Bulletin de veille QAI
N°04 - 2025

Objectif : *Qualité de l'air intérieur*

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS. Les éléments issus de cette veille sont founis sans garantie d'exhaustivité.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

Les bulletins de veille sont disponibles sur le portail documentaire de l'INRS. L'abonnement permet de recevoir une alerte mail lors de la publication d'un nouveau bulletin (bouton « M'abonner » disponible après connection à son compte).

Google Scholar, Lens, WoS

Chevalier, A., Iwatsubo, Y., Roudot, A.-C., Thireau, J., Oury, B., Ramalho, O.*, et al.*

Actualisation des valeurs guides de qualité d'air intérieur - Benzène (CAS n°71-43-2).

Anses 2024. 258 p.

En France, comme pour l'air extérieur, la qualité de l'air à l'intérieur des bâtiments constitue une préoccupation de santé publique, en particulier puisque chaque individu passe en moyenne, en climat tempéré, 85 % de son temps dans des environnements clos dont une majorité de ce temps dans l'habitat. L'environnement intérieur offre une grande diversité de situations de pollutions par de nombreux agents physiques et contaminants chimiques ou microbiologiques, liées notamment à la nature des matériaux de construction, aux équipements, à l'environnement extérieur immédiat et aux activités des occupants. Or, les pollutions peuvent avoir des conséquences importantes sur l'état de santé des individus, même si elles ne sont pas toutes quantifiables avec précision et s'il est souvent difficile de s'accorder sur la part des déterminants génétiques, sociaux et environnementaux dans l'apparition et le développement des pathologies observées : irritations, maladies allergiques, pathologies dermatologiques d'origine immunitaire, affections broncho-pulmonaires, intoxications aiguës, cancers, syndrome des bâtiments malsains (SBM ou sick building syndrome (SBS)), etc.Les données collectées par l'Observatoire de la Qualité de l'Air Intérieur (OQAI), mis en place par les pouvoirs publics en 2001, ont confirmé la nécessité de disposer, au niveau national et par polluant, de valeurs de référence permettant de situer les niveaux de concentrations mesurées dans les environnements clos et d'instaurer des mesures de réduction des émissions proportionnées notamment au risque potentiel encouru. Par ailleurs, le manque de niveaux de référence pour la qualité de l'air intérieur limite le développement de référentiels utiles pour la qualification, en termes sanitaires, des émissions de composés par les produits de construction, de décoration ou de consommation. Ces éléments manquent également pour la conception de protocoles en vue de la spécification de bâtiments à Haute Qualité Environnementale (HQE).À l'échelle internationale, des valeurs de recommandations sont proposées dans certains pays et par quelques organismes reconnus. Le rapport du projet européen INDEX (CE 2005), financé par la Direction Générale de la Commission Européenne pour la santé et la protection des consommateurs (DG SANCO), a dressé en 2005 une liste de polluants chimiques prioritaires des environnements intérieurs susceptibles d'être réglementés dans le futur et a proposé des valeurs guides de qualité d'air intérieur. Par ailleurs, l'Organisation Mondiale de la Santé (OMS) s'est engagée en 2006 à proposer des valeurs guides de qualité de l'air intérieur (OMS 2006) en distinguant trois groupes : substances chimiques, agents biologiques et polluants émis par la combustion intérieure. Les travaux relatifs spécifiquement à l'humidité et aux moisissures ont été publiés en 2009 (OMS 2009). Puis, des valeurs guides de qualité d'air intérieur ont été publiées fin 2010 pour neuf substances chimiques (OMS 2010). En France, des actions à court, moyen et long terme afin d'améliorer la qualité de l'air dans les espaces clos sont proposées dans les différentes éditions des Plans nationaux Santé environnement (PNSE). Pour faire face à l'enjeu sanitaire que représente la qualité de l'air intérieur et apporter aux pouvoirs publics des éléments utiles à la gestion de ce risque, l'Agence nationale de sécurité sanitaire de l'alimentation de l'environnement et du travail (Anses) s'est autosaisie en 2004 afin d'élaborer des valeurs guides de qualité d'air intérieur (VGAI), fondées sur des critères sanitaires.Les VGAI proposées par l'Anses constituent le socle initial du processus institutionnel visant à fixer des valeurs réglementaires de surveillance de la qualité de l'air intérieur.Afin d'appuyer les pouvoirs publics dans l'élaboration de valeurs opérationnelles permettant de mettre en place des actions d'amélioration de la qualité de l'air intérieur, le ministère chargé de la santé sollicite usuellement le Haut conseil de la santé publique (HCSP) en vue de proposer, à partir des VGAI de l'Anses, des valeurs repères d'aide à la gestion dans l'air des espaces clos, ainsi qu'un calendrier pour leur déploiement. Le HCSP tient compte, dans ses propositions, de considérations pratiques, réglementaires, juridiques, économiques et sociologiques.Enfin, conformément à la loi du 1er août 2008 relative à la responsabilité environnementale, des VGAI

réglementaires sont établies par le ministère chargé de l'écologie, inscrites dans lecode de l'environnement et sont associées à des mesures de gestion.

****

Qu, C., Zhang, Z., Liu, N., Zhao, Z., Guo, Z., Liu, J.*, et al.*

Adhesive-emitted odorants detection using an electronic nose: Unraveling algorithm applicability with controlled dataset characteristics.

Microchemical Journal, Vol. **212**, (2025)

Electronic nose technology is becoming increasingly important in pollution monitoring; however, the inappropriate selection of pattern recognition algorithms may lead to performance decreases. In this study, an electronic nose was developed for the qualitative classification of adhesives and quantitative detection of adhesive-emitted odorant concentrations. Meanwhile, the applicability of commonly used pattern recognition algorithms (support vector regression, partial least squares regression, artificial neural network (ANN), random forest regression (RFR), ridge regression, and Lasso regression) to datasets with controlled volumes and interference intensities was investigated by comparing their quantitative performance. In qualitative analysis, the support vector machine with polynomial nonlinear kernel and random forest achieved 100% accurate classification of 11 adhesive samples. In quantitative analysis, RFR demonstrated good generalization ability and interference insensitivity, with a mean absolute percentage error (MAPE) below 3% in the large-volume strongly interfering dataset and less than 25% in the small-volume strongly interfering dataset. While ANN showed certain data volume dependence and interference sensitivity. For dataset with small volume and weak interference, algorithms with simple structures could achieve accurate quantification (MAPE of 10%). Moreover, the algorithm applicability was validated on homologous datasets and the effectiveness of cluster analysis to remove outliers was discussed.

****

Pandamkulangara Kizhakkethil, J., Kourtchev, I.

Aerosolisation of new generation perfluoroalkyl ether carboxylic and sulfonic acids from aeration of contaminated aqueous solutions.

Atmospheric Environment, Vol. **352**, (2025)

There has been an industrial shift towards replacing legacy per- and polyfluoroalkyl substances (PFAS) with perfluoroalkyl ether carboxylic and sulfonic acids (PFECA and PFESA) including hexafluoropropylene oxide dimer acid (HFPO-DA), also known as GenX. These compounds have been detected in the atmosphere but their potential sources remain poorly understood. In this study, aerosolisation of six PFECA and PFESA from PFAS-contaminated water at concentrations and pHs representative of industrial sewage was investigated. All studied PFECA and PFESA were observed in the aerosols from the aeration of PFAS-fortified water at pH 6, 7 and 8. The aerosolisation behaviour of PFECA and PFESA increased with the analyte's carbon chain length and was influenced by the PFAS functional groups and pH of the aerated solution. PFESA with sulfonic acid groups aerosolised more from the solutions than PFECA with carboxylic acid groups. The ability of new generation PFAS to transfer from contaminated waters and become airborne (aerosolise up to a mass fraction 30.4 ± 2.7 %) raises concerns due to their potential health and environmental impacts. Our findings indicate that industrial and water management processes involving aeration of water contaminated with PFECA and PFESA could serve as potential sources of new-generation atmospheric PFAS.

****

Tangestani, M., Jafari, A. J., Kermani, M., Kalantary, R. R., Arfaeinia, H.

Application of Monte Carlo simulation and quantitative microbial risk approach to investigate seasonal variation of airborne particulate matter and bioaerosols in medical waste management department and wastewater treatment plant of Iranian hospitals.

Results in Chemistry, Vol. **15**, (2025)

This study addresses a significant knowledge gap by conducting a thorough analysis of pollutants in hospital environments and utilizing advanced risk assessment models to evaluate their health impacts on workers for the first time. The study aimed to assess the concentration of particulate matter (PM1–2.5, PM0.5–1, PM0.25–0.5, and PM<0.25) and bioaerosols (bacteria and fungi) in the air around waste disposal departments and wastewater treatment plants of selected hospitals in Bushehr city, Iran, during different seasons. A probabilistic risk assessment using Monte Carlo simulation and the Disability-Adjusted Life Years (DALYs) model was employed to evaluate the health risks of PM and bioaerosols on workers. The study collected 32 PM samples and 132 bioaerosol samples using a four-stage impactor and a single-stage Anderson sampler, respectively. The results showed that the highest concentration of PM was found in PM1–2.5, measuring 119.4 µg/m3, while bacteria and fungi concentrations were 617 and 756 CFU/m3, respectively. Additionally, larger PM sizes were more prevalent, and bacterial levels exceeded those of fungi in the wards. Waste disposal sections in hospitals exhibited higher pollution levels of PM, bacteria, and fungi compared to wastewater treatment plants, especially during summer. Bioaerosol levels exceeded existing standards in the surrounding air of these departments Risk values surpassed acceptable thresholds, indicating significant health concerns. Sensitivity analysis revealed that concentration (C) and exposure duration (ED) parameters had the most significant impact on worker health assessment.

****

Vandewiel, M. R., Eneyew, D. D., Awol, A. D., Capretz, M. a. M., Bitsuamlak, G. T.

Approximating CFD simulations of natural ventilation: A deep surrogate model with spatial attention mechanism.

Journal of Building Engineering, Vol. **105**, (2025)

Building natural ventilation is a sustainable approach to reducing energy use and emissions from buildings by minimizing reliance on energy-intensive systems. Computational Fluid Dynamics (CFD) simulations are often used to predict natural ventilation, enhance building design, and improve indoor air quality. However, CFD simulations are time-consuming and computationally resource-intensive due to the number of spatial and temporal discretization and iterations required to solve the governing Reynolds Averaged Navier–Stokes (RANS) equations. Additionally, CFD simulations require specialized knowledge, limiting the number of concepts designers can test. This study proposes a UNet-based surrogate model with a spatial attention mechanism to overcome the limitation of CFD simulations by approximating RANS simulations of natural ventilation in cross-ventilated buildings. The proposed surrogate model was trained with data from CFD simulations performed on buildings with multiple opening sizes and wind from different directions. The model was then evaluated while comparing it with the commonly used UNet with channel-wise attention as a baseline. Based on the evaluation results, the Spatial Attention UNet model outperformed the baseline model in predicting velocity flow fields, achieving a mean absolute percentage error of 4.7% compared to 14.7% for the whole domain and 17.0% compared to 32.1% within the building. Furthermore, the trained model achieved a tremendous speed, reducing more than an hour of CFD simulation into orders of milliseconds. The result proved that the proposed model could save designers effort and time while allowing them to test several design concepts quickly, sacrificing only a small amount of accuracy.

****

Sun, C., Wang, Q., Zhang, J., Zou, Z., He, X., Niu, J.*, et al.*

Cancer risk and sick building syndrome in different regions of China: Potential hazard from particulate matter and phthalate pollutants.

Sustainable Cities and Society, Vol. **124**, (2025)

Phthalates (PAEs), a class of synthetic chemicals, are harmful to human health and found in indoor particulate matter (PM), air and settled dust. Current risk assessments for indoor PAEs may not accurately reflect the risks for the Chinese population because they use parameters from the U.S. Environmental Protection Agency (U.S. EPA.). This study investigated the correlation among PAEs, PM and Sick Building

Syndrome (SBS) in Shanghai. Chinese exposure parameters were then used to assess the lifetime incremental cancer risk (ILCR) of di(2-ethylhexyl) phthalate (DEHP) for different age groups across various Chinese regions. A significant positive correlation was found between indoor PAEs, PM concentrations (PM2.5, PM4 and PM10) and SBS. Regional differences existed in the ILCR associated with non-dietary intake (ILCRintake) and inhalation (ILCRinhale) of DEHP. ILCRintake posed a higher risk than ILCRinhale, exceeding the U.S. EPA limit (1 × 10−6) in most regions (1.19 × 10−6 to 1.93 × 10−6) with the exception of North and South China. . ILCRinhale remained below this threshold (ranging from 0.01 × 10−6 to 0.75 × 10−6). These findings highlight that cancer risks from DEHP intake via dust warrant particular concern.

****

Guo, X., Afroz, R., Wu, S., Wong, K., Carney, V., Zuidhof, M. J.*, et al.*

Characterizing amino compounds in indoor poultry farms: air quality and its impact on workers and chickens in Canadian egg farms.

Environmental Science: Processes & Impacts, Vol. **27** n°(4), (2025), 960-973 p.

Indoor air pollution is a common problem in poultry and many livestock facilities. Small airborne amino chemicals (AACs), such as ammonia and short-chain amines, are common air pollutants in poultry farms. An elevated concentration of AACs can reduce the indoor air quality (IAQ) of the farm, affecting the production of chicken eggs, the welfare of the animals, and the occupational health of producers. Recent studies have identified ammonia and small volatile organic pollutants in poultry farms. However, the characterization of large AACs, such as uric acid (UA) and large amines, has rarely been reported, although many of them have been proposed as the main form of biological nitrogen waste. Our goal is to provide information on organic amino pollutants in poultry farms. This project includes an online aerosol sample using a particle-into-liquid sampler (PILS) and an offline chemical analysis using liquid chromatography mass spectrometry (LC-MS). With a selective characterization of AACs in a poultry farm, we found that UA and suspended particles are correlated with onsite management practices, such as barn lights. Among the three major indoor phases (gas, particles, and litter) in the facility, we report the phase partition of UA, NH3, NH4+, and large amines. The observation of these indoor pollutants has implications on the formation of dust particles and ammonia, and the results can benefit the poultry industry in solving persistent IAQ problems.

****

Deka, R., Das, K. K., Das, D., Saikia, M., Sarmah, P.

A comparative study on the natural ventilation performance in buildings with different roof shapes.

International Journal of Natural and Engineering Sciences, Vol. **18** n°(1), (2024), 32-44 p.

The extensive use of mechanical ventilation systems is severely impacting the environment as these systems are one of the major sources of greenhouse gas emissions. Natural ventilation can effectively replace mechanical ventilation systems if the performance of the former is enhanced. The performance of a natural ventilation system depends on many factors such as the geometry of the building, opening size, shape, and positions. The studies related to quantitative analysis of natural ventilation performance in buildings are limited. Even though some of the studies have investigated the performance of natural ventilation in flat-roof buildings, however, completely ignore gable roof buildings. Considering the widespread usage of gable roof structures it is highly significant to investigate the natural ventilation performance in gable roof buildings. Thus, in this work, the quantitative assessment of natural ventilation performance in gable roof buildings has been investigated and compared with the flat roof buildings using computational fluid dynamics (CFD). Six different configurations based on the relative locations of the windward and leeward openings were considered for both roof shapes. Numerical simulations were carried out using ANSYS-FLUENT software to investigate the ventilation performance for each of the configurations. The three parameters selected for evaluating the natural ventilation performance are normalized average velocity magnitude (V*), velocity homogeneity index, H, and normalized volumetric flow, Q*. The results showed that the flat roof configurations have higher values of V* and H which infers

that flat roof configurations have better natural ventilation performance than gable roof configurations. Moreover, among the six configurations tested the configuration with windward opening below the mid-height and the leeward opening above the mid-height of the building wall has the best natural ventilation performance. The configuration with the windward opening at the mid-height and leeward opening below the mid-height of the building wall has the highest volume flow rate.

****

Vázquez-Ruiz, A., Navarro, J. M. A., Hinojosa, J. F.

Computational Fluid Dynamics Analysis of an Office With Seated Persons and a Double-Duct Solar Roof Chimney for Passive Ventilation.

Journal of Solar Energy Engineering, Vol. **147** n°(4), (2025)

This investigation reports a detailed computational study of heat transfer and airflow in an office with seated persons with a double-duct vertical roof solar chimney (SC). The computational model was validated with experimental temperature profiles. The validated computational model was used to analyze the effect of the heating of the SC and one vertical wall of the room on temperature fields, flow patterns, and the draught rate (DR) (discomfort index) in the thermal system. According to the Standard 62.1 of the American National Standards Institute (ANSI) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the present arrangement is adequate for the ventilation of offices. According to DR values, in offices with seated persons, the use of solar chimneys offers a natural and comfortable ventilation alternative, causing the removal and exchange of air, thereby improving the entry of air without compromising comfort conditions.

****

Abdillah, F., Juangsa, F. B., Ahmad, A. H., Darmanto, P. S.

Computational Fluid Dynamics-based Simulation and Analysis of Air Conditioning System Application in Watercress Mini Plant Factory.

Journal of Physics: Conference Series, Vol. **2972** n°(1), (2025)

The projected population of Indonesia to reach of around 320 million people in 2045 is worried to threaten the growth of various plants. The threat occurs due to various human activities that result in reduced land for growing plants and climate change. Plants are needed by humans as a source of food, medicine, and other valuable products. Plant Factory (PF) is a place for indoor plant production with climatic conditions that can be adjusted according to needs and is used as an effort to increase plant production on limited land. The Mini Plant Factory (MPF) is a small-scale of PF. This study concerns to simulate the MPF model in order to understand better the distribution of air temperature and velocity in it. Computational Fluid Dynamics (CFD)-based simulations were carried out in the bright period (plants carry out photosynthesis) and dark period (plants carry out transpiration). Transient simulations conducted to determine the duration of the AC compressor turns on and off in a day operation. The duration is used to calculate the operating costs of the MPF. The investment costs and income are also calculated to estimate the payback period of MPF. The air temperature around the planting rack is kept close to 21°C in the bright period and 19°C in the dark period. Within 24 hours, the AC compressor is on for 9.2 hours and off for 14.8 hours. The investment cost incurred to make MPF on an existing building is IDR 22,961,471.00. MPF can generate income of IDR 11,673,851.00 annually. The payback period of MPF project in this study was around two years.

****

Guo, F., Ham, S. W., Kim, D., Kim, S. H., Moon, H. J.

Designing reinforcement learning algorithms for building HVAC control: From experimental observation to simulation comparisons.

Applied Thermal Engineering, Vol. **270**, (2025)

Advanced supervisory-level control with reinforcement learning (RL) is regarded as a promising solution for HVAC systems to minimize energy consumption while maintaining thermal comfort and indoor air quality. However, most RL applications were conducted in the simulation environment rather than real-world HVAC systems. This paper developed a value-based RL controller termed Deep Q-Network (DQN) for a typical central HVAC system and evaluated its performance in a building test facility. By comparing DQN with a rule-based controller, the study not only demonstrated the cases where DQN could properly maintain indoor comfort but also discussed possible reasons why DQN failed in some other situations. Recognizing the limitations of value-based RL algorithms from the experimental tests, a simulation study was conducted to compare DQN with an alternative RL approach, an actor–critic algorithm termed Deep Deterministic Policy Gradient (DDPG). In scenarios with a relatively large action space, DDPG outperformed DQN by requiring fewer computational resources and achieving better thermal comfort, lower energy consumption, and more stable control actions. The findings suggest that the ability of DDPG to handle continuous control variables more effectively allows for faster convergence in training and more precise control in practice, which enhances the overall efficiency and reliability of the HVAC system.

****

Hassan, M. A., Liu, J., Jiang, J., Faheem, M., Zhang, M., Yao, M.

Elevated volatile organic compounds and odorant emissions from used air filters due to ozone exposure.

Building and Environment, Vol. **275**, (2025)

Due to current lifestyle trends and heightened sensitivity to health, particularly in the post-COVID-19 era, the importance of indoor air quality (IAQ) and odor emissions has increased. Volatile organic compounds (VOCs), which are emitted from various indoor materials are significant air pollutants that adversely affect IAQ and occupant health. In this study, the interactions between ozone (O3) and residential air filters are investigated to analyze VOC emissions and associated odor intensity (OI) via gas chromatography-olfactometry-mass spectrometry (GC-O-MS). In this study, G4, F7, and F9 air filters exposed to an average O3 concentration of 100 ppb inside Tedlar bags for 8 hours resulted in significant increases in the VOCs. After O3 exposure, the G4, F7, and F9 filters resulted in 2.7, 1.1, and 1.4 time increase in VOCs, respectively. Olfactometric analysis revealed a substantial increase in OI after O3 exposure. The sum of the odor intensities (SOIs) increased from 3.84 to 4.57 in G4, from 3.93 to 4.37 in F7, and from 3.89 to 4.2 in F9. Aldehydes were major contributors to odor, and the key odorants were nonanal, toluene, and paraldehyde. These findings indicated that O3 not only enhanced VOCs concentration but also intensified the odor issues; thus, targeted improvements are needed to increase IAQ and reduce health risks through improved ventilation systems.

****

Bolli, E., Bellucci, A., Mastellone, M., Mezzi, A., Orlando, S., Polini, R.*, et al.*

Engineered SnO2-based thin films for efficient CO2 gas sensing at room temperature.

Applied Surface Science, Vol. **683**, (2025)

Tin oxide (SnO2)-based thin films were deposited on alumina printed circuit boards via electron beam evaporation to fabricate CO2 gas sensors operating at room temperature. Femtosecond laser surface nanotexturing was applied as a novel approach to optimize key gas sensitivity parameters, including surface roughness and grain size. Raman and X-ray photoelectron spectroscopy revealed that the sensitive layer consists of a 1 μm SnO film with a non-stoichiometric SnO2 upper layer for the as-deposited film. The electronic disparity between these layers forms a native SnO-SnO2 interface, creating a p-n junction that enhances sensor sensitivity. This sensor shows a sensing response ranging from 7 % to 20 % for CO2 concentrations of 1000 to 2000 ppm, and up to 40 % at 5000 ppm. Laser irradiation introduced periodic surface structures (~ 800 nm), increasing the roughness and the number of active sites for the gas sensing. Although no significant improvements were observed in terms of sensitivity, the fs-laser treated sensor

exhibited enhanced stability and reproducibility, indicating its potential for low-energy consumption gas sensing platforms for indoor air quality applications.

****

Tang, H., Yu, J., Geng, Y., Liu, X., Huang, Z., Yang, Y.*, et al.*

Enhancing occupant-centric ventilation control in airport terminals: A predictive optimization framework integrating agent-based simulation.

Building and Environment, Vol. **276**, (2025)

Enhancing ventilation efficiency is essential for the sustainable operation of large airport terminals, which typically consume significantly more energy than regular public buildings. However, fluctuating passenger distributions in space and time—driven by flight schedules and airport services—pose significant challenges to ventilation control, often resulting in unnecessary energy use and suboptimal indoor air quality (IAQ) management. To address this, our study proposes an innovative optimization framework to automate coordinated multi-zone ventilation control in large airport terminals using an agent-based passenger flow simulation model. Based on flight schedules, passenger flow within the terminal was simulated through pedestrian agents governed by the Social Force Model, enabling the accurate characterization of spatiotemporal passenger distribution and activities across different zones. This simulation was integrated with a physical ventilation model and a distributed evolutionary algorithm to achieve optimal IAQ management, energy efficiency, and flexibility in energy use. Over a two-month evaluation period, the optimized control framework demonstrated marked improvements over baseline fixed-schedule control, with the CO_2 compliance rate rising from 89.32 % to 99.6 %, total energy consumption reduced by 29.6 %, and daily peak power demand decreased by 27.2 %. This study showcases a practical, occupant-centric approach to improving operational sustainability in complex built environments.

****

Jia, P., Chen, Z., Mao, G., Zhang, Y., Liu, J., Xu, M.

Gas concentration prediction based on temporal attention mechanism in temporal convolutional networks.

Sensors and Actuators B: Chemical, Vol. **433**, (2025)

To predict indoor air quality, we can analyze the concentrations of gas present in the air. Accurate prediction of gas concentrations can help individuals identify the presence of harmful gas in the environment, thereby preventing potential accidents. Previous studies have utilized electronic nose (E-nose) in conjunction with traditional neural networks to obtain gas concentration information; However, these neural networks often experience a decline in prediction accuracy when handling longer time series data, failing to meet expected outcomes. To enhance prediction accuracy, this study introduces an innovative Temporal Convolutional Network (AGT-TCN), designed for the prediction of mixed gas concentrations in E-nose. AGT-TCN comprises a temporal convolutional network (TCN), gated recurrent units (GRU), a temporal attention mechanism and residual convolutions. In the experiments, we employed data from carbon monoxide and ethylene mixed gas (CO-ethylene) for concentration predictions and compared the results with baseline models including TCN, GRU, Long and short-term memory network (LSTM), convolutional neural network - long short-term memory network (CNN-LSTM) and Long Short-Term Memory-Transformer (LSTM-Transformer). The results demonstrate that AGT-TCN outperforms baseline in terms of prediction accuracy. This further confirms the applicability of the AGT-TCN in the early prediction of CO-ethylene concentrations.

****

Zhai, H., Liu, C., Wang, Y., Wu, Z., Tian, P., Fang, Z.

High-performance formaldehyde gas sensors based on Au/Pd bimetal decorated β-Ga2O3 nanorods.

Journal of Alloys and Compounds, Vol. **1022**, (2025)

Formaldehyde (HCHO) is a widely used gas but harmful. Nowadays, the state-of-the-art high-performance HCHO gas sensors are hard to satisfy most HCHO exposure conditions suggested by the Health and Safety Executive and the World Health Organization. In this study, Au/Pd bimetal decorated β-Ga2O3 nanorods HCHO gas sensors have been fabricated with fast response speed and very low limit of detection (LOD). The β-Ga2O3 nanorods gas sensors exhibit a response of 24.3, very short response/recovery time of 2.8/5.8 s to 50 ppm HCHO at 625 K. A good response linearity with a linearity factor of 0.69, and a very low LOD of 50 ppb are also achieved. The good HCHO sensing performance originates from the abundant surface adsorbed oxygen ions induced by a dual function of bimetal spill-over effect and nanostructure design. This work successfully introduces bimetal decoration to enhance gas sensing of β-Ga2O3 gas sensors, which provides a new strategy to fabricate high-performance HCHO gas sensors based on β-Ga2O3 materials.

****

Elsayed, M., Silvonen, V., Luoto, A., Lintusaari, H., Hakala, J., Timonen, H.*, et al.*

How air cleaners, ventilation, and outdoor air pollution influence air quality in European hospitals: Case studies from Finland and Romania.

Building and Environment, Vol. **276**, (2025)

In healthcare facilities, maintaining a controlled, contaminant-free environment is essential. This involves eliminating airborne contaminants and ensuring a continuous supply of clean air. The objectives of this study were to understand the differences in the indoor and outdoor characteristics of particulate matter pollution (fine particle mass (PM2.5), lung-deposited surface area (LDSA), and black carbon mass (BC) concentrations) and environmental conditions (air temperature, relative humidity and carbon dioxide concentration) in hospital buildings in Romania and Finland. Additionally, the effectiveness and impact of ventilation and air cleaning technologies on the indoor air quality were assessed. The highest mean concentrations of outdoor PM2.5, LDSA, and BC were observed in Bucharest, with values of 32.7 μg/m³, 59.4 μm²/cm³, and 3.3 μg/m³, respectively. The use of air cleaners effectively reduced indoor particulate concentrations in both naturally and mechanically ventilated buildings. In the naturally ventilated hospital in Bucharest, Romania, the use of air cleaners resulted in reductions of up to 93.8 % and 89.3 % in the median PM2.5 and LDSA indoor/outdoor (I/O) ratios, respectively. In the mechanically ventilated hospital in Espoo city in Finland, corresponding I/O-ratio reductions were 78.6 % and 69.9 %. These results highlight that indoor air quality is influenced by both indoor and outdoor air characteristics, as well as the building's ventilation and filtration systems. In addition, reduction in indoor concentration values emphasize the effectiveness of using portable air cleaners as a local solution for reducing particulate pollution when integrated with an appropriate natural or mechanical ventilation system.

****

Mandal, D. K., Bose, S., Biswas, N., Manna, N. K., Santra, S., Cuce, E.*, et al.*

Hybrid solar Chimneys: Enhancing thermal comfort and Alleviating indoor air pollutants − A comprehensive review.

Solar Energy, Vol. **293**, (2025)

Indoor air pollution (IP) remains underrecognized compared to outdoor pollution, despite extensive research on environmental contamination and outdoor air quality. Individuals of all age groups spend the majority of their time indoors—often over 90%—placing them at continuous risk of exposure to indoor pollutants and potential harm to both individual and public health. In this context, hybrid solar chimney (SC) systems have emerged as a promising strategy to enhance thermal comfort and mitigate indoor pollution levels. These systems employ thermal buoyancy for natural ventilation, thus improving indoor comfort and indoor air quality (IQ). Researchers have investigated several modifications to hybrid systems, such as integrating Photovoltaic cells (PV), Phase Change Materials (PCMs), evaporative cooling, and Earth-air heat exchangers (EAHE), to improve their efficiency, these studies have primarily focused on the thermal

comfort benefits. However, a notable gap remains in addressing indoor pollutants. In response, this review examines the potential of integrating a photocatalytic reactor into hybrid solar chimneys to target airborne contaminants while maintaining desirable indoor temperatures. The findings underscore the need for future advancements in hybrid Solar Chimney technology, particularly in optimizing multi-technology integration, enhancing photocatalytic materials, and establishing standardized performance metrics to evaluate both thermal comfort and air quality. Lastly, the review highlights the challenges facing these systems and proposes directions for future investigation.

****

Hefnita, H., Budiyono, B., Suhartono, S.

The indoor air quality and the occurrence of sick building syndrome among employees in the central surgery building of hospital X, Bandung.

Malahayati International Journal of Nursing and Health Science, Vol. **7** n°(12), (2025), 1532-1544 p.

Background: The prevalence of SBS (Sick Building Syndrome) among employees working in hospitals ranges from 21% to 80%, which is higher compared to other places. SBS has become an issue due to poor indoor air quality, including at Hospital X in Bandung.

Purpose: To analyze the relationship between indoor air quality and the incidence of Sick Building Syndrome among workers in the Central Surgery Building of Hospital X, Bandung.

Method: An analytical observational study with a cross-sectional design. The study population consisted of 105 permanent employees of the Central Surgery Unit. A sample of 91 workers was selected using random sampling. Inclusion criteria were permanent employment and working >7 hours a day, while exclusion criteria included employees on leave, sick, or unavailable. Data were collected through observation using instruments such as a thermohygrometer to measure temperature and humidity, a lux meter for lighting, a sound level meter for noise, and an anemometer for ACH (Air Changes per Hour), following the standards of the Ministry of Health Regulation No. 2 of 2023. Additionally, interviews were conducted using a questionnaire containing questions about SBS symptoms to gather data on the occurrence of SBS. Data analysis used Chi-square and logistic regression at a 95% confidence level and an alpha of 0.05.

Results: The study results indicated that the indoor air quality did not meet the required standards: temperature (77.3%), humidity (86.4%), lighting (63.6%), noise (0%), bacterial count (63.3%), fungal count (77.3%), and ACH (63.3%). There was a significant relationship between temperature, humidity, and ACH with the occurrence of SBS (p=0.001; p=0.003; p=0.031). However, there was no significant relationship between lighting, bacterial count, and fungal count with SBS (p=0.181; p=0.264, p=0.066).

Conclusion: Temperature, humidity, and ACH are variables that are associated with the occurrence of SBS.

****

Giosuè, C., Czerwinska, N., Remia, G., Stazi, F., Di Perna, C., Mobili, A.*, et al.*

Innovative multifunctional finish for the improvement of Indoor Air Quality: Performance at laboratory and pilot scale.

Building and Environment, Vol. **273**, (2025)

In this study, the impact of an innovative multifunctional finish on the Indoor Air Quality (IAQ) in terms of temperature (T), relative humidity (RH), and volatile organic compounds (VOCs) was compared to that of a commercial finish for the same application as reference. The two finishes were applied on the same commercial substrate and tested both at laboratory and pilot scale. At laboratory scale, the water vapour permeability, the moisture buffering capacity and the depolluting activity by adsorption of the innovative finish was 15 %, 100 % and more than 200 % higher than those of the commercial one on the same substrate, respectively. At pilot scale, the innovative finish was more effective than the commercial finish in buffering humidity variations (RH increases 53 % slower compared to the commercial solution),

temperature variations (-1.5 °C), and decreasing VOCs concentration (from 14 % up to 63 %, depending to the test conditions). Therefore, the innovative multifunctional indoor finish has proven to be more effective than the commercial one in improving IAQ not only in laboratory but also at pilot scale.

****

Rajdeep, P.

Innovative Ventilation System Approaches for Enhancing Indoor Air Quality in Energy-Efficient Building Environments.

International Journal of Information Technology and Electrical Engineering (IJITEE), Vol. **12** n°(5), (2023), 1-6 p.

Enhancing indoor air quality (IAQ) in energy-efficient buildings presents a dual challenge: maintaining comfort and health while minimizing energy consumption. This paper explores innovative ventilation system approaches tailored to such environments, emphasizing advancements in natural ventilation, mechanical systems, hybrid models, and smart technologies. Comparative analyses and quantitative modeling underline the role of adaptive ventilation in achieving optimal IAQ with minimal energy trade-offs. A discussion of challenges, opportunities, and future directions concludes the paper.

****

Banu, A., Mir, N., Ghiat, I., Abdullatif, Y. M., Amhamed, A. I., Al-Ansari, T.*, et al.*

Life cycle cost analysis of direct air capture integrated with HVAC systems: Utilization routes in formic acid production and agricultural greenhouses.

Journal of Environmental Chemical Engineering, Vol. **13** n°(3), (2025)

Integrating direct air capture (DAC) technology into Heating, Ventilation, and Air Conditioning (HVAC) systems offers an innovative approach to improving energy efficiency and indoor air quality in buildings while simultaneously reducing carbon emissions. This study investigates the economic feasibility of DAC integrated with HVAC by evaluating several key economic indicators including life cycle costing. Two adsorbents, Lewatit VP OC 1065 (Lewatit) and SBA-15, are evaluated within the system, for which the results indicate a significant economic advantage for SBA-15 over Lewatit. The levelized cost of the DAC with SBA-15 was found to be $202 per ton of CO2 captured, demonstrating competitive economics for this carbon capture technology. To enhance the process's economics, the captured CO2 is utilized in two key utilization pathways: low-carbon fuel and agricultural production. The first pathway explores the electrochemical conversion of CO2 into formic acid (FA). The system demonstrates strong economic potential, with an NPV of $6.41 million and a levelized cost of $0.499/kg of FA. Critical economic parameters, such as Faradaic efficiency, current density, and electrolyzer stack price, are identified and should be optimized through further research into electrolyzer design. Alternatively, the second pathway considers utilizing the captured CO2 for greenhouse CO2 enrichment, enhancing crop growth and reducing water consumption, thus addressing food security concerns. The NPV for the greenhouse system with CO2 enrichment was calculated to be $226,879, with a levelized cost of $1.13/kg of produce (tomatoes). Sensitivity analyses are performed on key economic variables, including the discount rate, electricity price, and final product selling price, to account for future market fluctuations.

****

Eid, A., Jodeh, S., Chakir, A., Hanbali, G., Roth, E.

Machine learning-based analysis of workers' exposure and detection to volatile organic compounds (VOC).

International Journal of Environmental Science and Technology, (2025)

This article examines the ability of supervised learning methods such as support vector machines, random forest (RF), and neural networks to characterize individuals exposed to volatile organic compounds (VOCs)

using VOC measurements collected from a carpentry workshop in a Palestinian village. The analysis reveals significant differences in VOC measurements among the categories of participated individuals, emphasizing the importance of VOCs as indicators. The predictive models achieved high accuracy in identifying gender, smoking status, and age, with the RF model reaching 100% accuracy in age prediction and 98% accuracy in smoking status prediction. In terms of VOC importance, “Toluene.2.4. diisocyanate” and “Propanal” were the top VOCs for predicting age, while “Toluene.2.4..diisocyanate” and “Bromodichloromethane” were crucial for predicting smoking status. For gender prediction, “Toluene.2.4..diisocyanate” and “Ethylbenzene” emerged as key VOCs. The study contributes to the field of environmental sciences and air pollution research, as well as providing practical recommendations for decision-makers. These recommendations emphasize the need to organize carpentry workshops and similar facilities in a way that reduces pollution and safely protects the health of nearby communities. By applying machine learning techniques, this research provides insights valuable for informed decision-making and for advancing business and environmental management practices in related industries.

****

Izbassarov, D., Auvinen, M., Kuula, J., Hellsten, A., Karppinen, A.

Modeling Dispersion by Indoor Turbulence with LES.

Air Pollution Modeling and Its Application XXIX

In the present work, the PALM-LES model is employed to study different indoor dispersion problems utilizing a dental treatment room as a test space. With high-resolution modeling, the structured LES solver is applied to different indoor configurations with varying ventilation conditions and room geometries. The aim is to investigate the role of enhanced mixing in indoor dispersion problems. The findings demonstrate that improved mixing lowers overall concentration levels and dilutes local concentration peaks indoors. These positive impacts can be achieved by moderate means, for example by employing a simple table fan.

****

Elancheziyan, M., Singh, M., Bhuvanendran, N., Won, K.

Ni-doped MnO2/Ti3C2Tx MXene nanocomposite for highly sensitive electrochemical ammonia gas sensing at room temperature.

Journal of Alloys and Compounds, Vol. **1022**, (2025)

Highly sensitive ammonia (NH3) gas sensors play a critical role in various industries due to their direct implication for health and safety. Nanocomposites have gained massive attention for recent electrochemical gas sensing. In this work, we first propose a Ni-doped MnO2/Ti3C2Tx MXene nanocomposite material for electrochemical NH3 gas sensing at room temperature. Ni-doped MnO2 nanowires were introduced to Ti3C2Tx MXene using a self-assembly technique to develop a high-performance gas sensor. The nanocomposite was characterized using BET, SEM-EDS, XRD, and XPS analyses, which revealed that the Ni-MnO2 nanowires were uniformly distributed on the MXene surface, significantly increasing the surface area. The Ni-MnO2/Ti3C2Tx MXene nanocomposite was immobilized on a screen-printed carbon electrode (SPCE), which is the most appropriate platform for portable and convenient electrochemical sensors, and ionic liquid was used as an electrolyte to achieve high stability. Electrochemical analysis showed that this new NH3 gas sensor had outstanding performance with a higher sensitivity and a lower detection limit of 0.072 μA/ppm and 0.23 ppm, respectively. It also exhibited a fast response time of 45 s at 20 ppm NH3 gas, high repeatability, selectivity, and long-term stability. In addition, the electrochemical NH3 gas nanosensor was successfully demonstrated to monitor food freshness.

****

Ambi, R. R., Mali, R. A., Pawar, A. B., Mulla, M. G., Pittala, R. K.

NiO nanosheet-assembled chemiresistive sensor for NO2 detection.

Applied Physics A, Vol. **131** n°(4), (2025)

This paper presents the deposition of nickel oxide (NiO) nanosheets at 0.05, 0.075, 0.1, and 0.125 M solution concentrations by using economical approach of chemical bath deposition (CBD) technique. X-ray diffraction analysis verifies that NiO is polycrystalline with a cubic phase. For NiO film prepared at 0.1 M, FE-SEM and AFM analysis reveals the formation of porous micro-structured morphology of randomly oriented nanosheets and the surface roughness of 62.1 nm, respectively. XPS analysis reveals Ni2+ oxidation state in Ni-2p spectra corresponding to the NiO with binding energy peaks at 854.2, 873.1, and 879.8 eV andNi3+ at 855.7 and 861.2 eV for Ni2O3.NiO nanosheets sensing performance evaluated at sensing conditions of 200 °C to 100 ppm NO2showed32.2% response with Tresponse = 17 s and Trecovery = 150 s. The results suggest that NiO nanosheets made with the CBD process could be suitable options for commercial NO2 sensing applications at 200 °C. Finally, NO2 sensing mechanism of porous NiO microstructure made up of nanosheets is discussed.

****

Cui, C., Xue, J., Liu, L.

Optimal control of HVAC systems through active disturbance rejection control-assisted reinforcement learning.

Energy, Vol. **323**, (2025)

Optimal control of multi-zone HVAC systems may suffer from noise and disturbances that affect control accuracy and performance, and faces computational challenges caused by multiple control variables. To address these challenges, this paper proposes a novel method that incorporates reinforcement learning and active disturbance rejection control through a main-auxiliary controller configuration. A main controller is designed based on twin delayed deep deterministic policy gradient, which is responsible for controlling zone supply airflows. An auxiliary controller is configured based on active disturbance rejection control, which regulates the fresh air ratio and meanwhile handling the disturbances and uncertainties. The two controllers work in parallel with exchange information in real-time to optimize HVAC systems in dynamically uncertain environments. In the proposed method, the control variables are separated and handled by main and auxiliary controllers respectively, which reduces the action space of reinforcement learning algorithm and partly decouples the thermal loads and ventilation loads. An EnergyPlus-Python co-simulation platform has been developed using real-world data. Test results demonstrate that the proposed AD-RL method can enhance indoor comfort and IAQ. Furthermore, compared to the rule-based method and the classical TD3-based approach, it can reduce the daily HVAC energy consumption by up to 22.37 % and 13.53 %, respectively.

****

Ma, L., Shi, X., Liu, J., Gao, S., Zhang, D., Cheng, Z.*, et al.*

Optimization of ultrasound-assisted lignin depolymerization using response surface methodology for low-formaldehyde emission wood adhesives.

Industrial Crops and Products, Vol. **227**, (2025)

The heterogeneity, high molecular weight, and low content of functional groups have limited the high-value utilization of lignin to prepare high-performance resins. To overcome this obstacle, ultrasound-assisted lignin depolymerization was investigated as a gentle, efficient, and inexpensive method to improve the functionality and homogeneity of lignin. The response surface methodology combined with the Box–Behnken design was employed to optimize the yield and molecular weight of oligomeric lignin by varying three parameters: sonication time, lignin mass fraction, and solvent ratio. The predicted optimal yield (33 %) and molecular weight (Mn = 700) under optimal conditions (3 h, 14.3 % lignin, and MeOH/H2O = 3:1) were almost the same as those obtained experimentally (Mn = 710), yield of 33.8 %, proving the validity of the model. The depolymerized lignin (DL) was directly substituted for phenol to prepare depolymerized lignin phenol-formaldehyde resins (DLPF). The rheological and adhesive properties of these resins were compared with pure PF resin and lignin phenol-formaldehyde (LPF) resins. An enhanced bonding strength, but lower curing temperature and formaldehyde emission, were observed. This study presents a cost-

effective and efficient method to prepare depolymerized lignin as the precursors of high-performance resins.

****

Aeinfar, S., Serteser, N.

Parametric study of energy optimization and airflow management in high-rise buildings with double-skin façade using a genetic algorithm and CFD.

Journal of Building Engineering, Vol. **105**, (2025)

This study investigates Energy Use Intensity (EUI) optimization through airflow management in a hypothetical high-rise office building in Istanbul, Türkiye. It focuses on a representative floor with a naturally ventilated Double Skin Façade (DSF), incorporating air-driven conduits to address ventilation challenges. The study's significance lies in enhancing fresh air provision while optimizing energy efficiency. The aim is to improve natural airflow on upper floors, where ventilation challenges arise due to wind flow characteristics, while reducing energy consumption. A parametric model was developed in Rhino-Grasshopper, integrating energy simulation via Honeybee under ASHRAE standards with EnergyPlus Weather (EPW) data. A genetic algorithm in Galapagos utilized to optimize façade openings, DSF cavity depth, and air-driven conduit dimensions to minimize EUI. Computational Fluid Dynamics (CFD) analysis in ANSYS FLUENT was conducted pre and post optimization to evaluate airflow behavior and validate ventilation efficiency. The optimized model achieved a 66 % reduction in EUI compared to the reference model, improved the Energy Performance Certificate (EPC) from G to C, and maintained Air Change per Hour (ACH) within ASHRAE standards. In conclusion, this study highlights the effectiveness of multi-variable optimization in improving both energy efficiency and ventilation performance. The integration of air-driven conduits into the DSF system, combined with a sequential optimization framework followed by post-optimization CFD validation, presents a streamlined approach to optimizing EUI and natural ventilation in high-rise buildings. Moreover, it provides valuable insights for early-stage high-rise building design, aiding in the reduction of reliance on mechanical systems and supporting sustainable building practices.

****

Lin, S., Zeng, T., Deng, L., Huang, H.

Performance analysis of a solar-driven rotating desiccant wheel air-conditioning system in Guangzhou.

Thermal Science and Engineering Progress, Vol. **61**, (2025)

To address the high energy consumption of air-conditioning systems in Guangdong, this study contributes a model of a solar-driven rotary desiccant wheel air conditioning system using TRNSYS. This model is used to investigate the operating characteristics of the system for an office building in Guangzhou during the cooling season, which spans from May to October. Firstly, the effect of the circulating pump flow rate of the solar collector and water tank on the regeneration gas temperature is evaluated. The results indicate that the regeneration gas temperature increases with the increasing flow rates of both circulating pumps under the conditions examined. The optimal flow rates for the regeneration gas, the circulating pumps of the solar collector, and the water tank are 720 kg·h−1, 960 kg·h−1, and 960 kg·h−1, respectively. Furthermore, the operational performance and energy consumption characteristics of the proposed and conventional air conditioning systems were analyzed and compared. Results demonstrate that the average electrical coefficient of performance (COP) of the proposed system is about 3.8, which is 1.37 times higher than that of the conventional air conditioning system, with an energy saving of about 24.7 % and a reduction in annual CO2 emissions of 744 kg. This work offers a new possibility for energy efficiency in buildings in high temperature and high humidity areas such as Guangzhou and validates the new system as a major contributor to experimental carbon reduction and carbon neutrality.

****

Escher, L., Rück, T., Jobst, S., Pangerl, J., Bierl, R., Matysik, F.-M.

Photodissociation-driven photoacoustic spectroscopy with UV-LEDs for ozone detection.

Photoacoustics, Vol. **43**, (2025)

This study presents the development and evaluation of a UV-LED based photoacoustic (PA) measurement system for ozone (O3) detection to demonstrate its potential for low-cost and accurate sensing while for the first time addressing the importance of photodissociation for PA signal generation for O3 in the UV range. With a detection limit of 7.9 ppbV, the system exhibits a significant advancement over state-of-the-art UV-PA O3 detection and is on par with laser-based setups. Following a novel discussion of the PA signal arising from photodissociation and its products, cross-sensitivity effects due to environmental factors such as temperature and gas composition were systematically analyzed. A digital twin driven compensation for these influences was implemented and evaluated. Despite the challenges associated with modeling the effects of H2O and CO2, the PA system shows considerable potential, though further studies in real world applications must be conducted.

****

Manke, A., Hicks, P., Hankey, J.

Pilot In-Vehicle Carbon Monoxide Detector Study.

National Surface Transportation Safety Center for Excellence 2025

This study addresses the critical issue of carbon monoxide (CO) exposure in truck cabins, particularly in vehicles used for work zones. The research explores the levels of CO within these confined environments, with the objective of identifying factors that could contribute to increased CO levels. Two Truck Mounted Attenuators equipped with CO sensors and data acquisition systems were monitored under real-world operational conditions from July to December 2023. The study shows that average in-cabin CO levels across the two vehicles were generally low, 1.22 ppm in Truck 1 and 1.61 ppm in Truck 2.

****

Li, Y., Liu, M., Xu, B., Ye, W.

Rethinking building ventilation and outdoor airflow rate–Can we engineer clean indoor air?

Renewable and Sustainable Energy Reviews, Vol. **215**, (2025)

Clean air is a human right, but providing clean air in the built environment amid climate change presents challenges. The conventional wisdom to develop efficient, low-carbon mechanical ventilation methods primarily relying on dilution remains difficult. Meanwhile, the pandemic raises promises and questions about how we view and apply indoor purification from portable air cleaners. This paper attempts to rethink the connotation of “clean indoor air” by categorizing its sources into four groups, i.e., filtered and unfiltered outdoor air, and purified and unpurified indoor air. A systematic review and analysis were conducted based on literature, market surveys, and standards. Three indices, i.e., Rout, Rin, and Re, were proposed to evaluate the cleanness considering outdoor pollution, indoor pollution, and induced risks, respectively. Air change rates, cleaning efficiency, and infiltration or transfer air were identified as key factors, and a sensitivity analysis was performed to assess their impacts. The feasibility of combining different “clean air” types is explored, and a qualitative analysis was proposed to outline a composite clean air roadmap. Clean air needs are first identified and categorized into three layers using the “3W” framework: target pollutants (What), occupants (Who), and scenarios (Where). Clean air strategies are recommended using a four-dimensional (4D) evaluation method, which assesses cleaning efficiency, energy consumption, flexibility, and manageability. This study provides insights into optimizing clean air systems by focusing on purified indoor air, aiming to enhance system efficiency, resilience, and energy savings, thereby addressing the increasing and diverse clean air demands in human-centered environments.

****

Vikas Pare, A. N., Athar Khan.

Role of machine learning in air pollution control and monitoring: A recent review.

In: Mechanical Engineering for Sustainable Development. 2025.

Air pollution is a significant environmental and societal issue, causing significant health risks. Researchers are exploring machine learning techniques to control pollution, focusing on potential sources and mitigation strategies. The main causes of air pollution include emissions, transportation dispersion, transformation, and immisions. The study aims to understand and mitigate these issues to improve air quality and safety.Pollution in air comes from both exhaust and non-exhaust emission sources, affecting both indoor and outdoor environments. Exhaust emission pollutants include NOx, CO, CO2, SO2, particulate matter, and volatile organic compounds. Non-exhaust emission sources include road wear, tire wear, brake wear, and road dust resuspension. Air pollution negatively impacts human health, particularly respiratory disorders. Machine learning is a successful technique for predicting, detecting, and monitoring air pollutants for air quality control. Random Forest and other machine learning models have been utilized for predicting air quality control and monitoring. These models include LSTM, MLP, RF, BRT, SVR, XG Boost, GAM, Cubist, ANN, Logistic regression, Auto-regression, Hybrid interpretable predictive model, k-nearest neighbors, Naïve-Bayesian classifier, and decision tree models. Support Vector regression and ANN models have been proven to be more accurate than other models.

****

Lv, Y., Wang, X., Liu, D.

Temporal distribution of environmental pollutants in high-occupancy buildings transitional spaces and exposure risk assessment for different flow paths.

Building and Environment, Vol. **275**, (2025)

As urbanization progresses, high-occupancy buildings have become the predominant urban residential form, but their transitional spaces may pose significant health risks. This study examines the temporal distribution of physical and chemical pollutants in these spaces and assesses exposure risks associated with resident flow. The results showed that the distribution of PM2.5, PM10, Total Volatile Organic Compounds (TVOC), and ozone is closely linked to residents' cooking and smoking behaviors, significantly increasing health risks on the same floor. Frequent carbon monoxide exceedances in elevator cars also indicates serious risks. The architectural design of transitional spaces shows efficacy in mitigating pollutants, with reductions of 9.8 %, 13.4 %, 36.5 %, and 90.4 % for PM2.5, PM10, TVOC, and ozone, respectively, from the apartment entrance to the foyer. Airflow patterns in the stairwell impact ozone and TVOC distribution, with pollutant molecular weight and reactivity being key factors in accumulation. This study used Bayesian Model Averaging (BMA) to develop an exposure risk assessment model, identifying noise, TVOC, and ozone as the primary risk factors of the apartment building. In elevator car (high-risk area), noise and TVOC accounted for 5.1 % and 94.9 % of the independent risk, respectively. Additionally, the synergistic effects of multiple pollutants at apartment entrance were significant, contributing 16.8 % to overall risk and further exacerbating health hazards. Flow path analysis indicated the highest exposure risks during elevator use, emphasizing the need for improved ventilation systems. These findings provide a scientific basis for optimizing apartment environments, assessing exposure risks, and promoting sustainable building designs that prioritize health.

****

[Thermal comfort and indoor air quality in some workplaces of the Polizia di Stato (State Police) in Italy]: Comfort termico e qualità dell'aria indoor in alcuni ambienti di lavoro della Polizia di Stato in Italia.

Giornale Italiano di Medicina del Lavoro ed Ergonomia, Vol. **39** n°(4), (2025), 230-239 p.

Introduction. Little can be found in the literature about thermal comfort and indoor air quality (IAQ) in law enforcement workplaces. This study, based on environmental surveys carried out by the Centro Sanitario Polifunzionale of Milan (Italian State Police Health Service Department), aims to assess the thermal comfort and IAQ in some of the Italian State Police workplaces. Materials and methods. Measurements

were performed in some indoor workplaces such as offices, archives, laboratories and guard-houses in various regions (Lombardia, Emilia Romagna, Liguria, Veneto, Trentino Alto-Adige) of Northern Italy. The PMV/PPD model developed by Fangar for the evaluation of the thermal comfort was used. We measured both CO2 concentration and relative humidity indoor levels for the evaluation of IAQ. We used Chi square and t Student tests to study both prevalence of thermal discomfort and low IAQ, and their differences between summer and winter.Results. For the purposes of the present study we carried out 488 measurements in 36 buildings (260 in winter and 228 in summer). Our results showed that thermal comfort was reached in 95% and 68% of environmental measurements (in winter and summer, respectively). In summer, we measured different types of thermal discomfort (it was almost always ranged ‡0,7

****

Senthong, P., Wittayasilp, S., Ladondu, K., Noochana, K.

Working conditions and the effect of ventilation in automobile repair shops.

Toxicology and Industrial Health, Vol. **41** n°(4), (2025), 211-219 p.

The aim of this study was to quantify VOC concentrations in different ventilation conditions, Wet Bulb Globe Temperature (WBGT), illumination and noise levels in two automobile repair shops. A cross-sectional study was conducted at two shops in Surat Thani province, Thailand. VOCs were collected by area sampling using charcoal tubes. The air samples were analyzed by GC-FID. The noise levels, illumination, and temperature were measured by using noise dosimeter, lux meter, and WBGT apparatus, respectively. Fifteen different VOCs were detected in both shops. Most of the VOCs measured had levels below the limit values suggested by ACGIH, except toluene and chloroform in shop B. The average VOCs concentrations in shop B after installation of local exhaust ventilation and opening the door for 30 minutes after finishing painting a car, was significantly lower than before and after installation of the local exhaust ventilation. The WBGT indoors varied within 26° to 31°C, TWA noise levels were within 63 to 90 dBA, and illuminations were within 250 to 988 lux. Sheet metal work task in shop A had noise levels exceeding the standard. Proper ventilation and using respirators during operator work are essential in eliminating health hazards of automobile mechanics. Hearing conservation program could prevent hearing losses.

****