Biodiv'airsanté

Experimentation report

Effectiveness of the Teqoya air purifier on mold spores in real-world conditions

Tests conducted from 20/08 to 18/09/2025

at the IAGE laboratory premises in Montpellier (34)

IAGE
ONE HEALTH EXPLORER®

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Summary

This unique experiment aimed to measure the effectiveness of Teqoya technology on airborne mold spores, which can cause numerous respiratory illnesses. We sought to make the best use of available resources to work under diverse and representative conditions, while employing validated methods and conducting reproducible tests.

To achieve this, we reused a prototype of Teqoya's new filter model, designed for integration into an air handling unit (AHU) in a commercial building, for example. It was tested at the IAGE laboratory in Montpellier (34), which specializes in dPCR analysis of microorganisms, including molds, and had already carried out preliminary sampling at its facilities. The protocol was established jointly by Teqoya, IAGE, and Biodiv'airsanté.

The plan was to compare the mold present at the inlet and outlet of the air purifier, before and after the air passed through the electrostatic filter. To ensure representativeness, samples were taken after one and two weeks of use. The test was replicated in two separate areas where previous analyses had already confirmed the presence of mold: the open-plan microbiological analysis area ("Lab," considered contaminated) and the building's reception area (considered clean, comparable to outdoor air).

The results demonstrated the high effectiveness of the electrostatic filter in the lab area, but were not as significant in the reception area. Indeed, low overall contamination was observed during the first week, but over two weeks, while the reduction was very clear in the lab area, it was much less pronounced in the reception area, where a higher concentration was found at the filter outlet than at the inlet.

This can be explained by several hypotheses, but the most likely is that the airflow in the Reception area is less well controlled than in the Lab, where there is no direct intake of outside air and less traffic. The disturbances caused by the repeated opening of the entrance door and the movement of staff certainly contributed to the sedimentation of spores on the wipes located above the filter. The fact that the various taxa involved *(Alternaria alternata, Cladosporium herbarum ,* and *Pan-Aspergillus)* were present in the outside air during the period in question tends to confirm this phenomenon.

This experiment therefore allowed us to draw conclusions about both the effectiveness of the Teqoya technology and the real-world protocol, which was unprecedented for this model and method. This information will be useful for potential further studies, as well as for the commercial deployment of the tested technology: the location and control of airflow will have a major impact on the actual air treatment efficiency at the sites of use.

Introduction

At the request of air purifier manufacturer Teqoya, Biodiv'airsanté France developed an experiment in partnership with the IAGE laboratory to evaluate the effectiveness of the technology on mold spores in the air under real conditions.

Historically positioned on air treatment by ionization without ozone production, Teqoya has been developing new models of electro-filters in recent years, which can be integrated into various supports: air inlets (with ALDES), domestic air purifier or Air Handling Unit.

It is on this latter model that we chose to carry out an experiment. After validating the effectiveness in real-world conditions for the removal of suspended particles, it was interesting to go further by evaluating the effectiveness on mold spores.

Mold poses a major health risk, whether through inhalation or food contamination in industrial settings, for example. We therefore explored this avenue by combining our expertise to improve our understanding of this technology and to consider new markets in France and internationally.

Materials and methods

a. Air purifier

The chosen model is Teqoya's latest creation, capable of being integrated directly into a building as an air handling unit (AHU) filter. The prototype, installed in a vertical enclosure and connected to a fan, has already proven its effectiveness against particulate matter (PM10 and smaller) in large volumes within Teqoya's premises. This experiment was therefore an opportunity to verify its effectiveness against fungal spores, which are naturally part of the airborne particles.

Photo 1. Installation of the Teqoya air purifier in the reception area of the IAGE offices.

b. Mold analysis

Choosing the method for mold sampling was the most complex step in this experiment. The IAGE laboratory developed a method for analyzing pathogenic molds using digital PCR (dPCR), but surface samples are usually taken with a swab, which did not seem suitable for the objective or the equipment involved.

The swab is primarily used for sampling from surfaces such as walls, ceilings, or furniture. It's not possible to obtain a representative sample at the device's entry or exit point. Therefore, a wipe was considered, but this also presents a limitation regarding active sampling. Indeed, it's difficult to reproduce the exact same samples on an uneven surface, whether using a swab or a wipe, so the results would not have been usable.

It was therefore ultimately decided to carry out passive sampling by attaching wipes to the device, before and after it passed through the filter. Two wipes were attached to each end so that the first could be removed after 7 days and the second after 14 days.

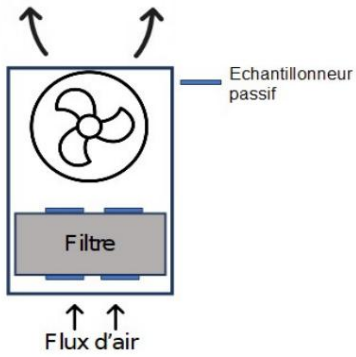

Figure 1: Diagram of wipe positioning (passive sampler).

c. Temperature and humidity conditions

Throughout the experiment, temperature and humidity conditions were measured using a Monit'air sensor (serial number 866760051448126), which also measures CO2 to assess air quality in an occupied room. This allowed us to monitor parameters that could influence mold growth in the affected areas, at 10-minute intervals.

As the battery was not recharged during this period, measurements ceased on September 15th; therefore, the last two days of the trial at the reception area are missing. This should have little impact on the 12-day average instead of the 14-day average.

Photo 2. Monit'air sensor.

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Results

1. Mold analysis

All the results were provided in a summary table (see Appendix 1), which allows for direct comparison of the values from one sampling point to another, but also between the 1st and 2nd week at each point.

Nom de l'échantillon (IC)	Description de l'échantillon (IC)	Alternaria alternata	Toxine Alternaria alternata pksH pksJ	Stachybotrys chartarum - Stachybotrys echinata	Aspergillus spp. (1)	Talaromyces marneffei	Cladosporium herbarum	Penicillium chrysogenum	Pan-Aspergillus (2)	Pan-fongique	Pan-bacterien
Zone labo ventilation C14	Ecouvillon	2,50E+02	ND	4,75E+02	ND	ND	1,26E+03	ND	1,94E+03	NA	NA
Zone labo ventilation C13	Ecouvillon	ND	ND	3,05E+04	ND	ND	6,22E+05	ND	2,40E+06	NA	NA
Zone labo ventilation C16	Ecouvillon	ND	ND	1,28E+03	ND	ND	3,34E+03	ND	1,21E+04	NA	NA
Hall accueil ventilation gauche	Ecouvillon	ND	ND	ND	ND	ND	7,73E+02	ND	1,01E+03	NA	NA
Hall accueil ventilation droite	Ecouvillon	ND	ND	2,52E+02	ND	ND	1,03E+03	ND	3,27E+03	NA	NA
Labo lingette entree T1	Chiffonnette	ND	ND	ND	ND	ND	ND	ND	3,45E+04	NA	NA
Labo-lingette-sortie-T1	Chiffonnette	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Labo lingette entree T2	Chiffonnette	ND	ND	4,58E+03	ND	ND	ND	ND	2,08E+04	6,23E+04	8,74E+04
Labo lingette sortie T2	Chiffonnette	ND	ND	ND	ND	ND	4,59E+03	ND	1,90E+02	ND	ND
Accueil-lingette-entree-T1	Chiffonnette	ND	ND	ND	ND	ND	1,57E+04	ND	6,23E+04	NA	NA
Accueil-lingette-sortie-T1	Chiffonnette	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Accueil-lingette-entree-T2	Chiffonnette	ND	ND	ND	ND	ND	2,43E+04	ND	2,01E+05	3,75E+05	7,37E+07
Accueil-lingette-sortie-T2	Chiffonnette	4,74E+03	ND	ND	ND	ND	1,18E+05	ND	4,32E+05	7,46E+05	6,36E+07
Lingette T0	Chiffonnette	ND	ND	ND	ND	ND	ND	ND	8,81E+03	NA	NA

Table 1. Complete results with notable results at T0 (in yellow), improvements results provided by the filter (in green), results without improvement (in red) and the control (in blue).

First, we find surface samples taken with a swab from the mouths ventilation at 3 points in the Lab and 2 points in the Reception at the start of the experiment (T0).

We find there common ambient air molds, such as *Cladosporium herbarum* (omnipresent) or certain Aspergillaceae (Pan-Aspergillus, other than the 4 targeted pathogenic species: *Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Aspergillus terreus),* or even a little Alternaria alternata on one of the points of the Lab (expected at this time of year).

However, abnormal *Stachybotrys (chartarum and echinata)* contamination was observed in 4 out of 5 locations, primarily in the lab. This toxic mold is usually found after a leak or water damage, which does not appear to be the case here. It was therefore almost certainly introduced via contaminated samples handled in the lab.

Analyses of the purifier's efficiency then begin, using samples taken with wipes placed on the device, before and after the filter.

In the lab, virtually nothing is found during the first week (T1), apart from a few Pan-Aspergillus at the filter inlet. At the outlet, the detection threshold for this taxon falls below the limit, and the others are not found, which already suggests an improvement.

Over two weeks (T2), this trend is confirmed. There is slightly less Pan-Aspergillus at the inlet, indicating that the measurement precision is so low that these results should be interpreted with caution. However, the trend toward improvement is also seen at the filter outlet for this taxon, with a concentration only slightly above the detection limit, indicating an efficiency greater than 99%. This level of performance is also observed for Stachybotrys, as well as for total flora (Pan-bacterial) and total fungi (Pan-fungal), but not for *Cladosporium herbarum ,* where the opposite phenomenon is observed. Since this latter species is very common in ambient air, we can assume that this is a direct contamination on the "T2 outlet Lab" wipe, and therefore an exception in these results. **We can thus conclude that the overall efficiency of the Teqoya filtration technology is on the order of 99% or more for molds and bacteria.**

The comparative analyses carried out later **at the Reception** are unfortunately not as clear and highlight a problem typical of experiments in real conditions: the environment is not controlled.

In the first week (T1), we find the same effectiveness as in the Lab on molds of the Pan-Aspergillus group (very present), but also on *Cladosporium* herbarum which is only detected at the filter inlet, which is a new positive point which goes in the direction of the previous trend.

The interpretation becomes more complex with the results from the second week (T2), where more mold was found at the filter outlet than at the inlet, and only a slight improvement in the pan-bacterial count. Furthermore, Alternaria alternata was also found, which was not detected on any other wipe. Since the mold could not have developed inside the unit (between the inlet and outlet samples), the most likely hypothesis is contamination of the unit from above during the second week. This could be related to the use of the reception area and the difficulty of controlling airflow there.

Finally, we find a control wipe T0, which only shows contamination with non-pathogenic Aspergillaceae, at a lower concentration than the other results of the samples taken at the inlet of the filter in each configuration.

2. Collection conditions

CO2 concentration, temperature and relative humidity conditions were continuously measured during the 2 phases of experimentation, in the Lab and in the Reception area, using a Monit'air sensor (Serial No. 8667600514488126, *see* **Appendix** 2).

Measured@	CO2 (ppm)	Temp (°C)	Humidity (%)
Average Lab	684.58	19.68	69.15
Average Reception	889.76	21.37	60.54
Mini Lab	367	18.3	55
Maxi Lab	1880	20.9	90
Mini Reception	410	19.8	50
Maxi Accueil	1672	22.4	83

Table 2. Summary of sampling condition measurements

We observe relatively similar conditions in both spaces, but some differences allow us to distinguish between them:

- Lab: more variable conditions, with controlled air renewal but a higher humidity.
- Reception: less strict lockdown but an overall higher occupancy rate On average, a slightly higher temperature and slightly higher humidity weak.

Discussion

The results in the Lab section are generally in line with expectations and confirm the desired effectiveness of Teqoya technology on airborne mold spores, which is always tricky in real-world conditions.

It is also worth noting that while the experiment worked well in the Lab section, it is not really usable in the Home section.

This is probably due to two reasons that had not been previously identified:

- The installation of the air purifier at reception was too exposed to uncontrolled airflows.
- The vertical position at people's height encouraged the deposition of mold on the device from the top, without passing through the filter.

We can therefore draw lessons from this both for future experiments, but also for the integration of the purifier on site as part of a commercial deployment.

Conclusion

This experiment aimed to evaluate the effectiveness of the electrostatic filtration technology developed by Teqoya on mold spores suspended in indoor air.

It has been shown that, under controlled conditions, a significant reduction (at least 99%) occurs as spore-laden air passes through the filter. However, this requires that the airflow not be disrupted.

This also demonstrated that integrating the prototype into a building was a crucial step that significantly influenced the results. To optimize the device's performance (in experimentation or use), it would be more effective to use it further away from people.

Appendices

- Appendix 1: IAGE analysis report
- Appendix 2: Monit'air sensor measurements