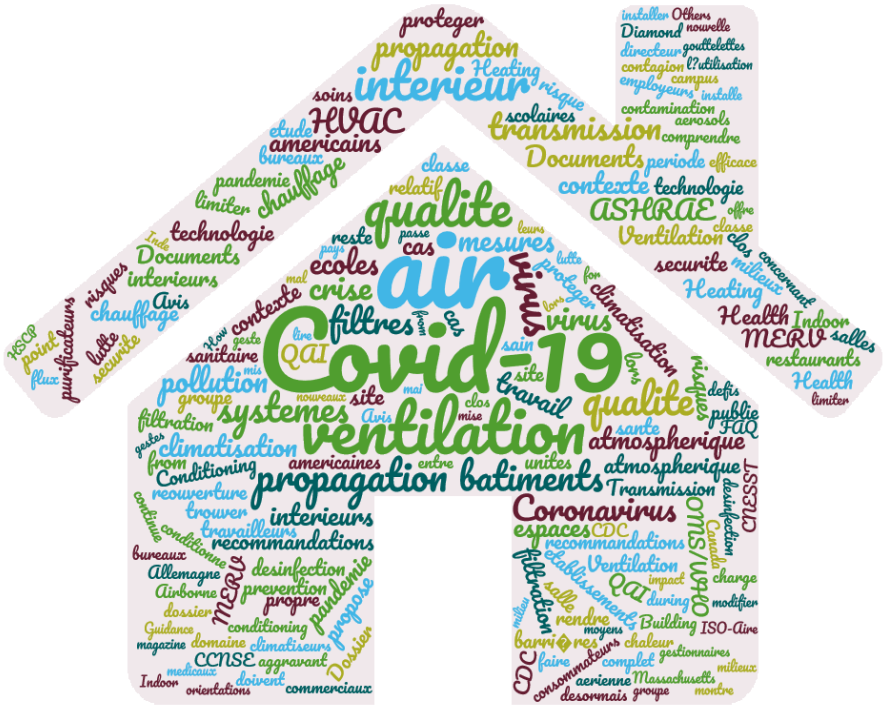

Bulletin de veille AéroCovid
N°122 – 01/10/2025

Objectif : *Air intérieur, ventilation, climatisation et propagation du Covid-19*

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Valsala Krishnankutty, V., Muraleedharan, C., Palatel, A.

Analysis of Disruption of Airflow and Particle Distribution by Surgical Personnel and Lighting Fixture in Operating Rooms.

Fluids, Vol. **10** n°(9), (2025)

Surgical procedures have significantly contributed to the increased life expectancy of the global population. The surgical procedures are carried out in specialised rooms within a healthcare facility normally designated as operating rooms or operating theatres. These rooms require meticulously designed heating, ventilating, and air conditioning systems to ensure optimal thermal comfort, strict sterility, and effective removal of airborne contaminants and anaesthetic gases. The performance of the system directly affects the risk of surgical site infections and associated post-operative complications. This study presents a computational fluid dynamics analysis of disturbance on airflow and particulate distribution within a representative operating room by the surgical staff and lighting fixtures concerning supply air velocity. The removal of the maximum possible particulate matter, precise control of air temperature and humidity, and unidirectional airflow in the surgical field were incorporated as key design strategies. The species transport model simulations revealed that while laminar airflow offers superior protection in terms of surgical site sterility, its performance is sensitive to disruptions caused by surgical lighting configurations and variations in supply air velocity. The findings highlight the complexities involved in maintaining optimal airflow conditions and underscore the need for integrative air conditioning design approaches that account for optimal design of surgical lighting and operational setups.

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Shen, D., Su, L., Yu, Q., Long, Y., Hui, C.

Attachment characteristics and mechanisms of aerosol microorganisms on the surfaces of different waste materials.

Journal of Environmental Chemical Engineering, Vol. **13** n°(5), (2025)

Pathogenic microorganisms in bioaerosols could adhere to the surfaces of different wastes and pose health risks to sanitation workers in household garbage room. However, the adhesion characteristics and mechanisms of aerosol microorganisms on the surfaces of different garbage materials are still unclear. In this study, simulated bioaerosol release experiments and on-site sampling were performed. Results showed that rubber, plastic, and glass surfaces were more susceptible to bioaerosol attachment than textile, wood, metal, paper, and bricks. The adhesion concentrations of Staphylococcus aureus were higher on rubber (77 CFU/cm2), followed by glass (70 CFU/cm2) and plastic (43 CFU/cm2). The surfaces of different parts of the garbage truck, particularly vehicle glazing, exhibited substantial bacterial contamination (73281 CFU/cm2), surpassing that on headlamps, wheels, and vehicle body by 79, 38, and 11 times, respectively. Prolonged exposure intensified EPS secretion and biofilm formation, especially on hydrophobic materials like rubber and glass. Attachment mechanism analysis showed that the reduced polarity of these materials enhanced dipole interactions, strengthened van der Waals forces, and overcame electrostatic repulsion, thus promoting microbial attachment. Environmental factors, including temperature, moisture, and organic matter, significantly influenced attachment. Organic matter, in particular, provided nutrients that facilitated biofilm formation on recyclable waste surfaces, indicating that recyclable waste contaminated by organic waste can accumulate high microbial loads, including pathogens. This study will help understanding the attachment characteristics and mechanisms of aerosol microbial on different waste materials and provide insights for worker hygiene protection and sanitation management in garbage rooms.

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Naddunuri, K., Bhattacharya, S. P.

Deriving Personalized ventilation system performance criteria.

Conference Proceeding by ASHRAE , 2025

Recent research has shown a growing interest in personal environmental controls systems (PECS) and personalized ventilation (PV) systems for enhancing occupant thermal comfort through localized cooling and heating. PV systems offer the potential to create preferred thermal environments and improve perceived air quality through a desk level control. Extensive research has explored PV systems in conjunction with various ventilation strategies, including mixing ventilation, displacement ventilation, underfloor air distribution, and ceiling mounted air distribution. Significant advancements have been made in recent years through personally controlled environmental chamber experiments using both human subjects and mannequins. The occupant's micro thermal environment under PV influenced by various parameters such as the background ventilation system, supply temperatures, flowrate variation, velocities and control strategies, air terminal device type, and its physical airflow characteristics. A comprehensive understanding of each of these variables is crucial to assess the PV systems performance. Therefore, in the present study, the paper aims to evaluate PV performance based on PV physical configuration, airflow dynamics, occupant health and wellbeing as well as its energy saving potential. The study adopts analytical method to assess the PV system effectiveness under various scenarios and establish performance assessment criteria for comparison until a sophisticated criterion is developed.

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Sankurantripati, S.

High-Fidelity Numerical Modeling of UV-Based Mitigation Strategies for Airborne Virus transmissions in Enclosed Spaces

Modélisation numérique haute fidélité des stratégies de mitigation par UV pour la transmission de virus aéroportés en environnements intérieurs.

Université de Toulouse. Thèse 2025

La pandémie de COVID-19 a mis en évidence le rôle des gouttelettes respiratoires ainsi que des aérosols et des surfaces comme vecteurs de transmission du virus. Les gouttelettes respiratoires sont formées et émises pendant la respiration, la parole, la toux et les éternuements. Ce sont des gouttes ou des résidus contenant des substances biologiques inhalables porteuses de virus qui peuvent rester longtemps en suspension dans l'air et atteindre des distances de plusieurs dizaines de mètres en étant transportées et dispersées par la circulation d'air générée par les systèmes de ventilation des bâtiments, des voitures, des bus ou des cabines d'avion. Ils peuvent également se déposer sur des surfaces et générer une contagion ultérieure par contact. Sur la base de cette description, la contamination de personne à personne par les gouttelettes respiratoires emprunte deux voies principales : une voie directe et une voie indirecte. Grâce à la distanciation physique et aux gestes barrières (lavage des mains, désinfection des surfaces, port d'un masque), la propagation du virus par cette voie directe est minimisée. La voie indirecte ne nécessite pas d'interaction directe ou rapprochée entre la personne infectée et le receveur pour qu'il y ait contagion. Elle peut se produire sur plusieurs heures et ne nécessite même pas que les deux individus se trouvent au même endroit au même moment car de petites gouttelettes respiratoires peuvent être transportées sur de longues distances par les flux d'air générés par les systèmes de ventilation et rester dans les locaux après le départ du patient. Le travail proposé concerne la modélisation des sprays chargés de virus émis par les humains, le développement de méthodes numériques massivement parallèles pour prédire la dispersion dans l'air (par des voies directes et indirectes) ainsi que l'efficacité des mesures visant à réduire la probabilité d'infection (adaptation de la ventilation) et des solutions de désinfection (rayonnement UV) appliquées au contexte du transport routier. En utilisant l'outil numérique AVBP du CERFACS, conçu à l'origine pour des applications en aérodynamique, l'effet de la propagation du virus dans un espace fermé sera quantifié, analysé et des mesures préventives innovantes seront proposées.

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Ma, X., Zhu, C., Li, M., Hu, W., Hong, M., Qian, F.

Highly efficient, dual-functional self-assembled PET-based filters for removal of particulate matters and bacteria.

Journal of Environmental Chemical Engineering, Vol. **13** n°(5), (2025)

With the rapid advancement of urbanization, individuals spend over 90 % of their time in indoor environments, where prolonged exposure to indoor air pollutants particularly particulate matters (PMs) poses significant health risks. This highlights the urgent need to develop advanced fiber-based filtration systems that simultaneously exhibit high filtration efficiency and antimicrobial properties. In this study, a multifunctional ZIF-8@PET/CA-PP composite filter material was fabricated using commercial PET membranes as substrates via a combination of electrostatic spraying and self-assembly techniques. The resulting material features a surface-functionalized CA/ZIF-8/PVDF-HFP composite layer. Comprehensive characterization revealed that the optimized filter material achieves exceptional PM2.5 filtration efficiency of 98.52 % (±0.72 %) with a low air resistance of only 57 Pa, while demonstrating antibacterial rates of 93.75 % against Escherichia coli (E. coli) and 94.2 % against Staphylococcus aureus (S. aureus). The outstanding performance can be attributed to two key factors: (1) the uniform dispersion and dense nanostructure of the functional layer significantly enhances particle capture capacity through combined mechanical and electrostatic filtration mechanisms; (2) the incorporated ZIF-8 nanoparticles provide effective antimicrobial activity by disrupting microbial membranes. Further validation through X-ray micro-CT scanning simulations confirmed the filter material's structural integrity and consistent filtration performance across varying airflow velocities. The ZIF-8@PET/CA-PP composite filter material developed in this work represents a promising candidate for next-generation air filtration applications, offering an optimal combination of low air resistance, high filtration efficiency, and robust antimicrobial properties. These advantages position the material as particularly suitable for improving indoor air quality in urban environments.

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Bae, D., Kim, Y.-S., Lee, C.-K., Song, K.-Y., Kwon, J.-H., Chon, J.

Identification and Characterization of Airborne Bacteria and Air Disinfection of Indoor Spaces in Multi-use Facilities.

Aerosol and Air Quality Research, Vol. **25** n°(9), (2025)

Consequent to the coronavirus disease 2019 (COVID-19) pandemic, indoor disinfection using high-pressure sprays has been prioritized. For high-pressure sprays to be effective, particles must be dispersed within a range of 10–30 µm. We had previously developed a novel disinfection system, which employs a portable high-pressure spray of pH-neutral electrolyzed water with hypochlorous acid, consistently generating particles within this size range. The system was validated for efficacy in laboratory settings but not in real-world settings. In this study, we aimed to evaluate its effectiveness in reducing airborne bacterial levels in various indoor environments including a public health center, senior care hospitals, fitness centers, and childcare center. We identified and quantified the bacteria and analyzed their antibiotic resistance profiles. Opportunistic pathogens known for antibiotic resistance, specifically ESKAPE bacteria (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species) were focused on. Over a six-month period in 2023, bacterial counts in air samples collected before and after air disinfection reduced significantly (72.9%). The counts that initially exceeded the South Korean regulatory limit of 800 CFU/m3 at selected facilities decreased to compliant levels. The most common isolate was Micrococcus luteus, followed by Staphylococcus spp., and Bacillus spp. The proportions of bacterial types before and after disinfection were similar. The ESKAPE pathogens constituted 15 of 793 isolates (1.9%), and seven ESKAPE pathogens (5 of 15, 33.3%) exhibited multidrug resistance to three or more antibiotic classes. These findings underscore the necessity for regular air disinfection protocols, especially in settings with vulnerable populations such as

the older adults and children, to effectively manage the risks associated with airborne multidrug resistant and opportunistic pathogens.

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Getnet, M. E., Dlamini, W. N., Liao, C.-H., Berekute, A. K., Chen, A.-F., Sallah-Ud-Din, R.*, et al.*

Improving Hospital Air Quality With a Nano-Ag/Chitosan-TiO2 Filter System and Cloud-Based Monitoring.

Indoor Air, Vol. **2025** n°(1), (2025)

Improving indoor air quality (IAQ) in hospital environments protects vulnerable patients and healthcare professionals from airborne pollutants and pathogens. This study integrates three interconnected components: a comprehensive analysis of hospital IAQ, an evaluation of a nanosilver/chitosan?titanium dioxide (nano-Ag/CS-TiO2) filter, and an assessment of real-time monitoring using a cloud-based platform. The nano-Ag/CS-TiO2 filter demonstrated enhanced efficiency in reducing a broad spectrum of pollutants, including particulate matter (PM2.5 and PM10), carbon monoxide, carbon dioxide, volatile organic compounds (VOCs), and microbial aerosols. Measurements were conducted across different hospital zones and timeframes to reflect typical hospital operations and assess the adaptability of the proposed solutions. The study further addresses the long-term use of nano-Ag/CS-TiO2 and underscores its advantages over existing filtration methods. Cloud-based monitoring provides real-time data, allowing for timely intervention for IAQ, particularly in high-risk areas like negative pressure isolation rooms. The finding in a negative pressure isolation room demonstrated significant improvement in IAQ postinstallation of the nano-Ag/CS-TiO2 filtration system. The integration of nano-Ag/CS-TiO2 filtration and real-time monitoring supports compliance with World Health Organization (WHO) IAQ standards. These findings highlight the potential for broader application in various healthcare settings, such as outpatient clinics and emergency departments. The study also ensures accuracy in pollutant detection, addressing the potential for false positives and negatives in cloud-based monitoring. This study highlights that a nano-Ag/CS-TiO2 filtration system can enhance IAQ in hospital settings by effectively removing air pollutants and inactivating airborne pathogens. This approach facilitates the development of evidence-based strategies for promoting healthier indoor environments in hospitals.

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R. D. Vaidya, N. H. Shahare

An Indoor Aeromycological Study of Hospitals in Amravati District.

International Journal of Scientific Research in Science and Technology, Vol. **12** n°(4), (2025), 1091-1097 p.

In hospitals, airborne fungal contamination can have serious health effects, especially for patients with weakened immune systems. This study examines the diversity and concentration of airborne fungi in indoor environment of two hospitals in Amravati district of Maharashtra state in India. From two rural hospitals general wards, pathology, and pharmacy were surveyed for aeromycological data. The samples were collected in the month of July 2022 to September 2022. Fungal spores were captured by collecting air samples using the settle plate method. The collected samples were cultured and different species were identified through microscopic examination. The results shows that aeromycoflora was abundant in both hospitals indoor environments. Cladosporium cladosporioides showed the highest percentage contribution in both hospital environments, with 41.93% in Hospital I and 68.55% in Hospital II. In contrast, Aspergillus ochraceus had the lowest contribution in Hospital I (17.74%), while Aspergillus flavus had the lowest in Hospital II (17.74%).

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Rodríguez, D., Jiménez, E., Quiles, R., Acosta, I., Bustamante, P., Campano-Laborda, M. Á.

Integral analysis of indoor environmental quality in a hemodialysis unit: Indoor air quality and airborne diseases relative risk.

Building and Environment, Vol. **286**, (2025)

Monitoring indoor environmental quality (IEQ) is essential in healthcare facilities, particularly in hemodialysis (HD) units where vulnerable patients remain for 4–5 h per session several times per week. This study conducted an integrated assessment of hygrothermal comfort, indoor air quality (IAQ), and airborne infection risk in an HD unit under two scenarios: natural ventilation and controlled mechanical ventilation (CMV). IAQ was evaluated through CO2, benzene, formaldehyde, ozone, and particulate matter (PM0.3, PM2.5, PM10), while hygrothermal comfort was monitored via air temperature and humidity, Relative infection risk was estimated using CO_2-based modeling adapted from the Wells–Riley approach. Results showed that CMV maintained CO_2 below 800 ppm, meeting Spanish regulatory standards, whereas natural ventilation was insufficient despite high envelope permeability. PM2.5 and PM10 remained within WHO guidelines, but peaks of PM0.3 were observed, emphasizing the need for finer particle control. Infection risk was strongly influenced by activity level and mask use, with healthcare workers posing greater risk than patients. Deficient filter maintenance compromised pollutant removal, occasionally increasing PM during CMV operation. These findings highlight the necessity of optimized and well-maintained ventilation systems to balance air quality, comfort, and infection control in HD environments, offering methodological insights extendable to other healthcare settings.

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García-Gutiérrez, L., Mellado, E., Martin-Sanchez, P. M.

An Integrated Analysis Approach to Unravel the Aspergillus Community in the Hospital Environment.

Journal of Fungi, Vol. **11** n°(9), (2025)

The genus Aspergillus, widely distributed across natural and urban environments, may cause allergies and opportunistic infections such as chronic or invasive pulmonary aspergillosis. Its high pathogenic potential for immunocompromised patients, together with the alarming increase of azole resistance reported in clinical and environmental isolates, claims urgent actions to assess and control the Aspergillus community in hospital environments. To contribute to that, here, we combine a large environmental survey covering numerous air and surface samples from different zones of three hospitals in Spain, with an integrated approach including general and selective culture- and eDNA-based analyses. Despite the high prevalence of Aspergillus observed, present in almost all indoor zones (mostly in air but also on surfaces) of the three hospitals, its relative abundance in the whole fungal community was limited and dependent on the used methods, with median values ranging from 1.4% (eDNA data) and 6.8% (cultivation at 28 °C) to 28.3% (cultivation at 37 °C). Remarkably, the most protected zones (intensive care units) showed the highest proportion of Aspergillus eDNA sequences. A total of 32 species belonging to 10 Aspergillus sections were molecularly identified, including well-known causal agents of invasive pulmonary infections such as A. fumigatus, A. flavus, A. terreus, A. niger, A. oryzae, A. sydowii, and A. tubingensis. This highlights the importance of such environmental assessments for monitoring and controlling the fungal burden in hospitals.

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Shukla, S., Singh, D., Maurya, A., Manocha, C., Sharma, S., Kumar, V.*, et al.*

Machine learning-driven strategies for optimal design of heating, ventilation, and air-conditioning (HVAC) filter media.

Sep Purif Technol, Vol. **380**, (2026)

The COVID-19 pandemic has highlighted the critical need to improve indoor air quality (IAQ) through efficient air filtration, especially in heating, ventilation, and air-conditioning (HVAC) systems. While dedicated high-performance filters are effective, their high-pressure drops result in significant energy consumption when used in HVAC systems. Herein, we report the application of machine learning (ML) models to predict filtration efficiency and pressure drop, enabling the design and optimisation of filter media in HVAC. Specifically, three ML models, Gaussian process regression (GPR), artificial neural network

(ANN), and decision tree (DT), have been trained on a dataset obtained from the literature. The dataset comprised key structural parameters of a wide range of filter media. The GPR model emerged as the most reliable predictor, exhibiting the highest coefficient of determination (R2) and lowest root mean squared error (RMSE) in predicting filtration efficiency and pressure drop, rendering it the most reliable predictor for small and uncertain datasets. The robustness of the GPR model is further confirmed via validation with commercially available filter media. In addition, the ML models accurately capture the established relationship between filtration efficiency and its characteristic drop at the most penetrating particle size (MPPS).

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Hou, J., Nakajima, M., Nishiuchi, Y., Ogura, D., Teramoto, A., Kuratomi, C.*, et al.*

Occupants and surface types drive microbial dynamics in controlled indoor environments.

Environmental Microbiome, Vol. **20** n°(1), (2025), 114 p.

Indoor microbial communities play a critical role in influencing indoor environmental quality and human health and are shaped by occupant activity, surface characteristics, and environmental conditions. While previous studies have examined these factors individually, systematic evaluations of their combined interactions, particularly involving Heating, Ventilation, and Air Conditioning (HVAC) and drainage systems, remain limited. This controlled, long-term (1.5-year) investigation assessed how human occupancy, surface moisture (dry vs. wet), aquaponics (soilless plant-aquarium systems), and environmental parameters (humidity, ventilation, and seasonal variations) influence bacterial and eukaryotic dynamics in tightly sealed residential units.

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Lee, W., Lee, S., Roh, J., Yeo, M.

On-site measurement-based analysis of temporary negative-pressure isolation rooms in a general hospital.

Developments in the Built Environment, Vol. **23**, (2025)

During the COVID-19 pandemic, patient rooms in a South Korean hospital were converted into temporary negative-pressure isolation rooms (TNPIRs) using HEPA filtration units (PHFUs). We analyzed data from three multi-bed TNPIRs under four PHFU conditions, assessing airflow rates, room pressure differentials, HVAC terminals velocities, and sulfur hexafluoride (SF6) tracer gas diffusion paths. Results showed that variability in PHFU performance produced uneven air change rates and pressure imbalances, while unintended airflow persisted through diffusers and grilles despite the central air-handling unit remaining inactive (HVAC). Additionally, tracer gas migrated via multiple routes including the plenum space above the T-bar suspended ceiling system, and some exhausted air re-entered the rooms. To address these issues, we propose real-time monitoring with automated controls and backup PHFUs; testing, adjusting, and balancing (T.A.B.); sealing HVAC terminals or installing backdraft dampers; and improving architectural airtightness. These proposed measures aim to manage airflow, strengthen airborne transmission control, and ensure environmental safety during public health emergencies.

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Ravnholdt, A. R., Ratnesar-Shumate, S. A., Santarpia, J. L.

A Review of Accidental Aerosol Generation in Laboratories and Laboratory-associated Infections.

Applied Biosafety, Vol. **30** n°(3), (2024), 229-238 p.

Introduction: Laboratory-acquired infections (LAIs) from exposure to infectious biological pathogens during laboratory operations present ongoing challenges despite modern biosafety measures. Notably, LAIs attributed to inhaling infectious aerosols continue to occur. Objective: This review aims to enhance understanding of the risks of LAIs associated with infectious aerosols. The first objective of this review is to

summarize studies that have characterized the potential for accidental aerosol generation in biological laboratories and to synthesize these findings. The second objective is to examine past LAI incidents involving infectious aerosol exposure to identify knowledge gaps. Methods: A literature review using PubMed and Google Scholar databases with relevant keywords was performed. The results were screened to identify studies that reported LAIs related to aerosol exposures. Thirty-eight articles pertaining to LAIs involving infectious aerosol exposures from an initial pool of 63 articles were identified. Discussion and Conclusions: This review underscores the need for comprehensive safety protocols to mitigate risks associated with LAIs due to aerosol generation. It identifies critical gaps in understanding aerosol dynamics, such as particle size distribution and the influence of laboratory automation. The review also highlights the inadequacy of current LAI reporting practices, advocating for improved documentation and standardized methods to enhance biosafety in laboratory settings.

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Govindarajan, K., Parasuraman, P. S., Rohini, P. V., Krishnan, Y. H., Kim, S.

Self-sterilizing nanofibrous filter loaded with usnic acid for enhanced removal of particulate matter and airborne pathogens.

Journal of Environmental Chemical Engineering, Vol. **13** n°(6), (2025)

Air pollution, in particular, fine particulate matter (PM), and airborne pathogens pose a severe global environmental challenge, demanding sustainable air filtration solutions. This study introduces a self-sterilizing nanofibrous air filter composed of usnic acid-embedded polyurethane nanofibers (PUNFs) fabricated via the electrospinning process. The role of usnic acid, a natural lichen-derived antimicrobial compound (NLDUA), exhibited high antibacterial activity, achieving 99.4 % disinfection efficiency against airborne Bacillus subtilis (2.5 × 105 CFU/mL) within 60 min through usnic acid-induced membrane disruption and reactive oxygen species (ROS) generation. The high performance of usnic acid-loaded nanofibers for PM capture (PU3NF, 99.32 %) with a lower pressure drop than PNF, yielding a high-quality factor (0.0665 Pa–1). The addition of usnic acid reduced the fiber diameter of PUNF, due to polymer chain stretching and enhanced surface roughness, which enabled superior PM capture through electrostatic interactions and mechanical sieving. Reusability tests confirmed stable performance (>95 % PM retention) after ethanol washing, a critical requirement for long-term applications. By integrating natural antimicrobial agents with scalable nanofiber technology, this work aims to develop energy-efficient, multifunctional air filters that address both particulate pollution and microbial contamination, thereby providing a sustainable solution for improving indoor air quality.

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Madsen, A. M., Árnadóttir, H. B., Bertier, P., Tunney, M. M., Hannerz, H., Verpaele, S.*, et al.*

Species-resolved exposure to fungi and bacteria, dust, and endotoxin during recycling of diverse waste types and systemic inflammatory response in workers.

Ecotoxicol Environ Saf, Vol. **304**, (2025)

The waste recycling workforce is growing across Europe. This study investigates the airborne exposure of workers recycling plastic, paper/cardboard, and electronic (e) waste, and examines whether serum levels of inflammatory markers correlate with exposure. Exposure was measured repeatedly and analysed for inhalable and respirable dust, inhalable endotoxin, fungi, and bacteria. Microorganisms were identified using MALDI-TOF MS on cultured microorganisms and bacteria by 16S rRNA marker-gene sequencing. Blood samples collected at the end of each workday were analysed for three markers of inflammation. Waste types/tasks had an impact on exposure levels for all exposures and temperature on exposure to anaerobic bacteria. Exposure levels to dust, endotoxin, and anaerobic bacteria differed between workers. Exposures were highest for those handling paper/cardboard and plastic waste. The alpha diversity indices for most exposures did not differ between types of waste handled, but eWaste was associated with a lower species richness. Beta diversity did not differ between indoor temperatures or waste types except for mesophilic bacteria and bacteria (NGS-data). The species Aspergillus niger, Penicillium brevicompactum,

Bacillus cereus, and Staphylococcus equorum were frequently detected. Serum levels of inflammatory markers increased with increasing exposure to dust, fungi or Penicillium spp, and anaerobic bacteria, but did not correlate with bacterial biodiversity indices. The study suggests further investigations of the impact of daily inhalation of bacteria able to grow anaerobically and fungi. Based on the high exposure levels, and the association between exposure and biomarkers of inflammation, it is advisable to explore risk management strategies aimed at minimizing worker exposure.

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Zhao, C., Morsli, S., Caramelle, L., Ganaoui, M. E.

Ventilation Velocity vs. Airborne Infection Risk: A Combined CFD and Field Study of CO2 and Viral Aerosols.

Fluid Dynamics and Materials Processing, Vol. **21** n°(8), (2025), 2001-2025 p.

Carbon dioxide (CO2) is often monitored as a convenient yardstick for indoor air safety, yet its ability to stand in for pathogen-laden aerosols has never been settled. To probe the question, we reproduced an open-plan office at full scale (7.2 m × 5.2 m × 2.8 m) and introduced a breathing plume that carried 4% CO2, together with a polydisperse aerosol spanning 0.5–10 μm (1320 particles s−1). Inlet air was supplied at 0.7, 1.4, and 2.1 m s−1, and the resulting fields were simulated with a Realisable k–ε RANS model coupled to Lagrangian particle tracking. Nine strategically placed probes provided validation; the calibrated solution deviated from the experiment by 58 ppm for CO2 (8.1% RMSE) and 0.008 m s−1 for velocity (15.7% RMSE). Despite this agreement, gas and particles behaved in sharply different ways. Room-averaged CO2 varied by <15%, whereas the aerosol mass rose to almost three-fold the background within slow-moving corner vortices. Sub-micron particles stayed aloft along streamlines, while those ≥5 μm peeled away and settled on nearby surfaces. The divergence shows that neither the CO2 level nor the mean age of air, taken in isolation, delineates all high-exposure zones. We therefore recommend that ventilation design be informed by a composite diagnosis that couples gas data, size-resolved particle measurements, and rapid CFD appraisal.

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