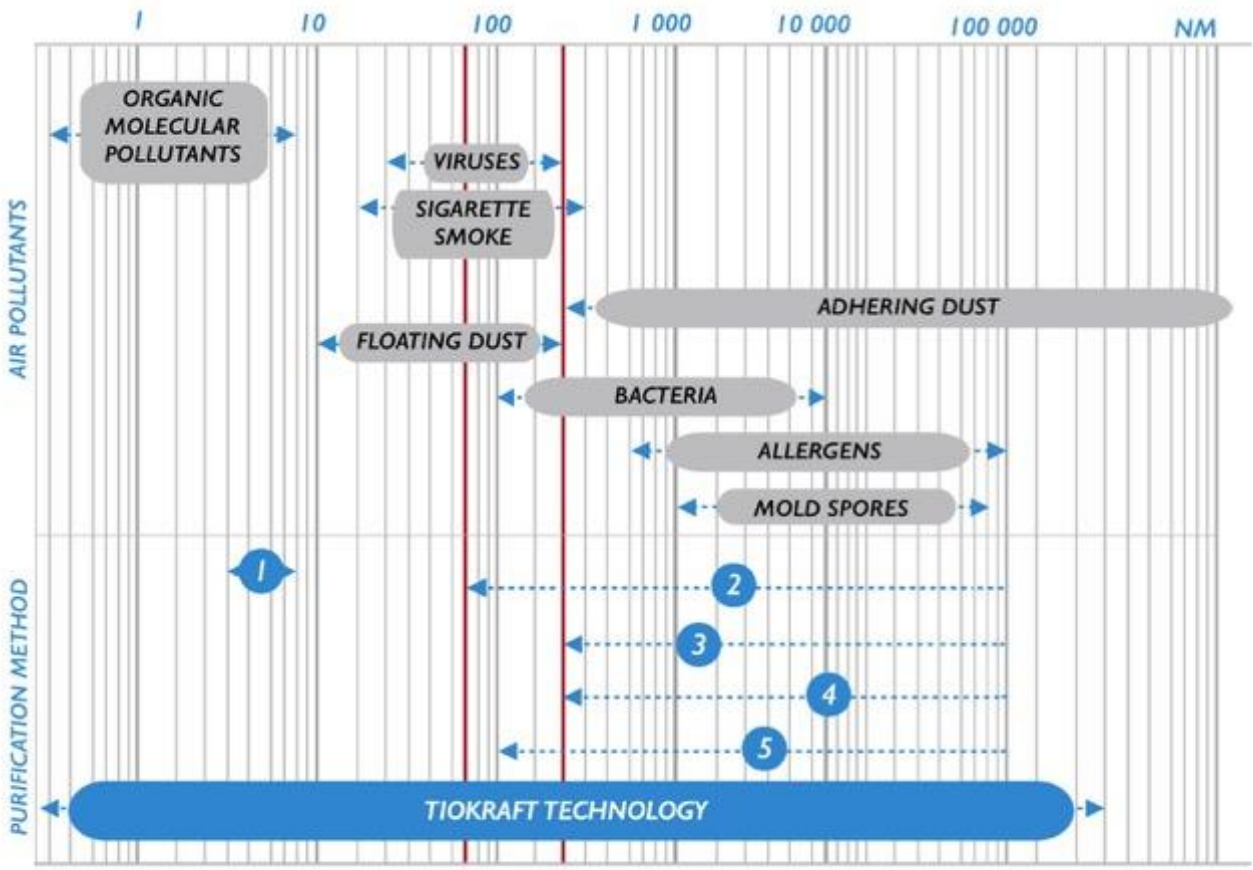

ПОКРАФТ
photocatalytic air disinfection technology

What are we dealing with?

All air pollutants can be conditionally divided by particle sizes. According to the European Environmental Agency (EEA), nanosize particles are the most dangerous for humans. These particles include molecular organic compounds (4-20 nm) that hit directly into blood, protein macromolecules of the main pathogens of acute allergy (20-40 nm), non-removable solid and liquid aerosol nanoparticles (20-100 nm), viruses (20 -300 nm), bacteria (from 100 nm).

The actual continuity of a significant increase in the requirements for the quality of air cleaning from nanoscale particles is also determined by the development of a number of high-tech industries in the field of microelectronics, pharmaceutics, medicine and biology.

LABORATORY RESEARCH PROVED :
THE MOST WIDESPREAD HEPA-FILTERS OF H13 CLASS DO NOT COLLECT PARTICLES LESS THAN 300 NM.
THE MOST POWERFUL INDUSTRIAL ELECTROSTATIC FILTERS ARE LOW- EFFECTIVE IN THE PARTICLE RANGE LESS THAN 80 NM.



TRADITIONAL METHODS OF AIR FILTRATION HAVE ITS NONREMOVABLE DISADVANTAGES

1 CARBON FILTERS

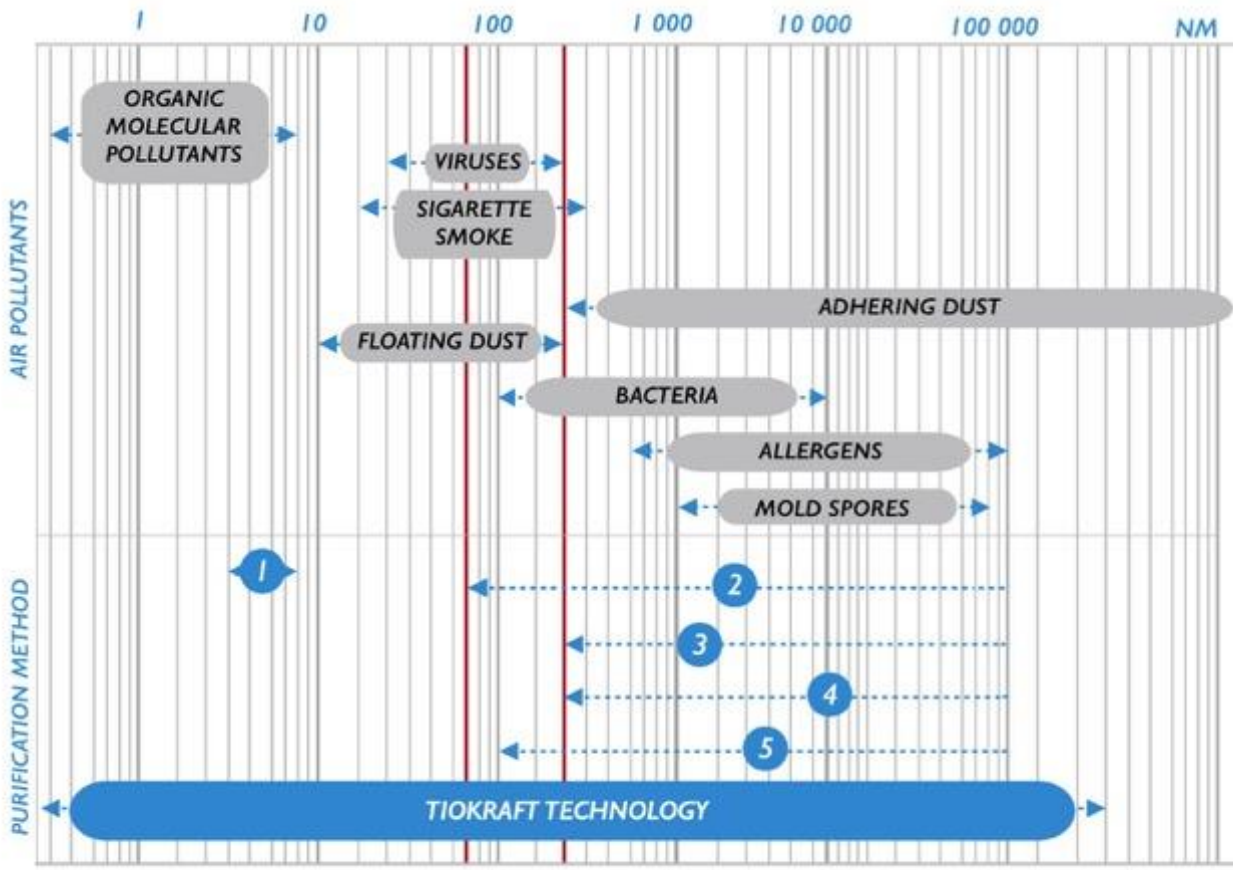
Technically can not purify air from volatile compounds with a molecular mass of less than 40 amu. (atomic mass unit). Therefore such dangerous substances as formaldehyde(H_2CO), methane(CH_4), sulfur dioxide (H_2S) and nitrogen dioxide (NO_2) are not retained by carbon filters. As toxins and dust accumulate, the filters are more likely to become **sources of pollution**.

2 ELECTROSTATIC FILTERS

The efficiency depends on the ionization voltage and the geometry of the depositing electrodes. The required voltage level for efficient operation is above 7 kV, but with this voltage electrostatic filters start to generate ozone- a toxic for the whole living compound with very low MPC (maximum permissible concentrations) values (0.02 mg /m^3). Ozone itself is difficult to capture, so the electrostatic filters have a low ionization voltage and, consequently, a low efficiency of catching aerosol particles.

3 PASSIVE *HEPA*-FILTERS

Catch particles larger than 300 nm, so that do not solve the problem of cleaning from the most dangerous nanoparticles. **The filtered microflora concentrates on the filters. Actively multiplying, creates a source of secondary pollution.**



4 ACTIVE *HEPA*-FILTERS

The principle of active HEPA filtration is a preliminary unipolar charging of aerosols, including biological ones, in the corona discharge zone with further capture of charged particles by a polarized HEPA filter.

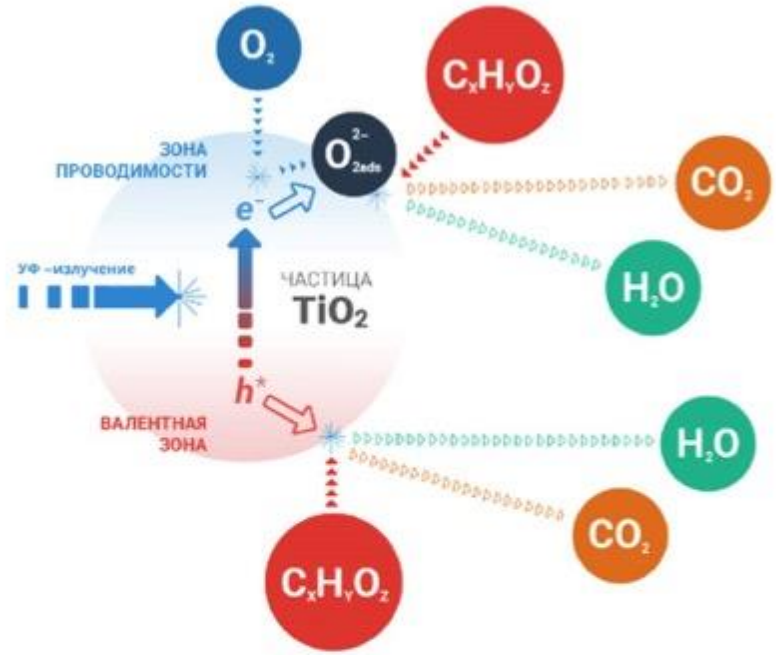
The captured charged particles are inactivated by ozone produced in the corona discharge zone. For effective work of this method, for example, to remove mold spores from the air, it is necessary to provide an ozone concentration in the device of not less than 1000 mg / m³ (MPC - 0.02 mg / m³) and to influence with such ozone concentration on spores within one hour. **The actual ozone concentrations in the devices with active HEPA filtration do not exceed 30 µg /m³, and the time when ozone exposures to contaminants in the devices is seconds.**

5 AIR CLEANING BY ELECTROPORATION

The process of electroporation is effective only in the environment of electrolyte, to destruct a cell in the air environment it is necessary to create an electromagnetic field 1000 times more powerful than claimed by manufacturers (3000 V / mm). In the case of viruses, electroporation is useless because of the **absence of the cytoplasm and the membrane in the structure of a virus.**

FUNDAMENTAL LIMITATIONS OF THE LISTED METHODS OF AIR FILTRATION COMPELS MANUFACTURERS TO SUPPLY THE DEVICES WITH LOW-EFFICIENCY OPTIONS SUCH AS ANTIMICROBIAL IMPREGNATION, UV IRRADIATOR OF HARD RADIATION, "PLASMA CLEANING», IONISATION, OZONATION, etc., THAT ARE NOTHING MORE THAN MARKETING TRICKS.

THE ESSENCE OF THE PHOTOCATALYSIS PROCESS



O_2 - oxigen

$C_xH_yO_z$ - volatile organic compound

CO_2 - carbon dioxide

H_2O - water in gaseous phase

TiO_2 - titanium dioxide

EFFICIENCY OF PHOTOCATALYTIC AIR CLEANING SYSTEM =

CATALYST CARRIER SURFACE AREA **x** VOLUME OF CATALYST AND ITS CHEMICAL PROPERTIES **x** POWER SOURCE OF UV-LIGHT

Numerous scientific studies have revealed that if selected incorrectly or in case of inefficiency of at least one component, the efficiency of the entire photocatalytic system tends to zero.

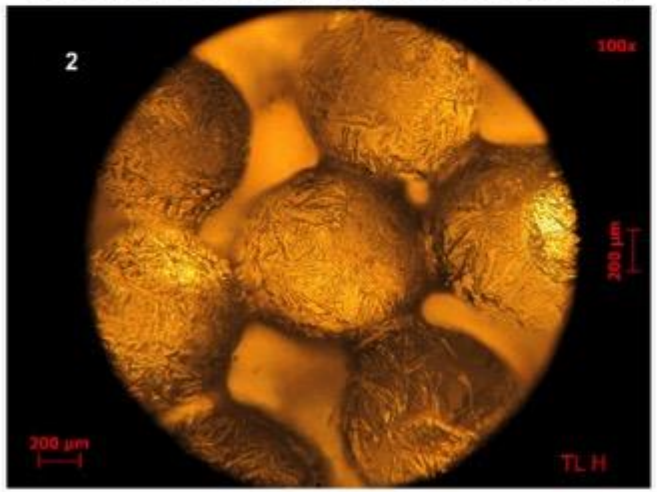

WE OVERCOME ALL THE SHORTCOMINGS
OF THE EXISTING METHODS OF AIR PURIFICATION,
MAKING A NEW STEP IN THE USE OF
PHOTOCATALYTIC TECHNOLOGIES

THE SINGULARITY OF TIOKRAFT TECHNOLOGY IS THE USE OF THE PHOTOCATALYTIC ELEMENT CONSISTING OF THE CARRIER AND THE CATALYST *(KOREAN PATENT No. 1018915120000)*

The carrier is a key element of the photocatalytic system.

The TIOKRAFT carrier has a porous structure, is made of inorganic materials, provides good adhesion of the photocatalyst powder, has a structural strength, a shape that allows maximum capture of UV radiation.

Production KNOW-HOW allows the carrier of the TIOKRAFT photocatalyst to be environmentally safe and absolutely harmless to humans.



ON THE PICTURE:

STRUCTURE OF THE CARRIER MADE OF POROUS GLASS - SINTERED GLASS BEADS DIAMETER 0.8 -1.0 MM.

ON THE PICTURE:

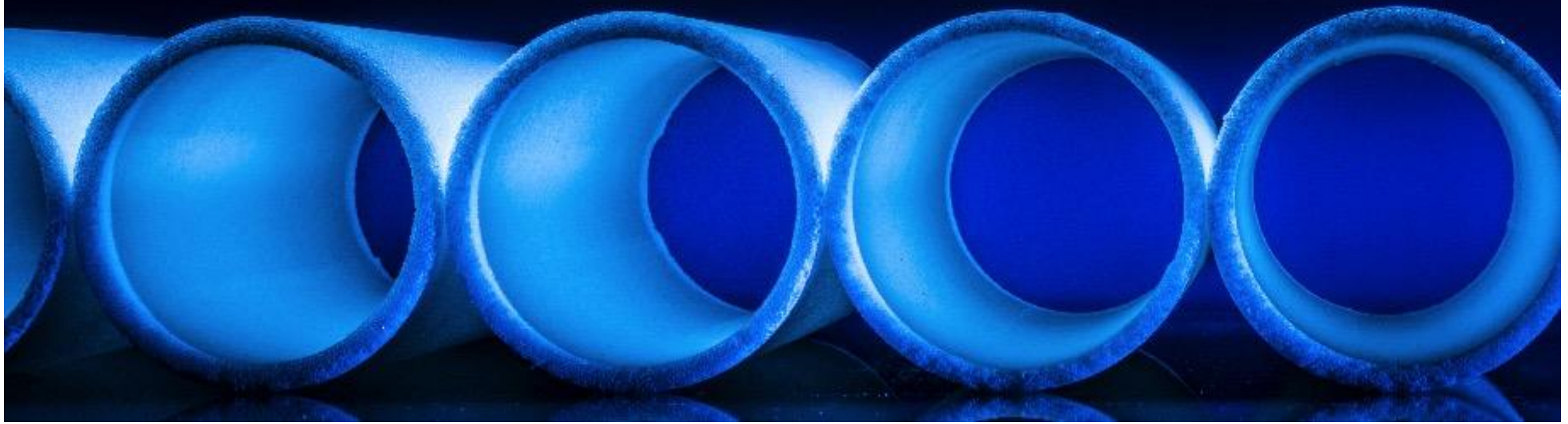
THE CATALYST - ULTRADISPERSE TITANIUM DIOXIDE POWDER OF OUR OWN PRODUCTION. BEADS SIZE - 40 NM.

PHOTOCATALYTIC AIR CLEANING SYSTEM "TIOKRAFT" IS THE MOST EFFECTIVE FROM REALISED IN THE WORLD

CARRIER IS IMPLEMENTED
IN THE FORM OF A PIPE AND A PLATE.
THE VARIETY OF FORMS DOES NOT HAVE BORDERS.

ON THE PICTURE:

WITH THE SIZE OF THE PIPE 80 x 420 MM
PHOTOCATALYST WORKING SURFACE
IS MORE THAN 3000 M^2



We believe that it is necessary to pay attention to the exceptional danger of VOCs that we breathe in with air every day

Common symptoms of exposure to HIGH levels of VOCs include:

Acute/short term exposures (hours to days)

- Eye, nose & throat irritation
- Headaches
- Nausea/vomiting
- Dizziness
- Worsening of asthma symptoms

Chronic exposures (years to a lifetime)

- Cancer
- Liver & kidney damage
- Central nervous system damage

Sources of VOCs

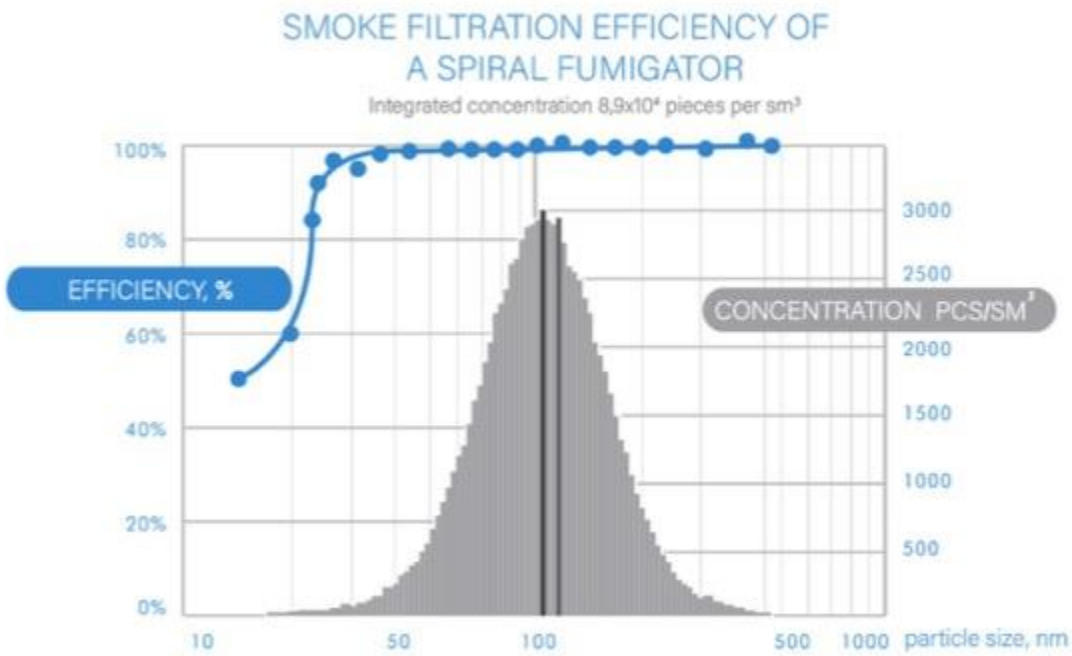
Volatile Organic Compounds (VOCs) may be present in our daily lives are: benzene, ethylene glycol, formaldehyde, phenol, styrene, methylene chloride, tetrachloroethylene, toluene, xylene, and 1,3-butadiene.

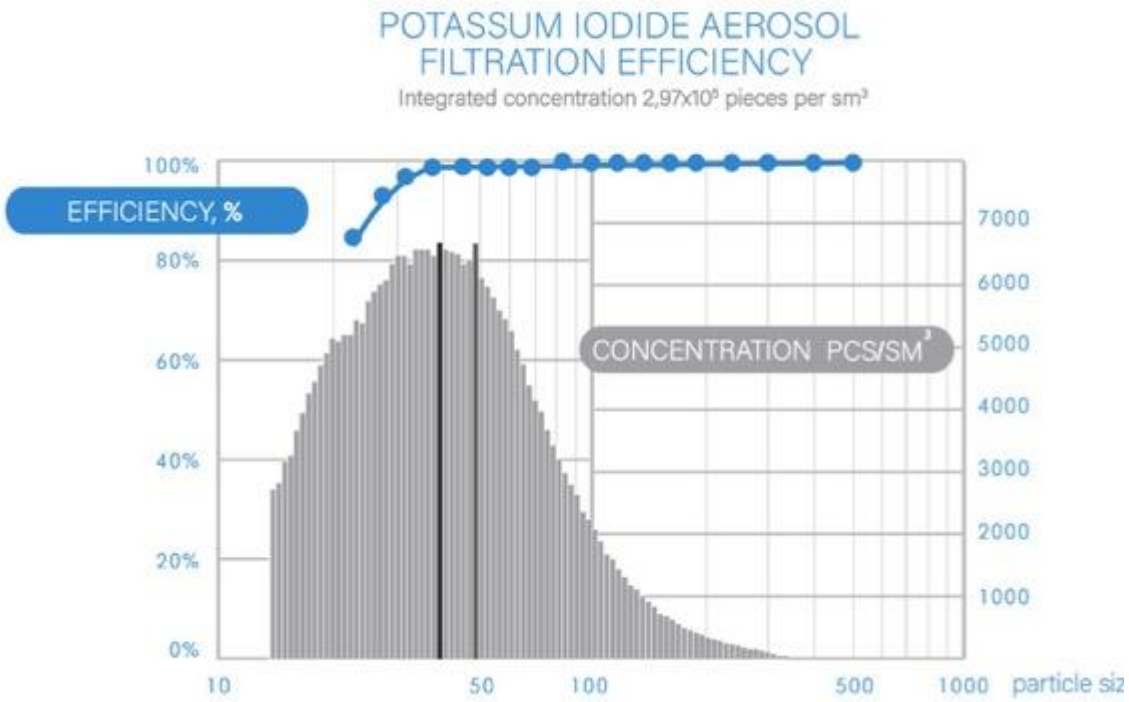
Tiokraft technology completely decomposes these VOCs to water and carbon dioxide

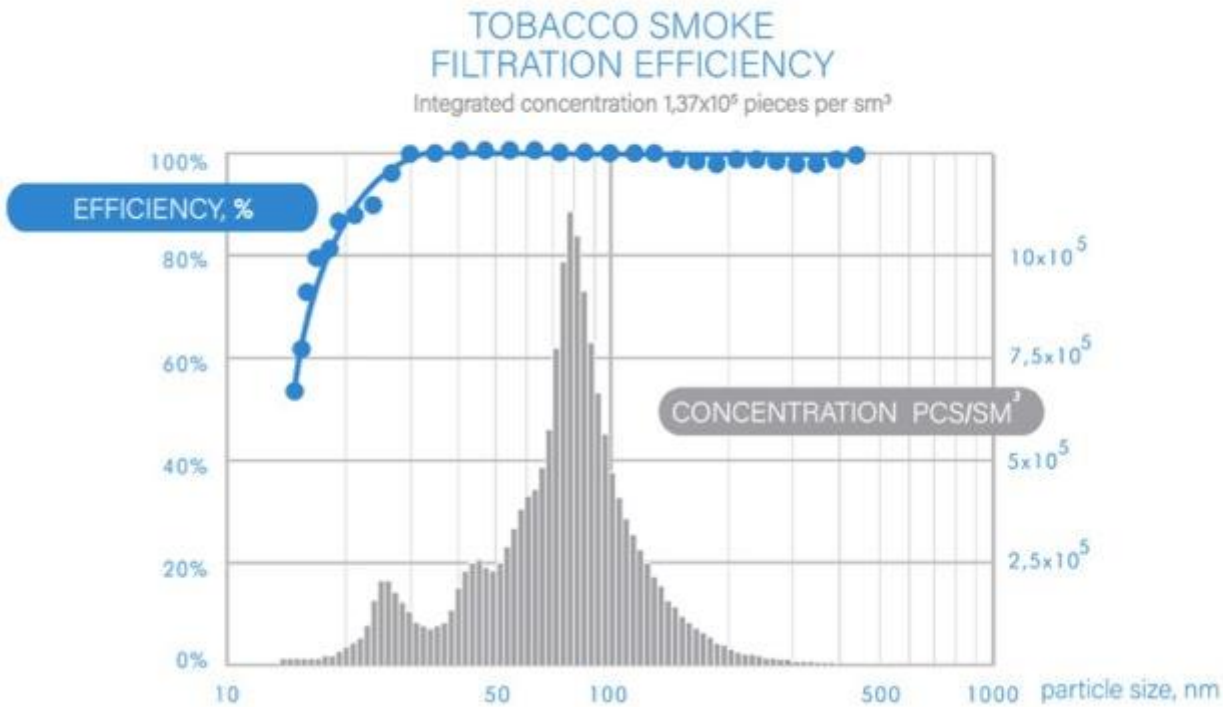

PHOTOCATALYTIC SYSTEM
TEST
RESULTS

THE RESULTS OF THE FILTRATION EFFICIENCY CHECKING OF THE CONTROL AEROSOL PARTICLES

The filtration efficiency of the system was determined on the results of measurements of the differential size distributions of the countable concentration of aerosol nanoparticles at the inlet and outlet from the purification system filtration zone with the use of the SMPS 3936 scanning electric mobility analyzer manufactured by TSI Corporation *(*USA*)*.







As a result of the experiments it was established that aerosol particles are collected by the system with the efficiency close to 100% in the range of their sizes from 20 nm. Bacteria and viruses are caught with the same efficiency, as most of the studied bacteria are 500-5000 nm in size, and viruses of 60-300 nm.

TEST RESULTS OF THE TIOKRAFT M400 IN THE NATIONAL HEALTH INSTITUTE JOHANNESBURG, SOUTH AFRICA

NATIONAL HEALTH LABORATORY SERVICE
NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

NATIONAL HEALTH LABORATORY SERVICE,
NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

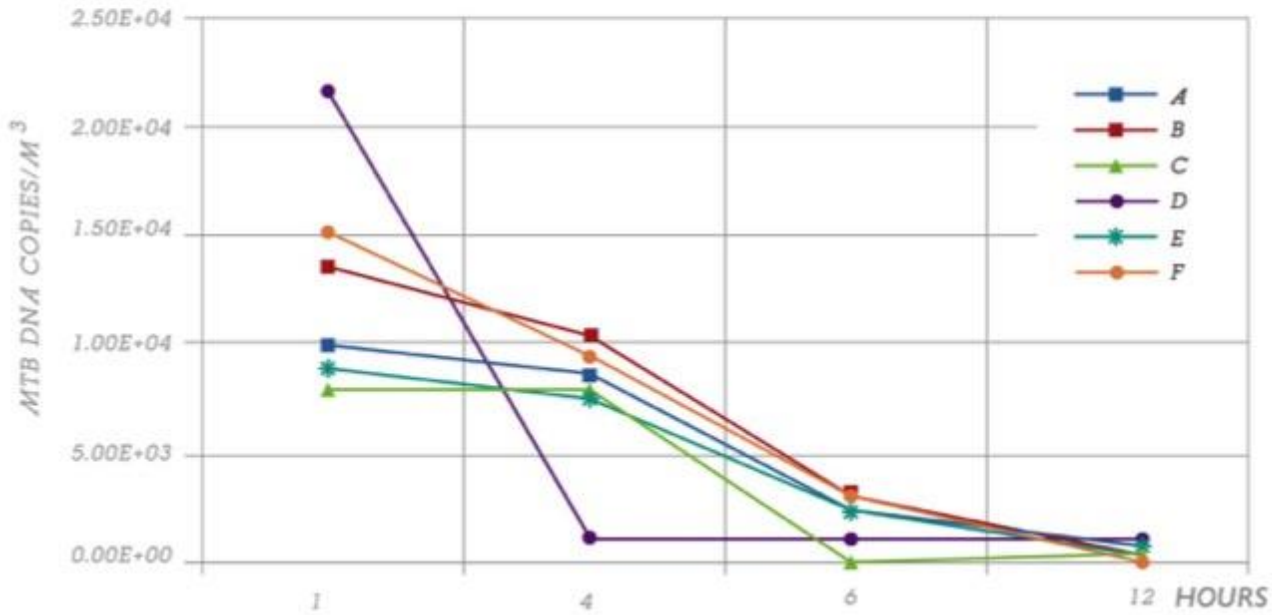
In the course of the experiments, an avirulent strain of tuberculosis (MBT H37Ra), closely linked phenolip-tically and genotically with a wild strain of a drug-resistant tuberculosis pathogen, was used. The initial solution of MBT H37Ra at a concentration of 1x10 bacteria / ml was converted into an aerosol, which was sprayed in a 16 m chamber for 60 minutes at a height of 0.9 m, simulating the average height of a person lying on a hospital bed.

Then primary air samples were collected at 6 sampling points (A, B, C, D, F, E) at a height of 1.4 m above the floor level in four time periods (1, 4, 6 and 12 hours). Bacteria were captured on membranes of polytet-rafluoroethylene fibers from the air environment. In real-time mode the collected samples were quantified using a polymerase chain reaction (QPCR).

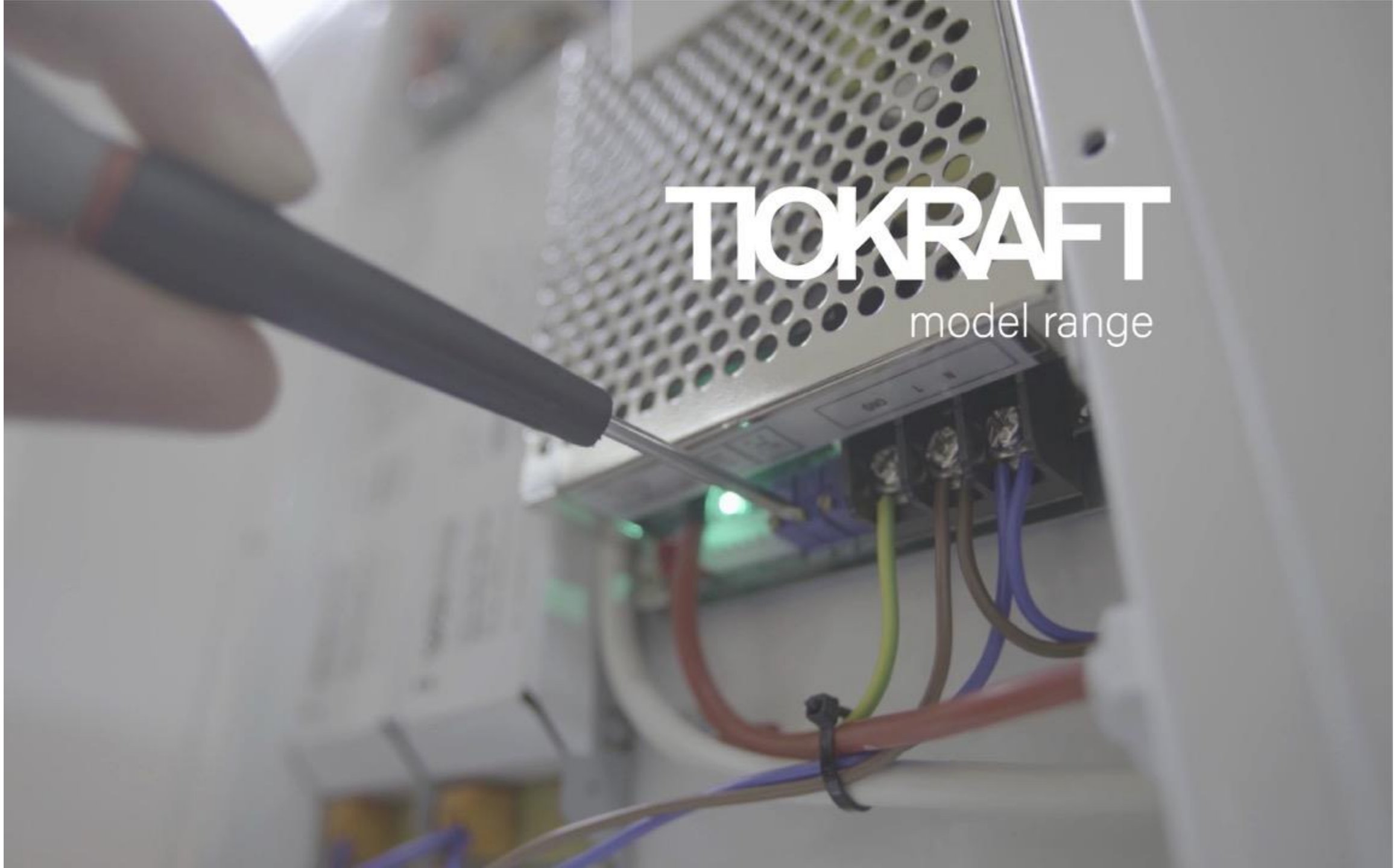
The results are presented as the number of DNA copies per m, where one bacterial cell of the H37Ra strain corresponds to one DNA copy.

The experiment was repeated with the TIOKRAFT M 400 operating at low output (about 120 m /h).

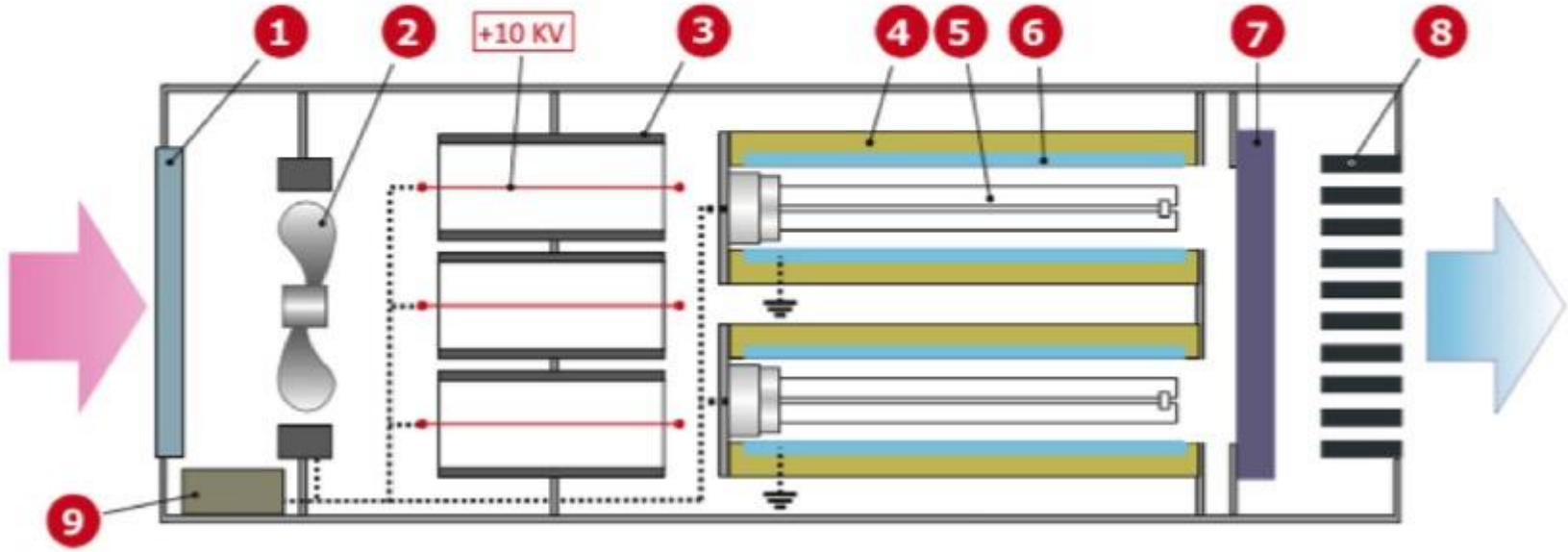
The average concentration of the H37RA strain bacterial cells contained in the air, detected with the operating TIOKRAFT M400 device



THE TIOKRAFT M400 EFFECTIVELY STERILISES AIR CONTAMINATED BY DRUG-RESISTANT TUBERCULOSIS INITIANT (H37RA STAMPS), REDUCING IN 12 HOURS TUBERCULOSIS BACTERIA CONCENTRATION IN 1000 TIMES


TIOKRAFT
model range

PURIFICATION SCHEME INTEGRATED PHOTOCATALYTIC DEVICES



1. **Prepurification filter** - removes coarse dust from the purified air
2. **Fan**- drives the purified air through the device

3-4. **Electrostatic filter** - holds the smallest aerosol particles, bacteria, viruses and mold spores

5-6 **Photocatalytic filter**- mineralizes organic molecular impurities, mainly to carbon dioxide and water. Consists of UV- lamps, which work in the "soft" radiation range **(320-405 nm)**, and photocatalytic elements on inorganic basis.

7. **Coal-catalytic filter -** prevents leakage of harmful substances by means of their adsorption on the surface of the carbon adsorbent. The technology of adsorption and photocatalytic filters collaboration allows to make the adsorbent reversible, with increasing operating life up to **10 times.**
8. **Carbon monoxide purification unit** - contains Pt / Pd catalyst on nanocrystalline carrier. In addition to carbon monoxide, it removes from the air the low molecular weight organic compounds (optional).
9. **Power supply and signaling** - includes sensor automatic control system (for **VR400A** only) assigning the air cleaner mode depending on the concentration of molecular organic contaminants in the clean air.

CONVECTION DEVICES

The best solution when you need
the maximum level of air purification
in premises up to 45 m² with zero noise level.

The reliability of the devices makes it possible to use them in a round-the-clock and stand-alone mode.

Air purification from molecular organic pollutants and pathogenic microflora occurs without accumulation of them inside the device.

It is recommended to use in the places of the longest stay:
a bedroom, a workplace in the office, a hospital room, nursery etc.

RECIRCULATION DEVICES

Effective in solving complex tasks of cleaning and sterilising air in rooms with high requirements for the clean air environment, and in rooms with the presence of a large number of contamination foci.

To solve non-standard problems, the devices have the following options for refitting:

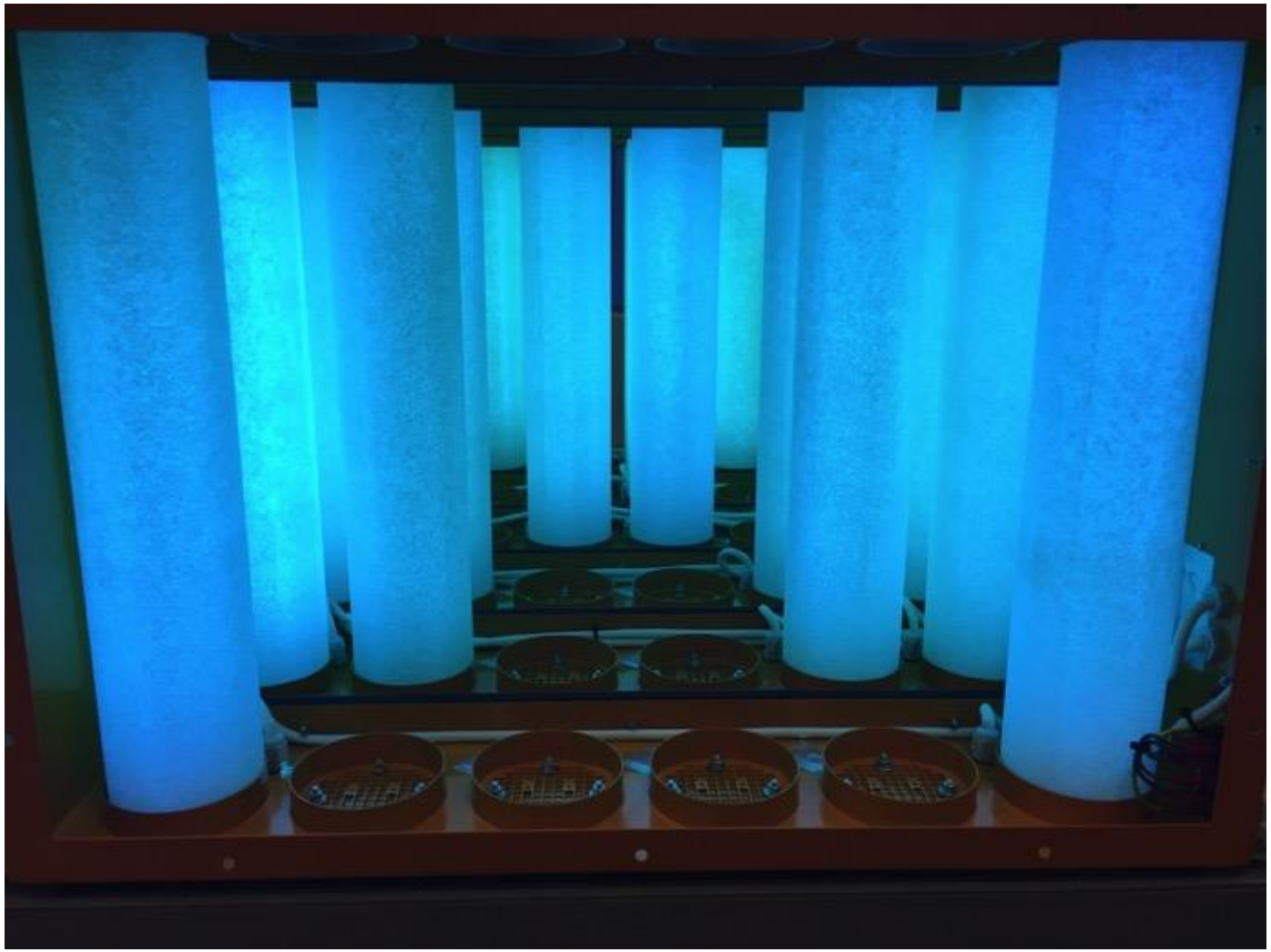
+ control unit with gas sensor for automatic analysis of the air condition of the room and selection of the optimal operating mode of the device;
+ electrostatic unit for trapping fumes and thin aerosols;
+ adsorption unit for capturing chlorine and fluorine-containing substances;
+ catalytic unit based on platinum for carbon monoxide removal.

NON-STANDARD SOLUTIONS

There are non-standard solutions for the TIOKRAFT modules integration into:

- Interior items;
- Individual respiratory protection;
- The system for food waste utilisation;
- Smoking rooms, etc.

On the picture:
floor hanger with built-in photocatalytic cleaner TIOKRAFT



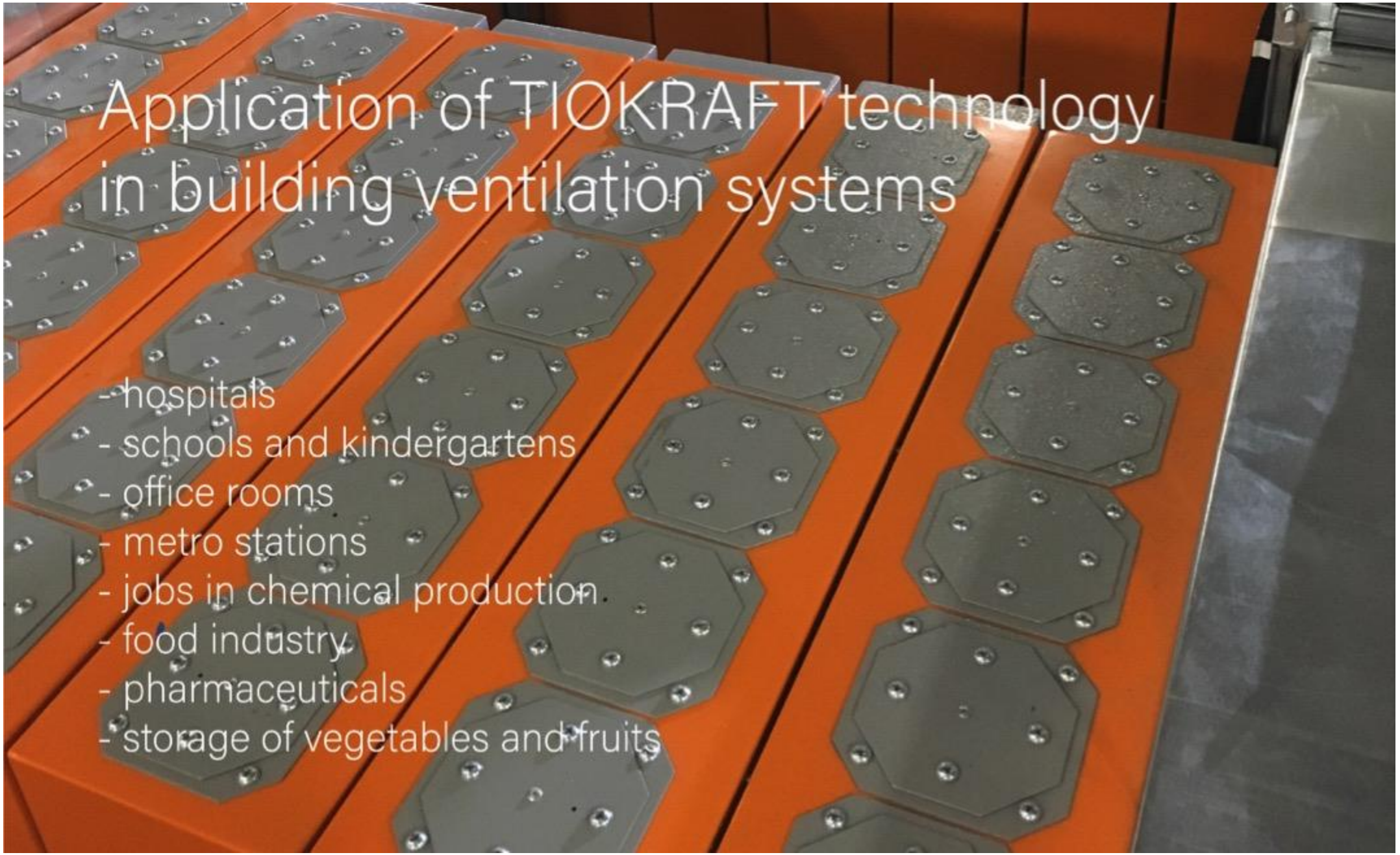
TIOKRAFT SPECIAL SOLUTIONS

Having such universal technology and experience of implemented projects in our hands, we can approach the issues of creating clean environments in a complex way, designing individual solutions according to the customer's specifications.

Among the completed projects, **it is worth paying attention** to the following:

P Channel equipment with high productivity (from 150 to 16 000 m^3 / h);
P Air steriliser for the food industry;
P Air disinfectant for agriculture and livestock husbandry;
P Microclimatic installations for museums and archives;
P Air disinfectors for railway transport and others.

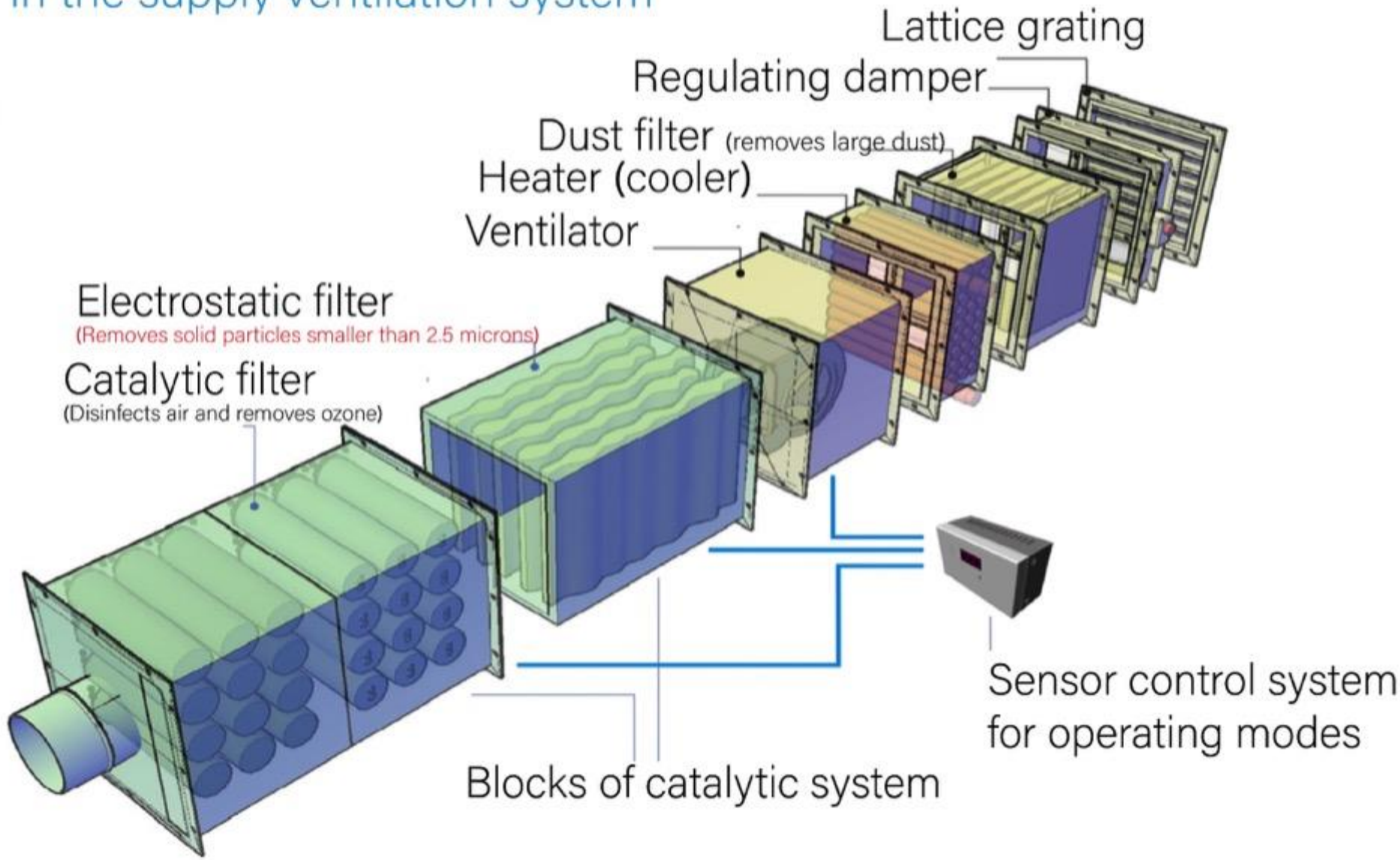
On the picture:
photocatalytic air disinfector TIOKRAFT
Productivity 10000 m^3


Application of TIOKRAFT technology
in building ventilation systems
- hospitals
- schools and kindergartens
- office rooms
- metro stations
- jobs in chemical production
- food industry
- pharmaceuticals
- storage of vegetables and fruits

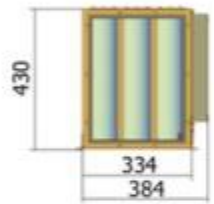
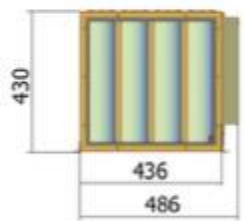
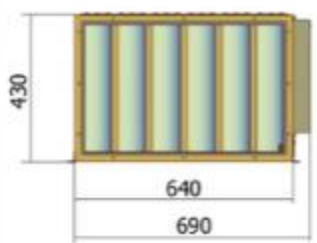
Options for using TIOKRAFT technology in ventilation systems

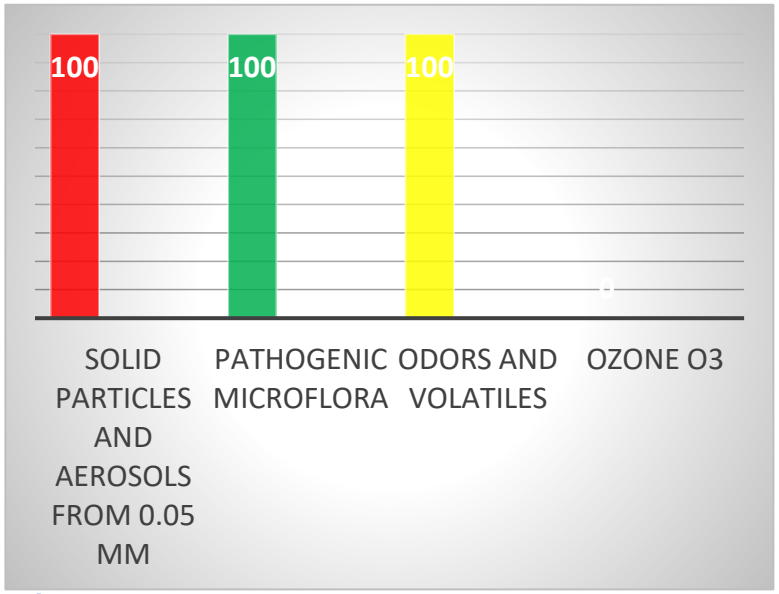
1 - Stand-alone device for cleaning and disinfection of street air in small rooms
2 - Disinfection of recirculation air in the general ventilation system of the building
3 - Cleaning and disinfection of air in the ventilation system of the building
4 - Autonomous disinfector of indoor air (recirculation)

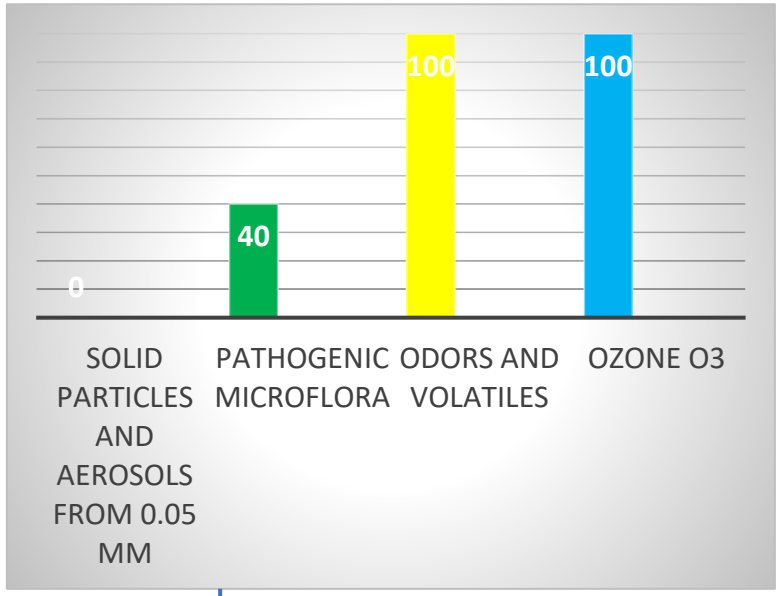
Complete solution for decontamination and air purification from fine dust in the supply ventilation system

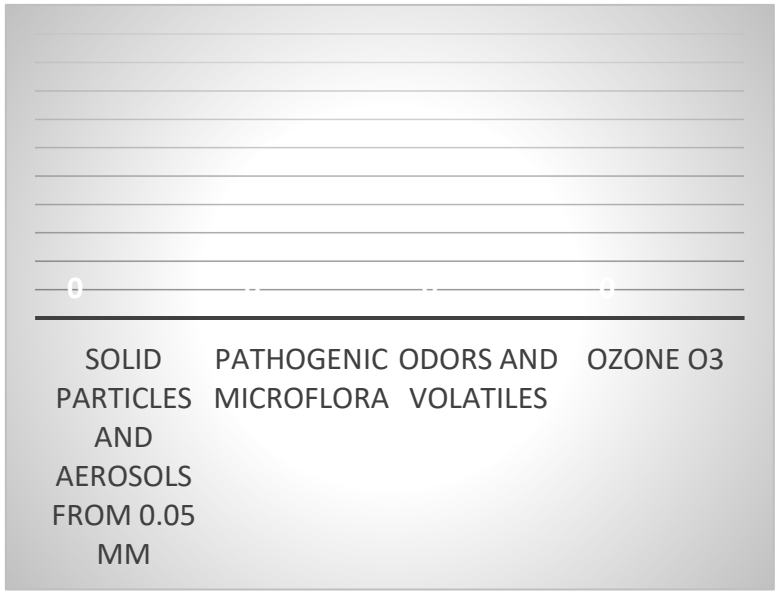


Typical dimensions and optimum performance of photocatalytic modules for channel systems for air purification and disinfection

600-2200 Productivity for cleaned air (m3 / h) The photocatalytic filter is installed (36 W) Photocatalytic filter not installed		465	620	775	930
		600 K337	750 K349	900 K3511	1000 K3613
		650 K438	1000 K4412	1200 K4514	1500 K4617
		1200 K6314	1600 K6418	1800 K6520	2200 K6624


100
100
100
0
SOLID PARTICLES AND AEROSOLS FROM 0.05 MM
PATHOGENIC MICROFLORA
ODORS AND VOLATILES
OZONE O3


0
40
100
100
SOLID PARTICLES AND AEROSOLS FROM 0.05 MM
PATHOGENIC MICROFLORA
ODORS AND VOLATILES
OZONE O3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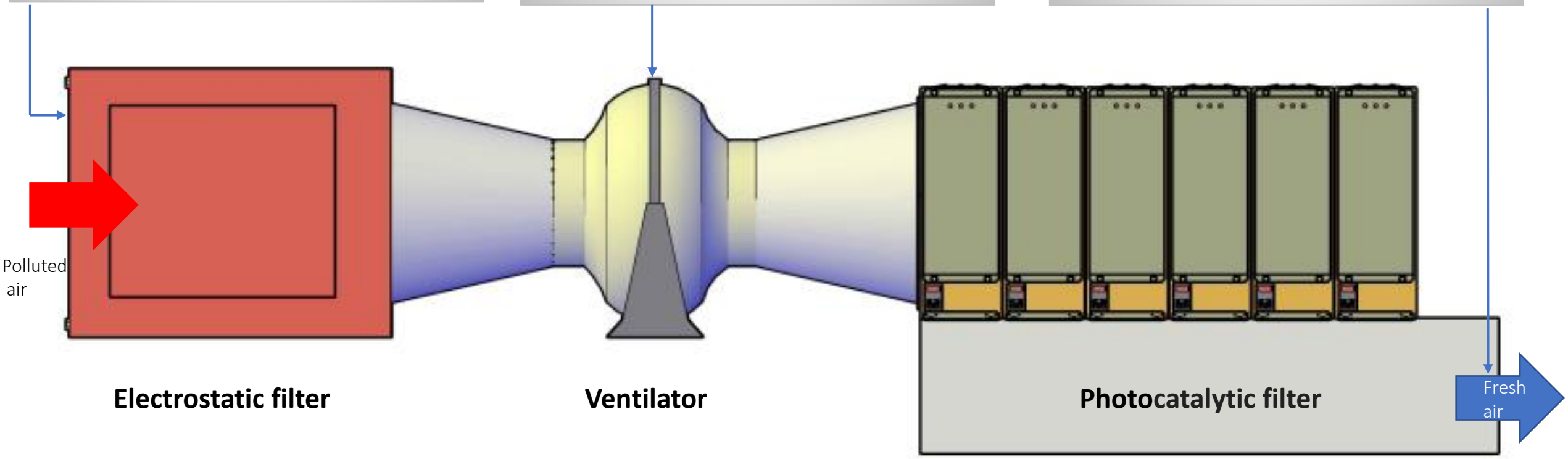
SOLID PARTICLES AND AEROSOLS FROM 0.05 MM
PATHOGENIC MICROFLORA
ODORS AND VOLATILES
OZONE O3


Polluted air
Electrostatic filter
Ventilator
Photocatalytic filter
Fresh air

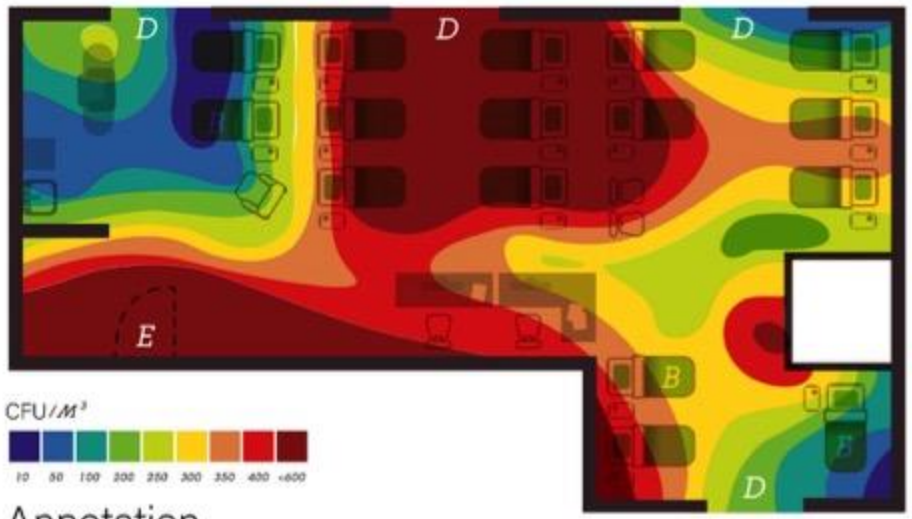

TIOKRAFT IN MEDICINE

Air disinfection in the cardiac recovery unit of the Moscow City Clinical Hospital No. 70

Test conditions

1. Room space - 160 sq m 2. Ceiling height - 3.5 m 3. Doors and windows - periodically open 4. The number of people constantly present - 10-15
5. The number of installed photocatalytic devices (Tiokraft M400) - 1 6. Air cleaner performance for cleaned air - 120 cubic meters per hour

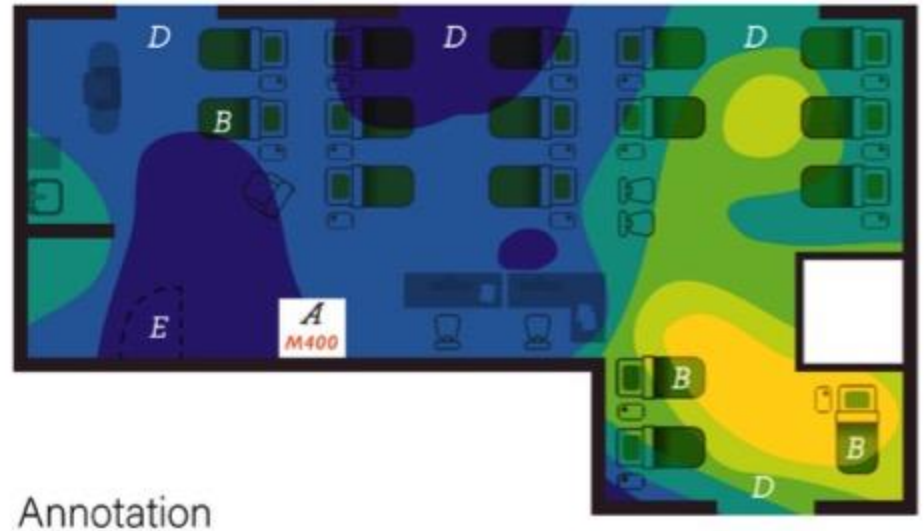
Inital condition



Annotation

The value of CFU in the certain parts of the block reached values of more than 1000 units/m³

Microbiological state of the aerial environment six days after switching on the device



Annotation

1. The average value of CFU decreased to 50-100 units per square meter
2. The efficiency of cleaning is determined to a considerable extent by gas-dynamic flows, which are formed during the air purifier's operation

State Medical Institutions where TIOKRAFT equipment is installed in the last year

1. FSBI "3 Central Military Clinical Hospital. A.A. Vishnevsky "of the RF Ministry of Defense;

2. FSBI "Academician V.I. Shumakov Federal Scientific Center for Transplantology and Artificial Orchids";

3. State Budgetary Healthcare Institution "Morozovskaya Children's City Clinical Hospital" Moscow;

4. N.N. Blokhin National Medical Research Center for Oncology of the Ministry of Health of Russian Faderation;

5. Moscow Regional Perinatal Center of Balashikha;

6. Center for Palliative Care in Podolsk;

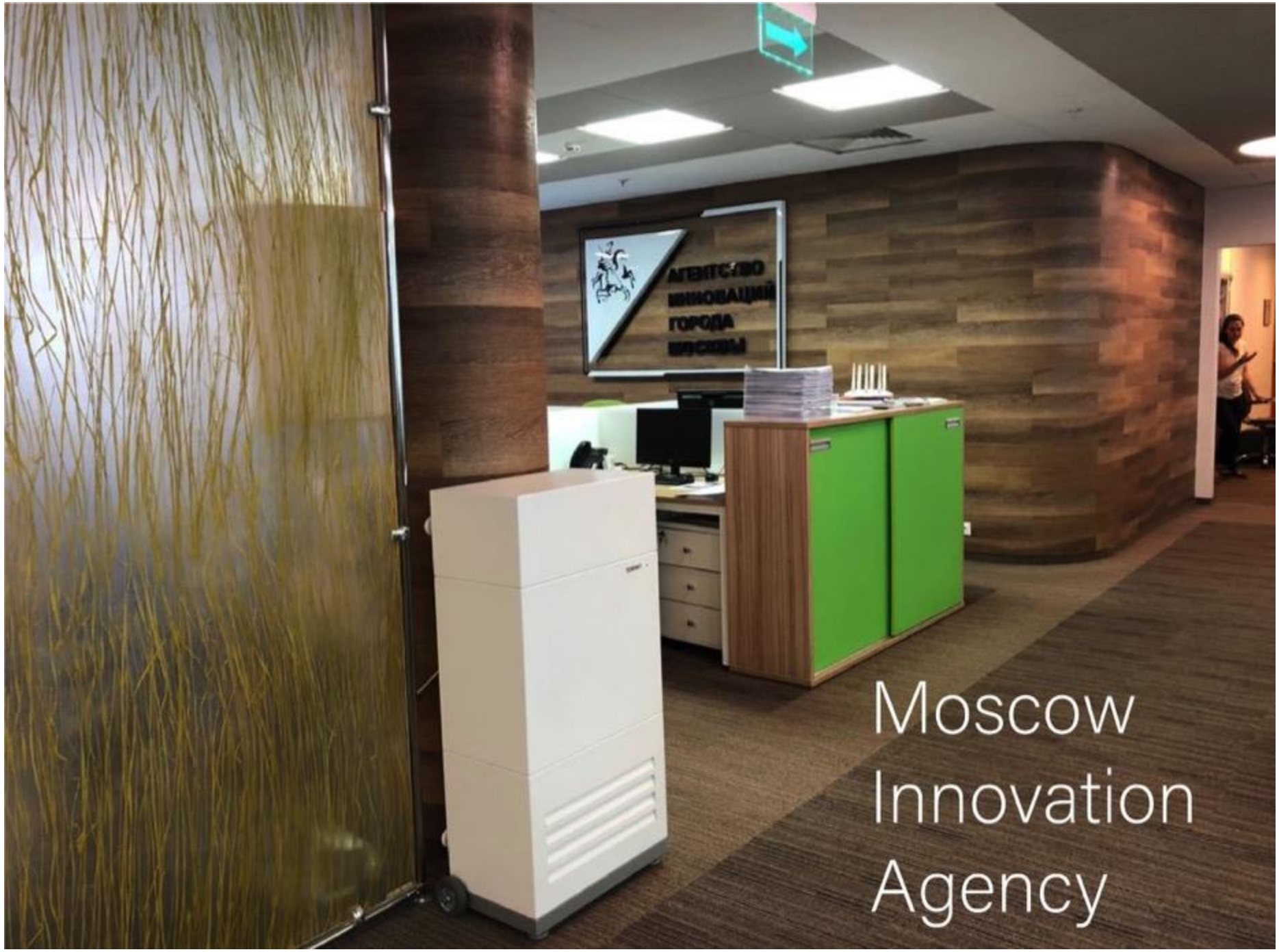
7. City Clinical Hospital No. 17, Moscow;

8. V.F. Voino-Yasenets Scientific and Practical Center for Specialised Medical Care for Children Health Department of Moscow;

9. Hospital for veterans of wars № 2 of the Department of Public Health of Moscow;

10. Z.A. Bashlyaev Children's City Clinical Hospital;

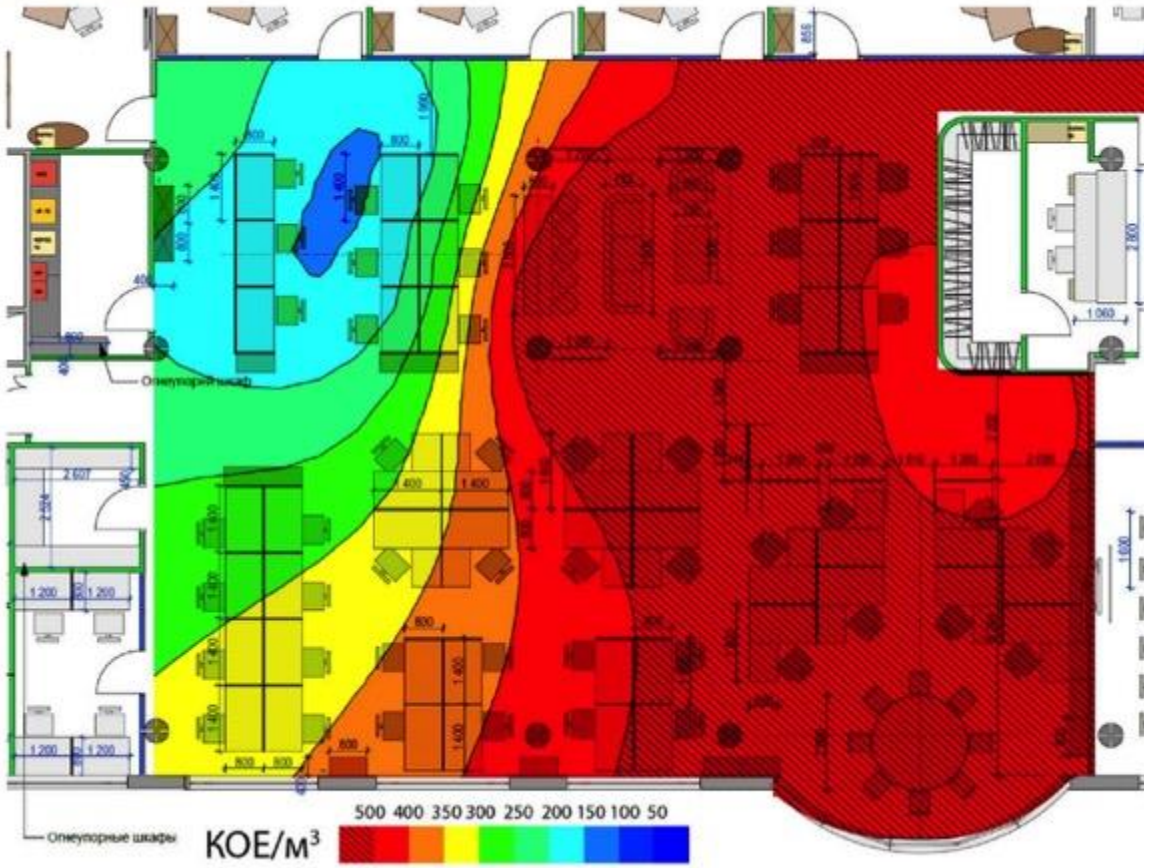
11.Central Clinical Hospital of the Russian Academy of Sciences


Moscow
Innovation
Agency

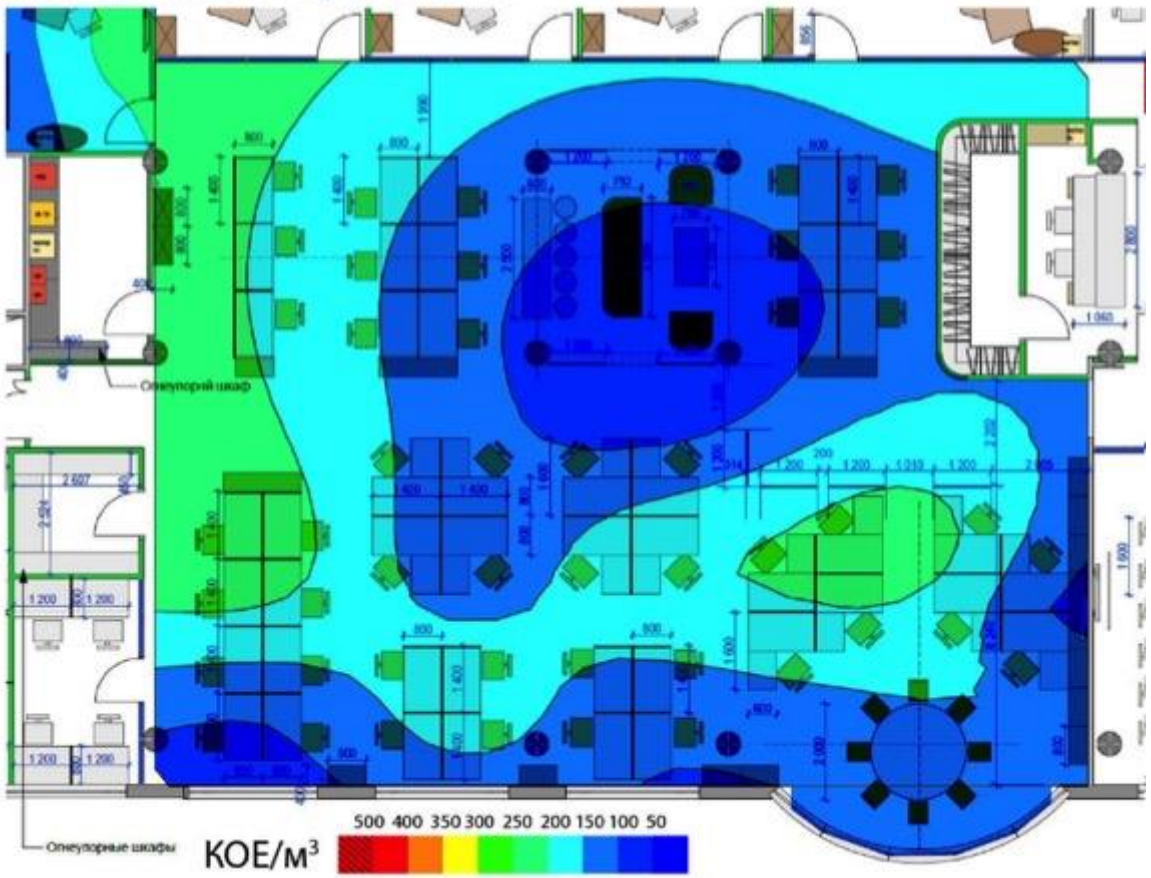
OPEN SPACE

Area: 285 m²
Number of employees: 52

Initial condition

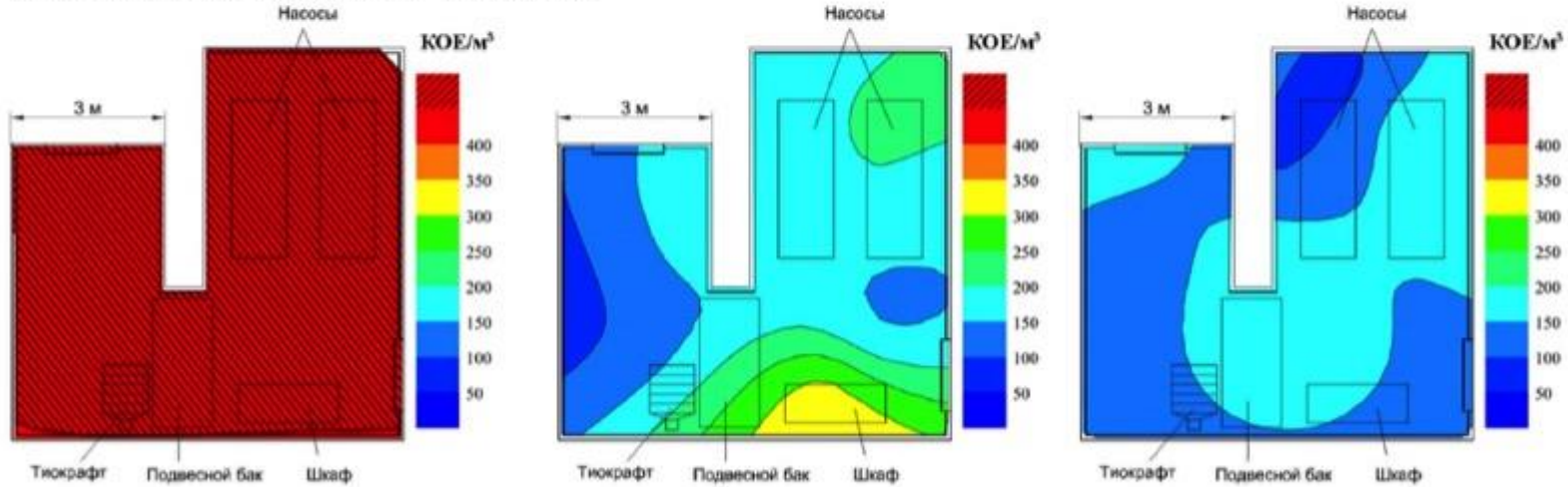


Microbiological state of the aerial environment
seven days after switching on the device

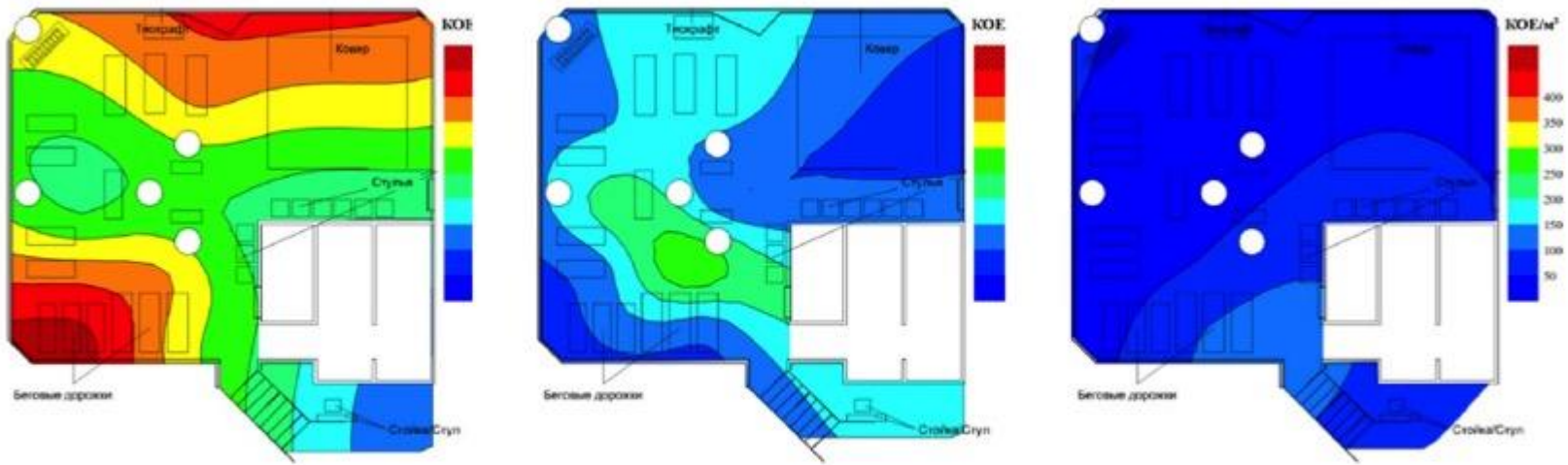



TIOKRAFT in Novotel at Sheremetyevo Airport
NOVOTEL

In the auxiliary room for collection of food waste with an area of 60 m²
the device TIOKRAFT VR 2500



In the fitness club room with an area of 75 m² there is a device TIOKRAFT M 400 AE



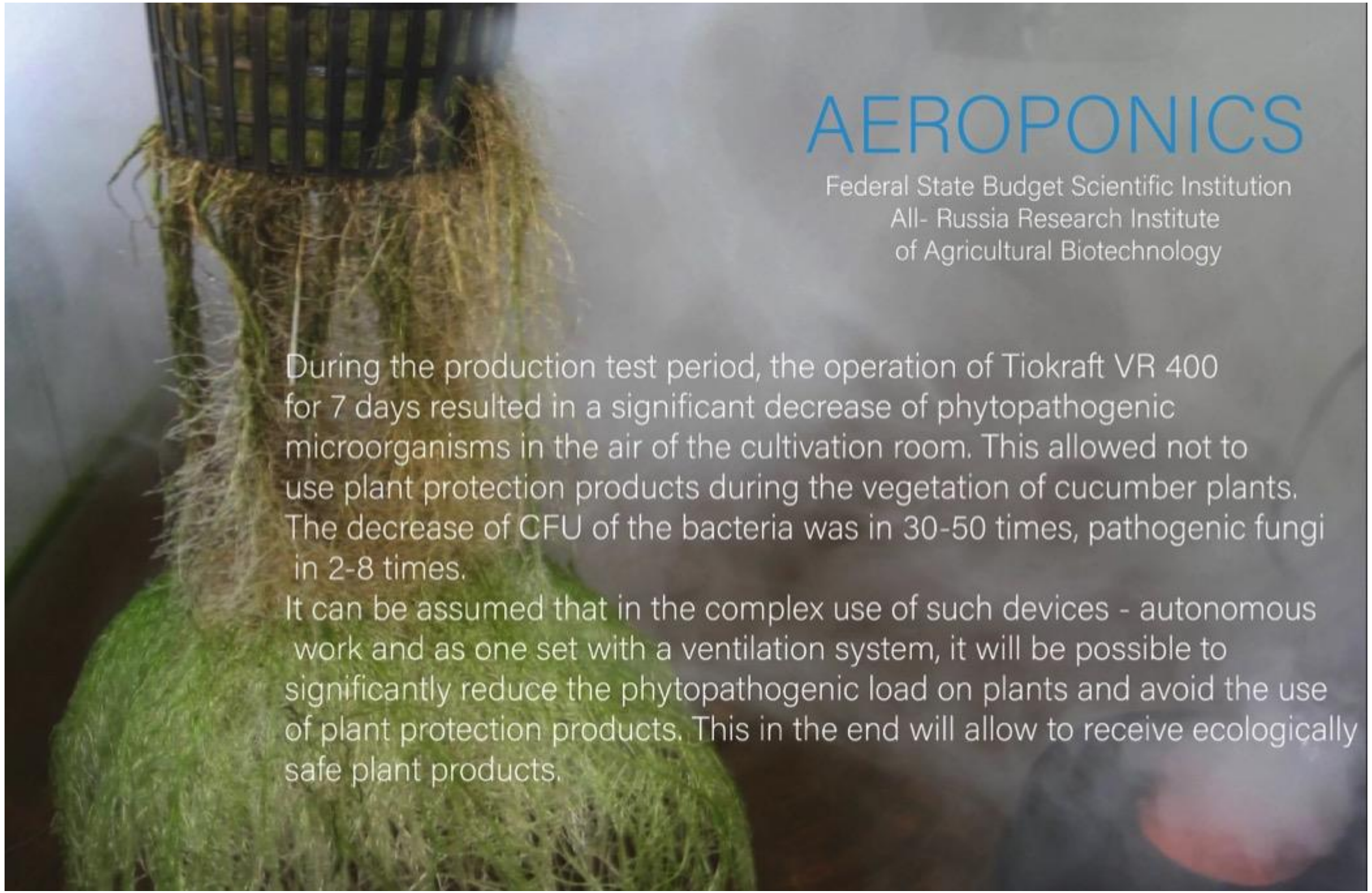
22/12/2017 30/12/2017 19/01/2018


Friendly zones
at gas stations
ЛУКОЙЛ
ЛУКОЙЛ
1
А-76
ДТ
3
5
5
1

Children's zone
at the gas station Lukoil

Cafe area at the gas station Lukoil


TIOKRAFT
IN AGRICULTURE



AEROPONICS

Federal State Budget Scientific Institution
All- Russia Research Institute
of Agricultural Biotechnology

During the production test period, the operation of Tiokraft VR 400 for 7 days resulted in a significant decrease of phytopathogenic microorganisms in the air of the cultivation room. This allowed not to use plant protection products during the vegetation of cucumber plants. The decrease of CFU of the bacteria was in 30-50 times, pathogenic fungi in 2-8 times.

It can be assumed that in the complex use of such devices - autonomous work and as one set with a ventilation system, it will be possible to significantly reduce the phytopathogenic load on plants and avoid the use of plant protection products. This in the end will allow to receive ecologically safe plant products.

RESULTS OF THE RESEARCH BASED ON THE BASIS OF POTATO STORAGE OF «BELAYA DACHA FARMING» LLC

1. Reduction of losses of potatoes up to 5-10% by reducing the spread of bacterial and fungal diseases

2. Increasing of storage life

3. Elimination of the odors of organic origin

4. The creation of a sterile air environment in the vegetable store


Plant for the utilization
of medical waste

Tiokraft installed in the exhaust ventilation.
The power of the instruments is 10000 m3/h.
Complete removal of odors from air emissions is ensured, which made it possible to place the plant in an urban area

Archives and museums

Since 2017 TIOKRAFT devices have been installed:

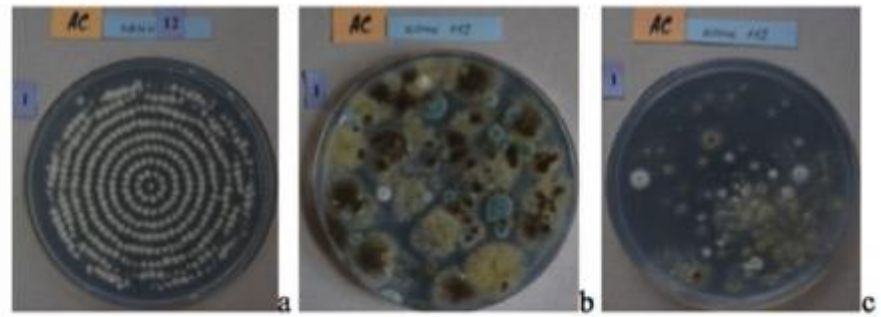
1. Federal Government Institution"Russian State Archive of Scientific-technical documentation";
2. Archive of the Privolzhsky bank of Sberbank of Russia;
3. Regional departments of the Pension Fund of the Russian Federation.
4. Russian State Archive of Scientific and Technical Documentation;
5. Archive of the Russian Academy of Sciences (St. Petersburg);
6. Central Public Library (St. Petersburg).

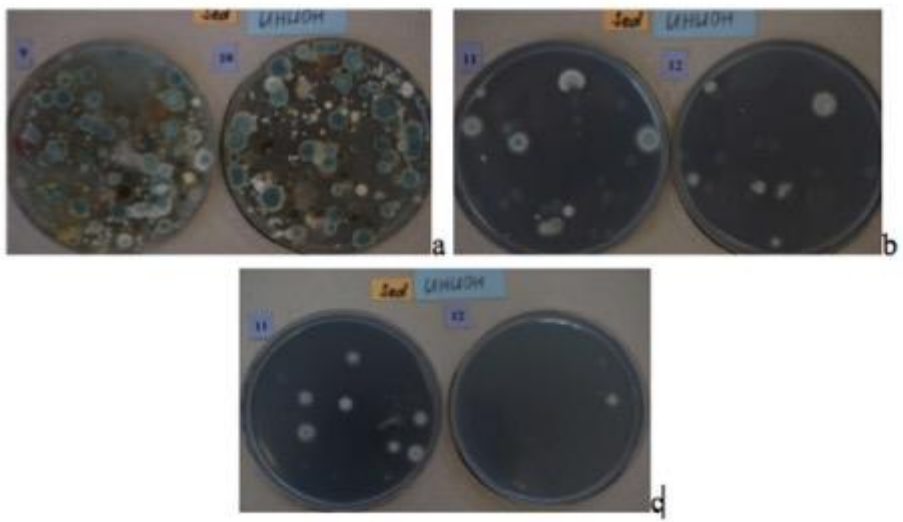

Elimination of the consequences of fire in the library
of scientific information of the Academy of Sciences

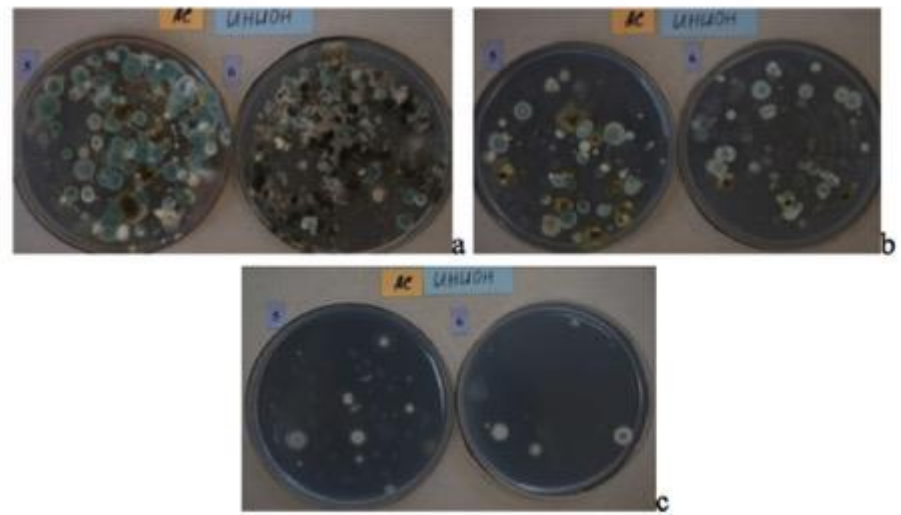
Equipment TIOKRAFT removed mold spores in the air in the premises where work was carried out to save wet books. The initial concentration of mold in the premises was about 1 million CFU/m3. Within 6 days the concentration of mold in the air decreased by 1000 times

In the photographs, the results of microbiological air analysis:

a) prior to the start of operation of the instruments
b) one day after the start of work
c) 6 days after the start of work

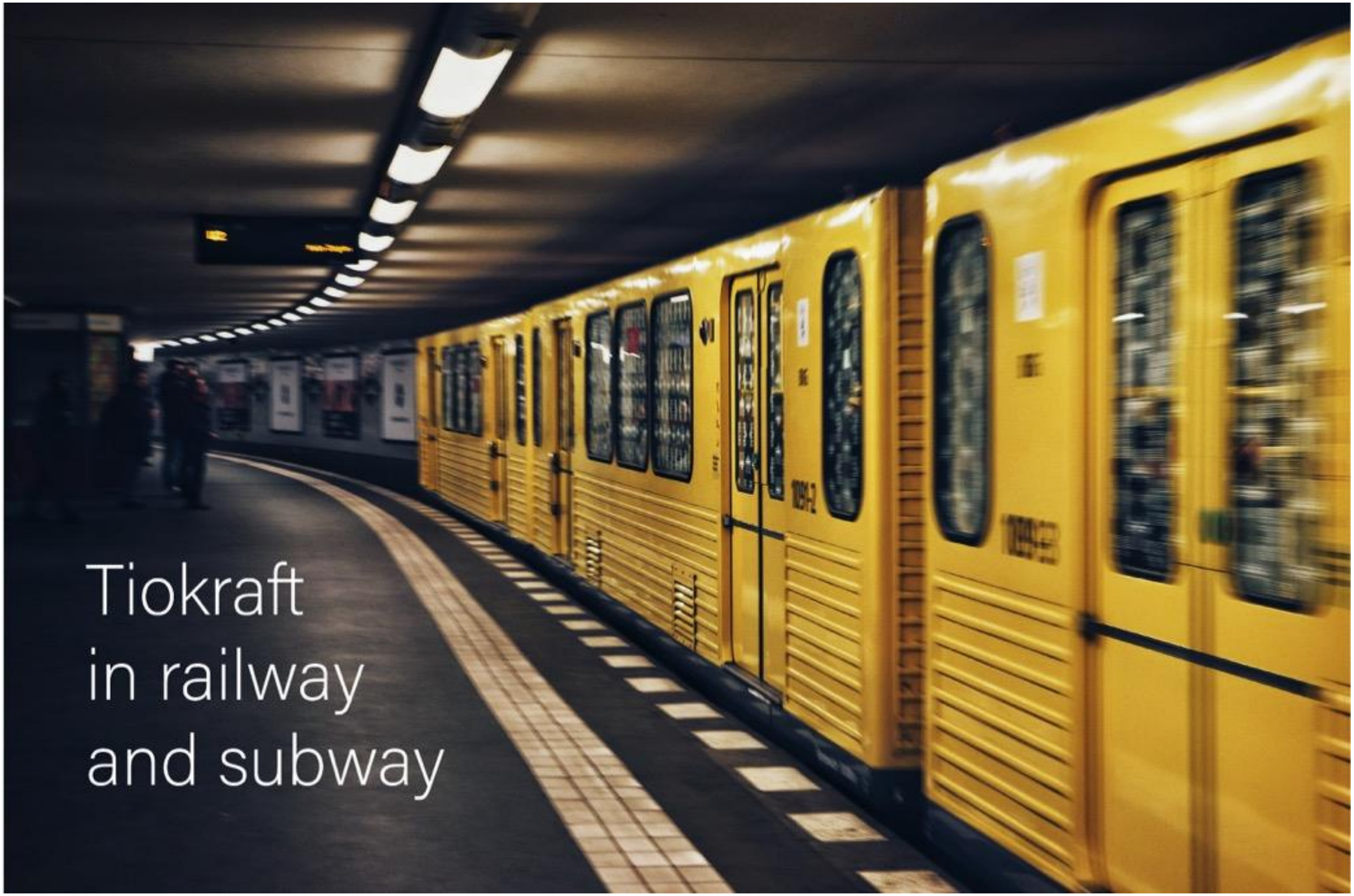






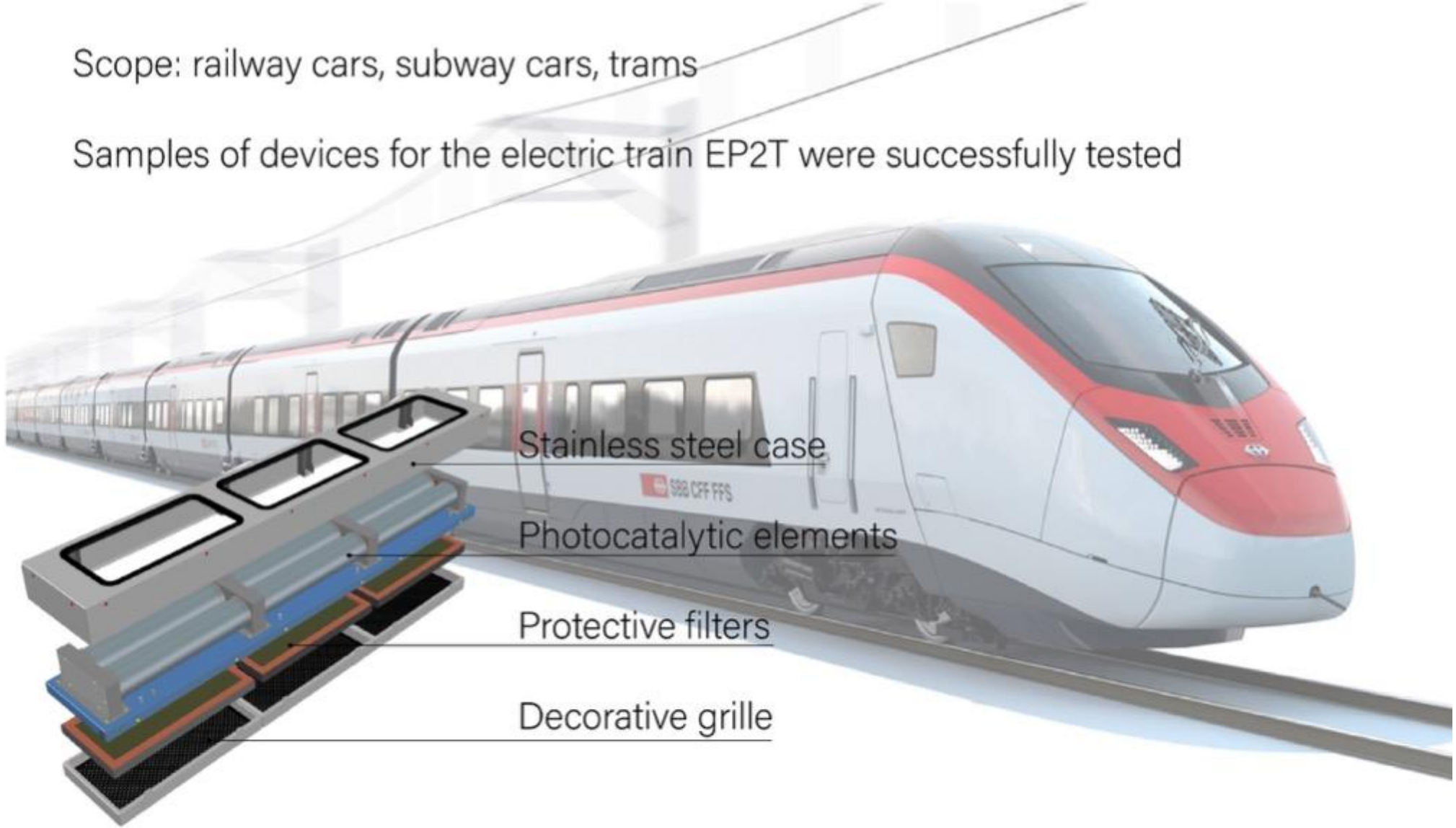
Summer 2018 year.
TIOKRAFT won a competition for the reconstruction of air disinfection systems in the building of the summer palace of Petra I **(on the picture)**.

The Russian State Archive of Scientific and Technical Documentation initiated the development of state rules and procedures for the use of photocatalytic air disinfection systems in the archives of the Russian Federation


Tiokraft
in railway
and subway

Scope: railway cars, subway cars, trams

Samples of devices for the electric train EP2T were successfully tested

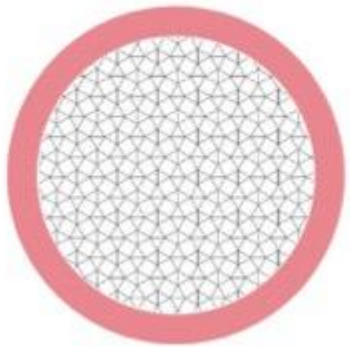


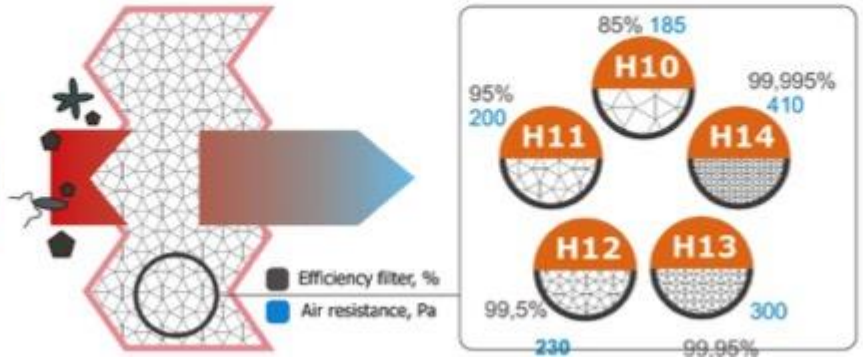
No mercury and other dangerous elements in the construction of devices, apply LED sources of ultraviolet light

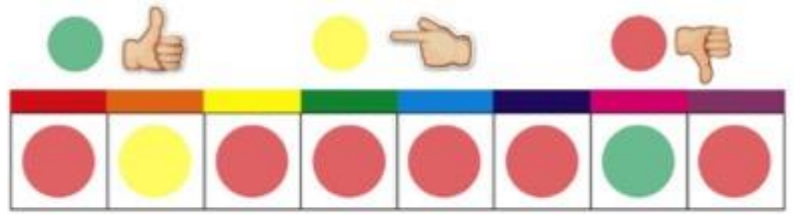
Let's summarize in the comparative table air cleaning and disinfection methods

Measures	Maintenance cost	Microbes, viruses, mold	Light volatile organic compounds	Heavy volatile organic compounds	Ozone	Organic aerosol	Dust, inorganic aerosol	Work in wet conditions

HEPA-filter

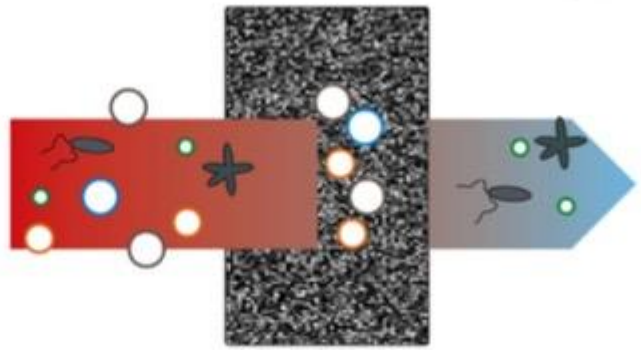






- Penetration of the filtered microflora on the inner surface of the filter after 2 months of operation.
- No microflora inactivation.
- High cost of replacement filters

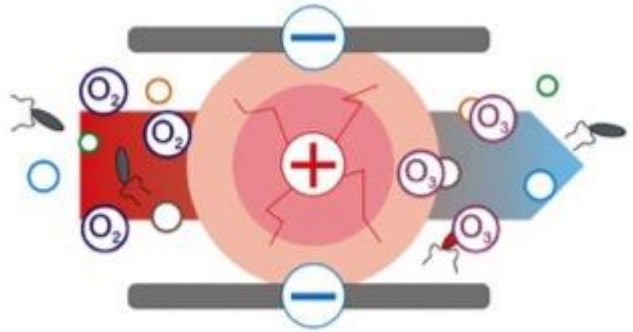
Carbon filter



- Does not catch light toxic compounds (for example formaldehyde).
- Requires timely replacement, otherwise it begins to pollute the air

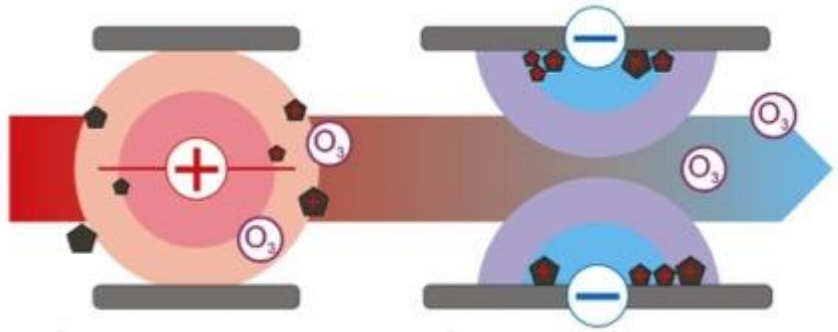
Measures	Maintenance cost	Microbes, viruses, mold	Light volatile organic compounds	Heavy volatile organic compounds	Ozone	Organic aerosol	Dust, inorganic aerosol	Work in wet conditions

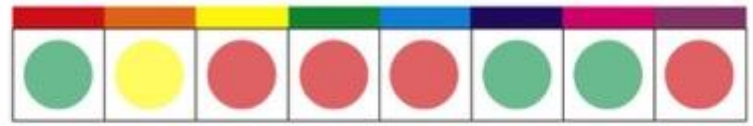
Plasma filter



- Ozone release when operating in hazardous concentrations.
- Low oxidation rate of volatile organic compounds.
- Does not destroy mold spores.

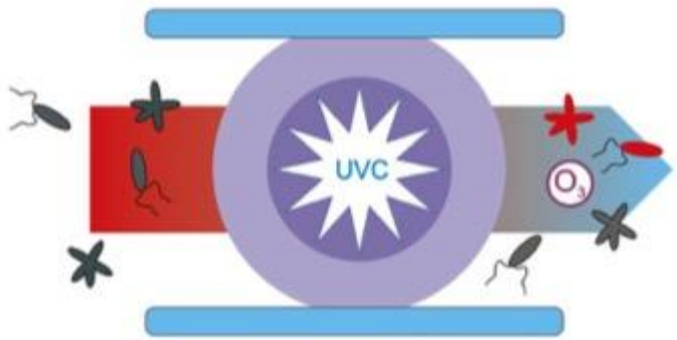
Electrostatic filter

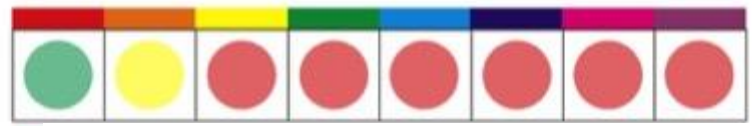




- Produces ozone and nitrogen oxides during operation.
- Impossibility to work with humidity> 85%.
- Danger of self-ignition of organic aerosols

UV irradiation

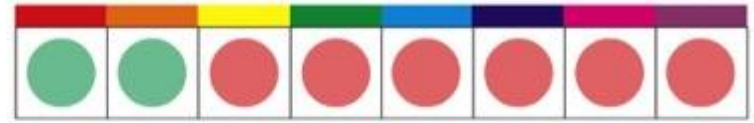




- In most cases, only slows down the rate of reproduction of bacterial infections.
- Does not destroy mold spores.
- Requires frequent maintenance

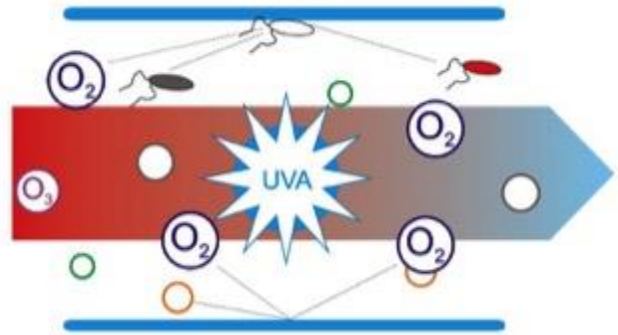
Measures	Maintenance cost	Microbes, viruses, mold	Light volatile organic compounds	Heavy volatile organic compounds	Ozone	Organic aerosol	Dust, inorganic aerosol	Work in wet conditions

Pulsed irradiation



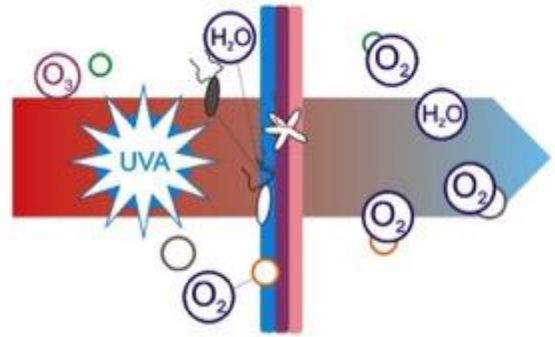
- Ozone release when operating in hazardous concentrations.
- Application in confined spaces (<25 m2).
- Work only in the absence of people
  The presence of shadow areas

Photocatalytic filter



- Low oxidation rates of organic compounds.
- Limited microflora inactivation.
- Pollution leakage at salvo emissions

TIOKRAFT technology



- Significant resistance to air flow (50-100 Pa).
- The relative fragility of the carrier of the photocatalyst.
- Work at humidity not less than 20%

SUMMARIZED RESULTS

The existing technologies of air purification and air disinfection have a number of fundamental drawbacks, which significantly limit the areas of their application and do not provide a comprehensive solution to the problem.

These shortcomings include:

- reduction of cleaning efficiency over time;
- release of toxic ozone;
- imited inactivation of pathogenic microflora (especially mold spores);
- the need for constant replacement of filter elements;
- the inability to remove volatile organic pollutants with a low molecular weight (eg formaldehyde);
- Low efficiency of purification from aerosol contaminants with a particle size of less than 0.3 μm

Technology "TIOKRAFT" allows:

- overcome all of the above disadvantages of existing methods;
- Ensure the possibility of air purification from nanosized particles;
- to create devices with high performance for use in large-scale projects;
- sterilize air in the presence of people

The scope of the technology of TIOKRAFT is limited only by our imagination


Thank you for attention
TIOKRAFT