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EVALUATION OF THE FUNCTIONALITY AND EFFICIENCY OF AN AIR PURIFICATION TECHNOLOGY

DEXWET INTERNATIONAL AG

EXPERT OPINION

Project number:	**Y0636**
Client:	Dexwet International AG Wienerstraße 129 2345 Brunn am Gebirge
Exhibitor:	**Dipl. Ing. Peter Tappler** Generally sworn and court-certified expert compliance with the air - Pollution of indoor airMicrobiology - Mold loads in interiorsConstruction chemistry, building materials - Pollutant content and emissions of building materials 1150 Vienna, Stutterheimstr. 16-18/Stg.2/2.Stock/16m Tel: 0664-300 80 93 Fax: 01-983 80 80-15e-mail: p.tappler@innenraumanalytik.at home: http://tappler.innenraumanalytik.at
Collaboration:	DI Cornelia Pfaller
Date of exhibition:	02.09.2020

Table

1 Task and summary

It is now considered certain that the SARS-CoV-2 virus is mainly transmitted indoors. Since it is unknown in virtually all conceivable cases whether infected persons are located in publicly accessible interiors, minimizing the risk of virus transmission is of the utmost importance.

In addition to "droplet and lubricating infection", the path of infection via the finest particles in the air (aerosols) is increasingly the focus of consideration. Cases involving numerous infected persons who have been infected by a person on the same day without direct proximity ("superspreading events") show that this transmission path plays an important role in practice. It is well known that in addition to a good ventilation situation in general, cleaning of the room air also significantly reduces the number of pathogenic aerosols, thus also the risk of infection in rooms where infected persons are present. [1]

It is to be assumed that the "Dexwet-filter system" on the basis of the documents provided[2] is appropriately suitable to reduce aerosols in interiors in the size range less than 5 microns and on it adhering /contained viruses, but also larger particles.

Especially with regard to the prevention of transmissions of aerosol-borne viruses (e.g. SARS-CoV-2) or bacteria as well as other indoor air ingredients such as allergens by air, the technology can contribute to infection prevention and health preservation, provided it is used in an appropriate way for preventive air purification.

[1] WHO (2020): Transmission of SARS-CoV-2: implications for infection prevention "I'm not here. 9 July 2020. https://www.who.int/news-room/commentaries/detail/transmission-ofsars-cov-2-implications-for-infection-prevention-precautions.

[2] The accuracy and completeness of the documents communicated have not been verified by the Signatory

2 Task

The suitability of air purification devices with "Dexwet technology" with a view to reducing the risk of transmission of the SARS-CoV-2 virus will be clarified in the context of an expert opinion.

In particular, it is to be determined whether the technology can in principle be suitable for reducing aerosols delivered in densely occupied rooms without sufficient air change with fresh air (outdoor air) of possible virus emitters with adhering/containing infectious viruses.

3 Documents used

The following documents were used as the basis for this report (excerpt):

Name	Exhibitors	Date
DEXWET Report	GPR Aerosol-Inc	02.11.2008
LGA Investigation Report	LGA QualiTest Ltd.	13.05.2005
OFI opinions	Technology & Innovation Ltd.	04.06.2007
Test report DEXWET Modular fine dust filter	Man + Bumblebee	04.04.2006

4 Introduction and background[3]

The pandemic spread of SARS-CoV-2 has massively affected and affected private, professional and social life. The possible transmission path of SARS-CoV-2 via aerosols in the air has meanwhile been detected and described. The World Health Organization (WHO) also points out that SARS-CoV-2 can be transmitted not only by direct droplet infection but also via airborne particles. The main transmission pathway for SARS-CoV-2 is the respiratory uptake of virus-containing liquid particles that occur during breathing, coughing, speaking and sneezing.[4][5][6][7]

The number and size of potentially virus-containing particles produced by a human person strongly depends on the breathing rate and activity. Even with quiet breathing, (possibly virus-containing) particles are released. The risk of infection is increased by the simultaneous presence of many people in buildings or by the stay and activity of many people in a confined space. Activities that increasingly release aerosols include loud speaking, shouting, singing, sporting activity or loud

3 Text partially taken from Umweltbundesamt (2020): The risk of transferring SARS-CoV-2 indoors, it can be Reduce ventilation measures. Commission's opinion on indoor air hygiene on Umweltbundesamt

4 Robert Koch Institute Germany (2020): SARS-CoV-2 Plant-Profile about Coronavirus Disease-2019 (COVID-19), retrieved 06.08.2020

5 Morawska L., Milton D. (2020): It is time to address airborne transmission of COVID-19. Clinical Infectious Diseases, https://doi.org/10.1093/cid/ciaa939

6 WHO (2020): Transmission of SARS-CoV-2: implications for infection prevention "I'm not here. 9 July 2020. https://www.who.int/news-room/commentaries/ detail/transmission-ofsars-cov-2-implications-for-infection-prevention-precautions

7 Buonanno, G., Stabile, L., & Morawska, L. (2020): Estimation of airborne viral emission: quanta emission rate of SARS-CoV-2 for infection risk assessment. Environment International, 141, 105794. https://doi.org/10.1016/j.envint.2020.105794

support for the players at sporting events. Schools, sports and concert halls and various event rooms are affected in this regard.[8]

Coronaviruses themselves have a diameter of about 0.12-0.16 microns (microns), but are usually emitted as part of larger particles. In medical parlance, these particles are often distinguished into "droplets" (diameter > 5 microns) or "aerosols" (diameter < 5 microns) (usually referred to as droplet infections). In terms of their properties, however, there is no sharp boundary between "droplets" or "aerosols", the transition is fluid. Often ignored is the fact that humans emit very large particles only when sneelled. Normal speech and coughing generate almost exclusively small droplets. In addition, the aerosol particles released into the environment change according to their size and composition, depending on the environmental conditions.[9]

In theory, a liquid droplet with a diameter of 100 microns that leaves the respiratory tract at breathing height (approx. 1.5 m) would sink to the ground within a few seconds. In the air, however, the exhaled droplets usually shrink rapidly due to the evaporation of a large part of their water content. This produces smaller particles that can remain in the air for much longer, possibly several hours. Under laboratory conditions, it was found that propagatable viruses in airborne particles were detectable up to 3 hours after release, and several meters of propagable viruses were detected by an infected person in a hospital room. [10][11]

In Central Europe, a large part of our daily routine takes place, about 80-90%, but not outdoors, but in doors. The places of residence change from the apartment, via means of transport (buses, trains, cars) to the workplace (e.g. offices) or schools, universities, shopping areas, cinemas, theatres, etc. Only in very few cases can dormant air be assumed indoors. The movement of airborne particles is therefore determined not so much by deposition (sedimentation processes) and diffusion (physical distribution), but rather by air currents. Flows are caused by air supply and distribution when opening windows and doors ("free" ventilation), via technical ventilation equipment (air conditioning and ventilation systems), but also by temperature differences (convection). In addition, temperature and pressure differences between indoor and outdoor air play an important role in air movements. Human movement and activities also lead to air movements in the interior. Therefore, particles can be transported over several meters and distributed indoors within a short period of time. This also applies to potentially virus-containing particles. In the interests of infection protection, therefore, interiors should be supplied with as high air exchange and fresh air content as possible or cleaned for other types of aerosols.

The use of effective cleaning principles for aerosols can help to reduce the aerosol concentration of the indoor air in times of a pandemic, especially in rooms where adequate ventilation is not possible due to the supply of outdoor air, and thus to minimize the risk of infection. The use of such technologies can support efficient ventilation measures and can be accompanied in cases where a large number of people are in the room at the same time. Such technologies can effectively remove suspended particles (e.g. aerosol-adhering/containing viruses) from the room air.

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8 Hartmann A, Lange J, Rotheudt H, Kriegel M (2020): Emission rate and particle size of bioaerosols when breathing, speaking and coughing, preprint, http://dx.doi.org/10.14279/depositonce-10332

9 Hartmann A, Lange J, Rotheudt H, Kriegel M (2020): Emission rate and particle size of bioaerosols when breathing, speaking and coughing, preprint, http://dx.doi.org/10.14279/depositonce-10332

10 Van Doremalen N, Bushmaker T, Morris DH et al. (2020): Aerosol and surface stability of SARS-CoV-1 as compared with SARS-CoV-2. The New England Journal of Medicine 382, 1564-1567, https://www.nejm.org/doi/full/10.1056/nejmc2004973

11 Lednitzky JA et al. (2020): Viable SARS-CoV-2 in the air of a hospital room with COVID-19 patients. medRxiv, Preprint, 04. August 2020 doi: https://doi.org/10.1101/2020.08.03.20167395

5 Information on "Dexwet Technology"

According to the customer, the patented "Dexwet filter technology" consists of oil-absorbing plastic filter rods arranged parallel and offset to each other in two or more rows. Although air permeable, the filter rods represent a barrier that deflects the air flow at least once on both sides, about 20-30% of the air volume flows through the porous rods themselves. On the surface of the filters, a special silicone oil is used to provide a adhesive layer, which is supposed to permanently bind dust particles of any size, from coarse dust to particulate matter of classes PM 10, PM 2.5 and ultrafine dust, by swirling the air flow.

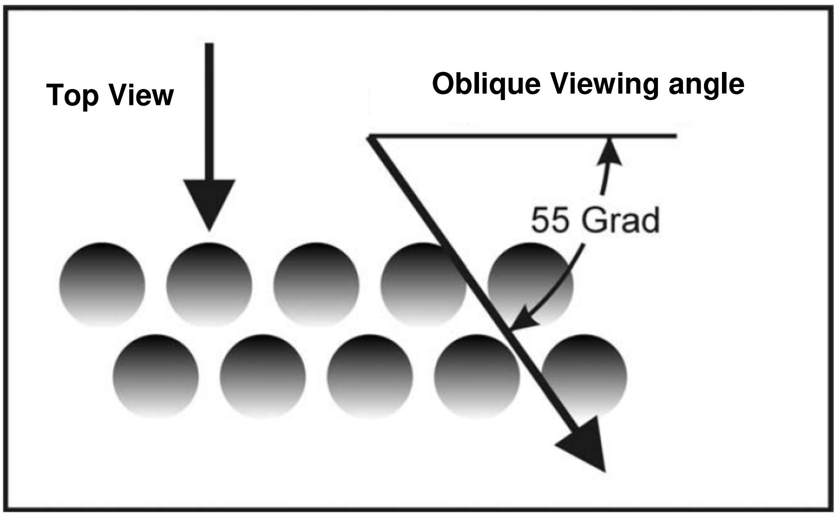
According to the manufacturer, the silicone oil used is medically harmless and temperature resistant up to 120°C. According to the client, it has a very high surface tension, which attracts micro- and nanoparticles in the near range, which in addition contributes to the efficiency of this special filter principle. As soon as particles come into contact with the filter medium, they are absorbed in the oil and cannot leave it. Since the silicone oil is not volatile and therefore always stays moist until the filter is available for exchange, filtered particles are deposited in the oil, biological particles (including viruses) are killed or inactivated.

The effectiveness of the "Dexwet filter technology" has been proven in practice in many areas of application over the last 15 years, according to the client. Originally developed for barrier-free filtration of fine and ultrafine dust emitted by modern laser printers, the next application was the freeing of slot machines from fine (st)dust and has been an industrial solution with a great global spread since 2009. Dexwet also manufactures high-performance filters for motorsport racing cars (NASCAR). With the Vacuum Filter System APF (Aluminium Particle Filters), the "Dexwet filter technology" was also used in more extreme boundary conditions – near the speed of sound under vacuum conditions.

A special feature of the "Dexwet filter technology" is the fact that the filter effect increases in the first 10% of the recommended service life. Due to the accumulation of coarse dust particles in the filter, which – as soon as they come into contact with the filter medium – are completely coated with silicone oil, additional filter medium and thus an additional surface is formed, which also increases the degree of separation from initially around 90% to the respective maximum above this value. Despite the open and air-permeable design, the application area was indicated for example laser printers in the range PM10 and PM2.5 as well as ultrafine dust high separation effects with a single filter run.

In radiators, conventional filter media for the filtration of particulate matter cannot be attached to convection radiators due to their high natural air resistance without greatly reducing airflow and thus significantly degrading the efficiency and energy efficiency of the radiator. In 2015, the customer stated that the "Dexwet technology" was further optimised in terms of air permeability together with the industrial partner Vogel&Noot in order to apply cleaning effects even in the slow convection air flows of 0.2m/s and below, which emanate from radiators.

The following diagram shows the function scheme of the technology —the airflow goes along the arrow leading down at an angle:



6 Expert assessment of "Dexwet technology"

It should be noted that the assessment was made to the documents submitted, the accuracy and completeness of which have not been verified by the Signatory. However, an assessment of plausibility was carried out, with higher emphasis on studies carried out by independent bodies (such as the OFI organisation).[12]

The cleaning performance in the size range of interest (< 5-10 microns) has been checked in a comprehensible manner by different institutions under different boundary conditions in laboratory situations and appears plausible due to the technology used. The measurements were carried out partly under conditions of an exhaust air flow from copiers, where particles were deposited on the filters. Measurements continued under laboratory conditions where synthetic fine dust was used.

[12] https://www.ofi.at

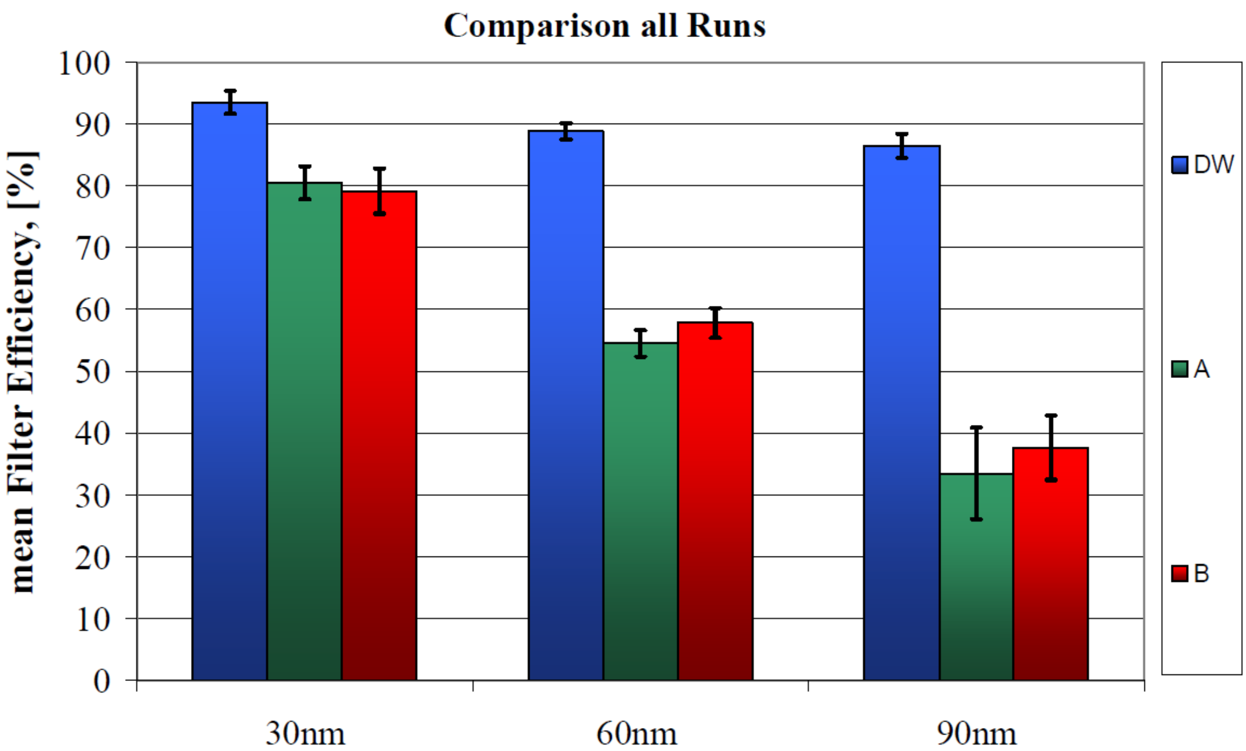
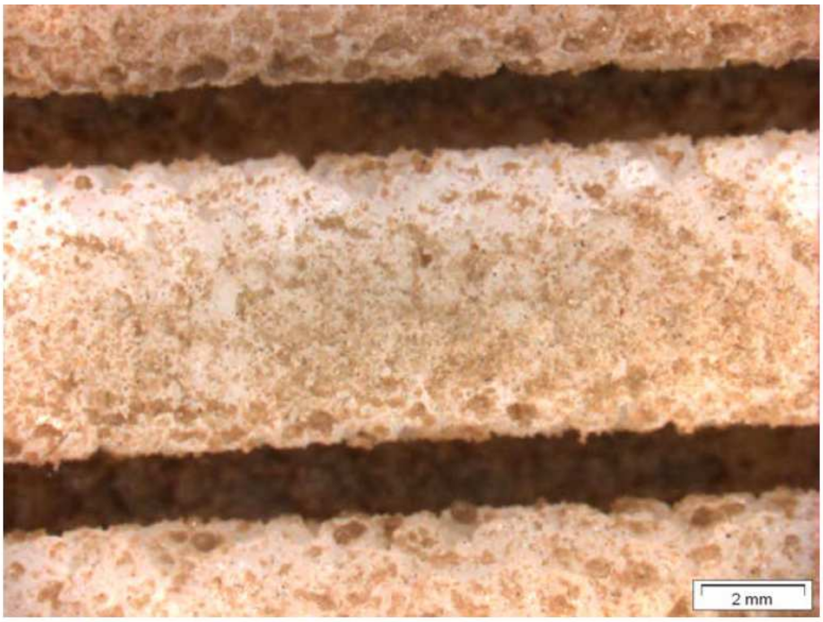


Fig 2: Comparison of the filter effect for three relevant particle size ranges

Fig. 2 from the publication of GPR Aerosol-Inc. indicates the cleaning efficiency in the nanometer range depending on the particle size. In this practical test, the "Dexwet filter system" was compared with two other filter systems developed for use on office machines. The graph shows that the Dexwet filter (blue) had significantly better filter effects than the two conventional filters.

Figs. 8 and 13 shows a detailed view of the particle deposits on the filter rods on the
Raw air inflow side after dusting with ISO-fine or test soot FW 1 from the publication of hummel & Mann. The clearly recognizable deposits are visible.



Illustrator 8: Detailed view of particle deposits on the filter rods on the raw air inlet side after dusting with ISO fine (ISO 5011)

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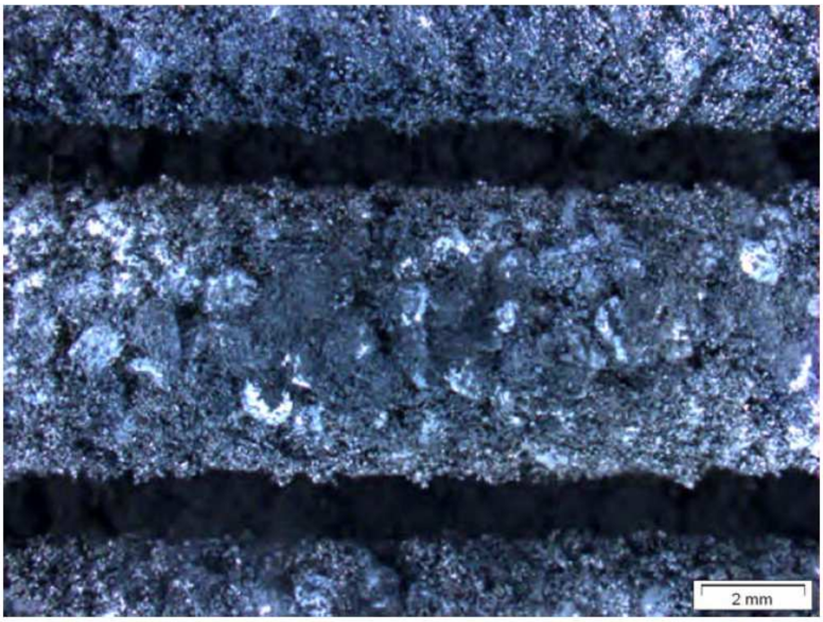

Illustrator 13: particle deposits on the filter rods on the raw air inlet side after dusting with test soot

Figures 32 and 33 from the OFI publication show the distribution of particle sizes and the distribution of particle volumes of multiple filters. They show that the majority of the particles attached to the filters are below the value of 1 micron (aerodynamic diameter), especially in the fine dust range, but that coarser particles are also accumulated by mass.

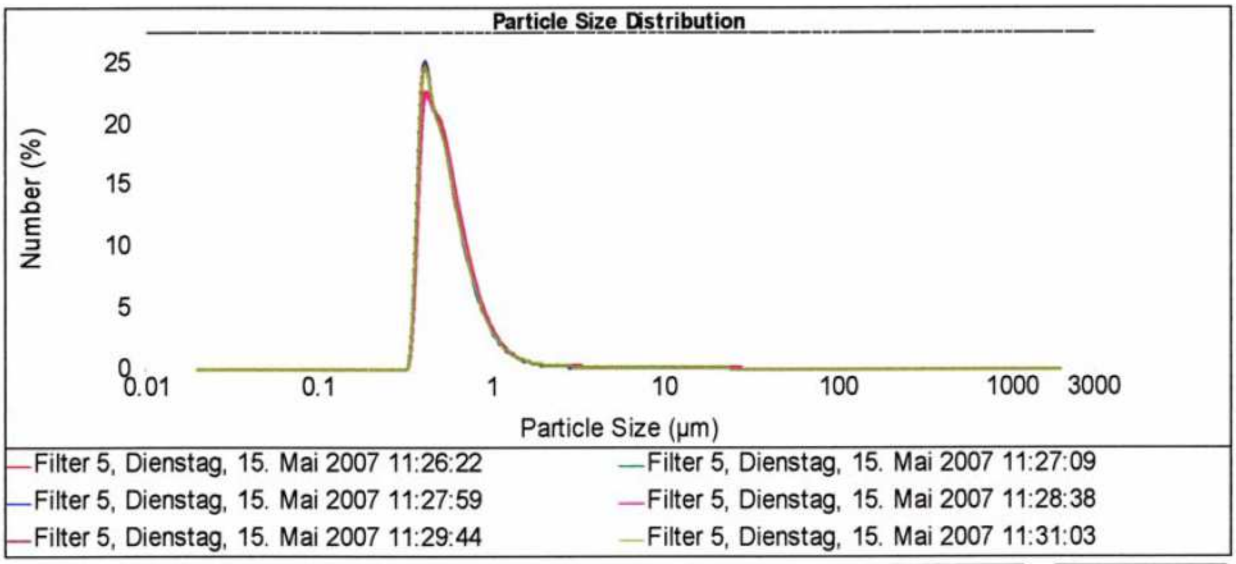

Illustration 32: Sample 3.1.5, evaluation of the number of particles

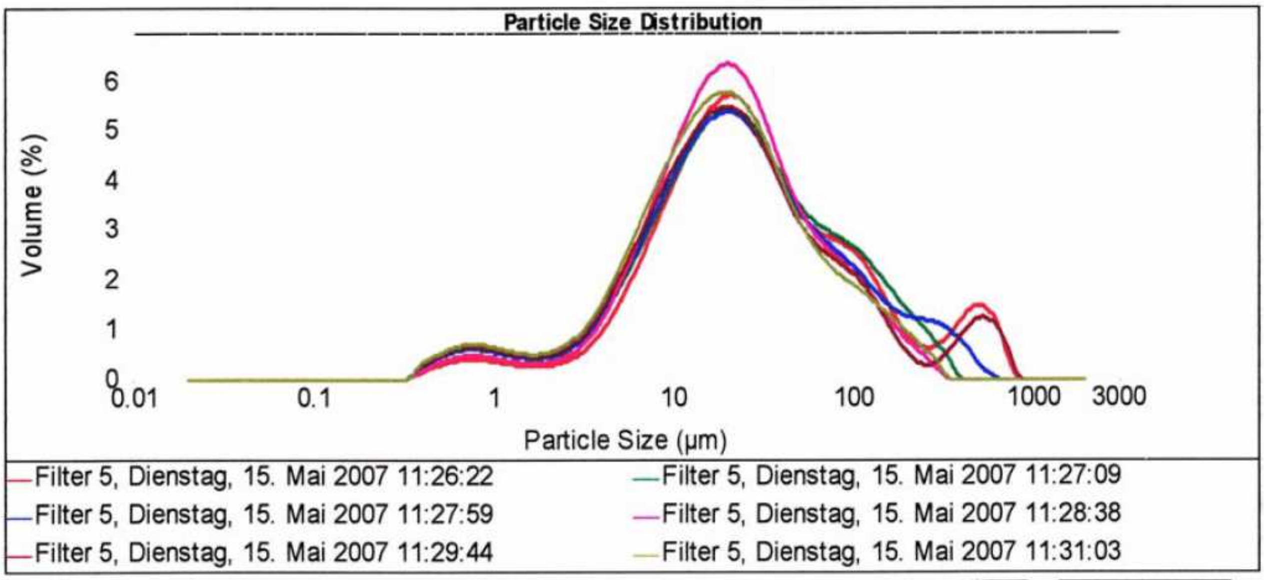

Illustration 33: Sample 3.1.5, evaluation of the volume of the particles

With regard to the effectiveness of the "Dexwet filter technology" against biological particles, bacteria and viruses, it should first be noted that air filters cannot in principle distinguish between different types of particles (organic, inorganic, metallic), but only show filter effect according to the particle size. Thus, the results of the "Dexwet technology", which until now had been specifically related to fine dust PM10 and PM2.5 and ultrafine dust, can also be transferred to the effectiveness against bacteria and viruses, which themselves and their possible carriers (aerosols) are also in this size spectra in terms of particle size. With a diameter of 80-140 nm, the viruses would also fall into the cleaning area of the "Dexwet filter technology" even without a carrier. On the basis of the available data, it can therefore be assumed that the "Dexwet filter technology" is also suitable for filtration of particles that can cause disease in humans. This is to be assumed or applicable for pollen (10-70 microns), which can cause allergies and can be classified as PM10 or greater by size, for bacteria

(1-5 microns) classified in class PM 2.5 and also for viruses that can be classified as fine dust (< 1 micron) and ultrafine dust (<100 nm). On the basis of these considerations, it can also be assumed that against the SARS-CoV-2 virus, which is currently under discussion, it is sufficiently effective. [13]

The convection air flow emanating from radiators itself contributes to the constant turbulence of the room air and the particles and droplets contained therein. Therefore, for example, the preventive filtration of the convection air flow of radiators with the Dexwet Pure Air Filter seems to be a very sensible measure to improve the air quality in the interior in the cold season, both with regard to the reduction of the concentration of particulate matter and against any risk of infection by disease carriers.

Advantages of the technology used over devices with other cleaning systems (e.g. HEPA filters) can result from the lower pressure drop due to the design. It can be assumed that the noise emission of the device is lower, which can be of decisive importance especially when used in offices or school and lecture rooms.

Air purification devices with the "Dexwet technology" are effective in a suitable way, on the basis of the documentation provided, especially aerosols in the size range below 5 microns (but also larger particles) in an efficient way. Especially with regard to the prevention of transmission of aerosol-borne viruses (e.g. SARS-CoV-2) by air, the technology can make a decisive contribution to infection prevention. [14]

Dipl. Ing. Peter Tappler

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[13] Kaniyala Melanthota et al. (2020): Kaniyala MelanthotaS. Banik, S., Chakraborty, I., Pallen, S., Gopal, D., Chakrabarti, S., and Mazumder, N. (2020). Elucidating the microscopic and computational techniques to study the structure and pathology of SARS-CoVs. Microsc Res Tech. After https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Virologische_Basisdaten.html

[14] The accuracy and completeness of the documents communicated have not been verified by the Signatory

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Specialist sections | **Working as an SV** | **Specializations** | **Infrastructure** | **Training Career**

Specialist groups/areas:

FG No.	Field and link to specializations	Material limitation / In particular for	End.Zert.
03.02	Microbiology	**Only for:** Mold loads indoors	12.12.2024
06.30	Cleanair, Remediation in case of loads	**Only for:** Loads of the indoor air	12.12.2024
51.07	Building	**Only for:** Pollutant content and emission of building materials	12.12.2024
72.78	Building materials	**Only for:** Pollutant content and emission of building materials	12.12.2024

Profile:

Managing Director of

THE IBO Interior Analysis OG Measurements of pollutants such as formaldehyde, VOC, particulate matter, PCP, asbestos indoors Measurement and assessment of moulds in interiors
Tracergas measurements in
buildings Indoor climate tests
Hygiene tests of air conditioning systems
Odour assessments according to ÖNORM S 5701
Investigation of black dust, Magic Dust
Investigations of construction products for pollutants

Activities as SV - Information on orders:

Overview: Subject of the expert opinions (limitation to 10 entries)

Client	Subject-matter of assessment	Question (shortened)
BG Hietzing	Molds	Measurement of the concentration of mold spores in the room air
LGZ Vienna	Odors	Assessment of a bedroom in which an atypical smell occurred, with regard to reasonableness
BG Fünfhaus	Air passage	Investigation of a possible air passage from a business premises to an apartment above
BG Inner City of Vienna	Mould	Extent of infestation of a restaurant with mould
BG Fünfhaus	Dioxins, PCP, heavy metals	Assessment of an alleged exposure to dioxins, heavy metals and PCPs in residential areas
BG Fürstenfeld	Pollutants indoors	Examination of a house for VOC, formaldehyde and mold spores
BG Fünfhaus	Wall moisture, mould	Cause/cause of large-scale mould infestation in an apartment
BG Inner City of Vienna	Wall moisture	Investigations of wall moisture, cause of wall moisture in a basement restaurant

Specializations:

Mold ininteriors, molds,
building moisture
tracer gas
measurements Magic Dust, black dust
PCP, formaldehyde, VOC, solvent odor, odours in interior
interior sthermography
Testing of materials for formaldehyde content
Examination of materials for buns according to ÖNORM M 6219

Infrastructure:

Equipment:

Chemical-Microbiological
Laboratory Gas Chromatograph Mass
Spectrometer Photoacoustic
Infrared Detector Measuring Instruments for Total Spores, Vital Spores in Air
Thermography Camera
Photometer
Test Chambers for VOC, Gas Analysis according to ÖNORM EN ISO 12460

Studied environmental analysis/ TU-BOKU Vienna, duly completed in November 1992	
Since 1988	Dealing with questions of ecological construction and housing
Since 1991	Lecture activities on "Pollutants in doors"
Since 1993	Head of the measurement and consulting service Interior/ Austrian Institute for Building Biology and Ecology Vienna (Member of the Board 1992-2001 and from 2010)
School year 1994/95	Teaching activity Camillo-Sitte HTL Vienna: Special course in building ecology (specialist: Ecological building materials theory)
1995-1998	Managing Partner DI. Scheidl Umweltanalytik GmbH/ Vienna
Since 1998	Managing Partner of IBO Interior Analysis OG Vienna, Chemical Laboratory, Technical Office for Physics
Since 1996	Lecturer at the Danube University Krems, Department of Building and Environment, as part of the postgraduate courses
Since 1999	Head of the Indoor Air Working Group at the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK)
Since 2012	Permanent member of the Commission for Indoor Air Hygiene at the German Federal Environment Agency (D)
Since 2016	Lecturer at the Vienna Campus, lecture on interior analysis

Privacy policy