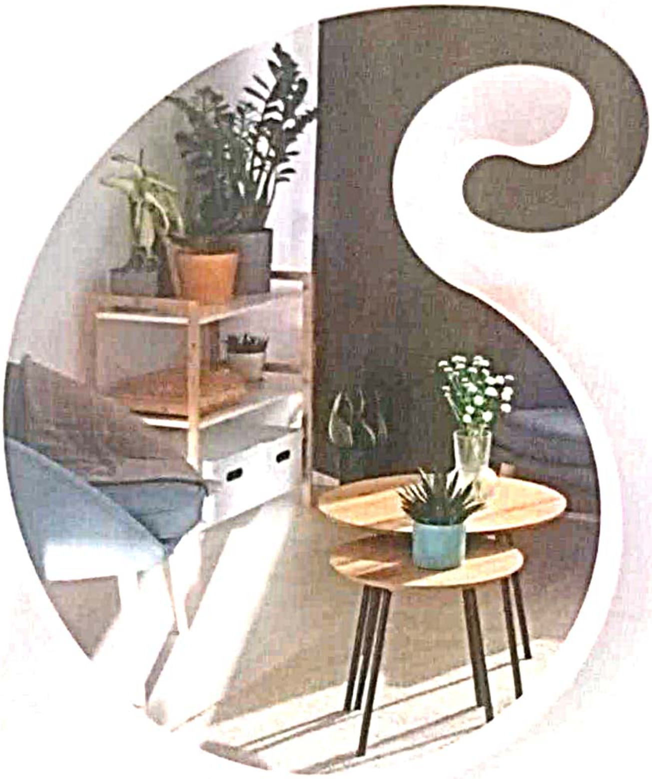
SIE

INDOOR Environmental Quality 2024

National Conclave On Indoor Environment Quality 2024



COMPENDIUM

IEQ-2024: Transitioning From Outdoors to Indoors

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FOREWORD

Dr. Rakesh Kumar
SIE President

It gives me immense pleasure that Society for Indoor Environment (SIE) is organising its First National Conclave IEQ 2024 on 2nd March 2024 at IIT Delhi.

This unique conclave is aimed at understanding Indoor Environmental Quality (IEQ), which is an area less explored in India. This Conclave will create an impetus and initiate a tradition of bringing together researchers, academicians, industry professionals and experts in indoor environmental science and technologies from all over the world.

This conclave will initiate a dialogue amongst all the participants in an informal setting to present and discuss new and current work on Indoor Environment. This compendium is aiming to bring together the recent scientific knowledge with a focus on India in the field of Indoor Environmental Quality.

The conclave has also brought together the distinguished experts such as Prof. Mukesh Khare from IIT Delhi, Prof. Pawel Wargocki from Denmark Technical University, Mr. Ashish Rakheja from ASHRAE, Dr. Amita Athavale from KEM Hospital and Ms. Mili Majumdar from GBCI and many more eminent researchers and scientists, representing all aspects of Indoor Environment ranging from building design, health, productivity, ventilation and thermal comfort.

I am sure SIE organising committee will bring out an excellent knowledge transfer and consistent improvement of application- based scientific temperament through IEQ 2024

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Securing High Indoor Air Quality is a Prerequisite for Healthy Buildings

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Studies have shown that high indoor air quality improves comfort, reduces the prevalence of acute non-clinical health symptoms, improves work performance and learning, and positively affects sleep quality. Avoiding toxic pollutants in indoor environment will also reduce the health risks. High indoor air quality should also be understood as the air that does not increase infection risk, i.e., the air with no infectious pathogens. Despite this knowledge, regulating indoor air quality in buildings appears to create numerous challenges, and it seems less comprehensive than, for example, the requirements regarding the thermal environment.

Often, regulating indoor air quality is achieved by defining ventilation rates and carbon dioxide (CO_2) levels. Is this the right approach? What are the minimum requirements we need to put in place regarding indoor air quality? This talk will attempt to answer these questions and construct the framework for setting air quality guidelines in buildings.

Indoor air quality is probably the most complicated and the least understood regarding which components and contaminants affect human responses, at which concentrations, and in which combination. Indoor air contains thousands of pollutants, which have their sources indoors and outdoors. There are also indoor pollutants that are produced during chemical transformations, which can occur indoors due to reactive species such as ozone or hydroxyl radicals and ultraviolet light.

The definition of all components and their effects on humans seems impossible, especially considering that many new chemicals are introduced to the market daily, and their toxicological information is often unknown or incomplete. Of the 40,000 to 60,000 chemicals in commerce, only 1% has been tested for toxicity, and it will simply be impossible to characterize all of them. Another complication is that indoor pollutants occur at very low concentrations that are difficult to measure even with the traditionally used laboratory-grade instrumentation and require very advanced and expensive instruments for identification.

These complications are the reason why often, when indoor air quality is discussed rather than the actual pollutants and their mixtures, the proxies for the levels of air quality are used, including among others the level of outdoor presumably clean air supplied by ventilation, the concentration of carbon dioxide in occupied spaces, the use of low-emitting materials and local exhaust capturing pollutants at source, or the levels of specific pollutants for which sufficient toxicological information is known including particle matter and a few organic and inorganic pollutants listed by the World Health Organization Air Quality Guidelines.

Air quality is essential when discussing the risks for discomfort and health because breathing the air is one of the dominant exposure pathways. During each breath, 500-600 ml of air is inhaled. Since 10-15 breaths are taken each minute, 5 L to 9 L of air is inhaled or 7 m^3 to 13 m^3 a day. These volumes correspond to 9 kg to 16 kg a day, much more than the daily consumption of water and food, even cumulative, the latter being much strictly regulated concerning the quality, toxic contaminants, and associated risks. Recent studies additionally show that human skin can also be a significant exposure pathway for some pollutants, and considering intake and dose, the contribution to exposure can be at the same magnitude as inhalation. One important matter is that many (if not all) pollutants are invisible, and their effects are often delayed in time.

High indoor quality can only be obtained by ensuring that outdoor air quality, or the air used to ventilate the buildings, is of a high quality. Studies have shown that more than 50% of all chronic health effects attributable to exposure to pollutants in the air are due to exposure to outdoor pollutants inhaled indoors. Buildings are not tight, and pollutants from ambient air are transported indoors. As we spend 80-90% of our time indoors, we inhale outdoor pollutants mainly indoors. Thus, regulating indoor air quality requires regulating outdoor air quality or the pollutants that have sources outdoors. This regulation can be done by having strict regulations regarding outdoor pollution or using a system for cleaning the air supplied indoors. The periods with haze and the pollution generated during wildfires are the best demonstration of the importance of controlling outdoor pollution.

It is often stated that the definition of air quality guidelines is complex. This statement is valid for the reasons provided above. Sometimes, the term complex (difficult) is understood as impossible. But this interpretation is entirely incorrect. We have knowledge that allows us to create the air quality guidelines. Even if imperfect, they will save many lives and improve the quality of life of many. The experience obtained with these guidelines will allow us to improve them. But they must be enforced. If not, and when having no guidelines, no progress will be achieved, and useless discussions will continue.

How do we address Indoor Air Quality in City Level Air Quality Action Plans?

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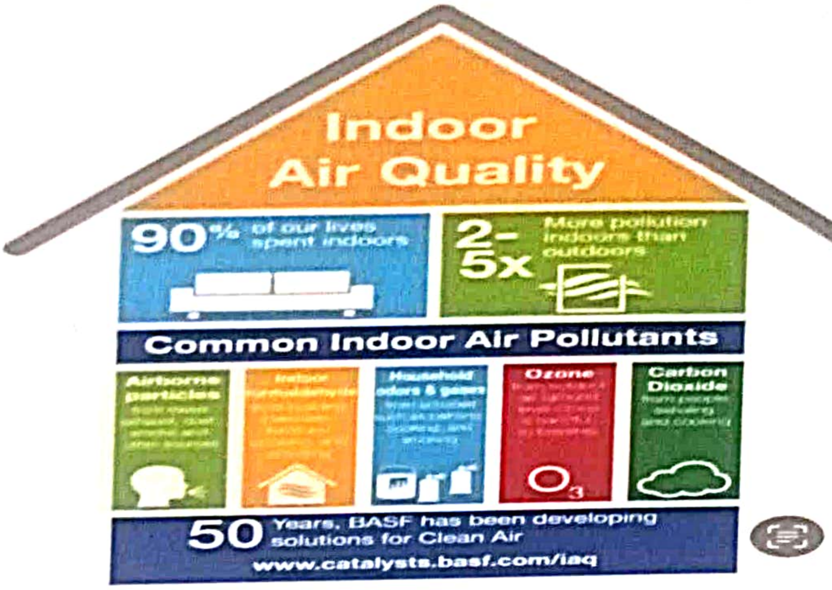
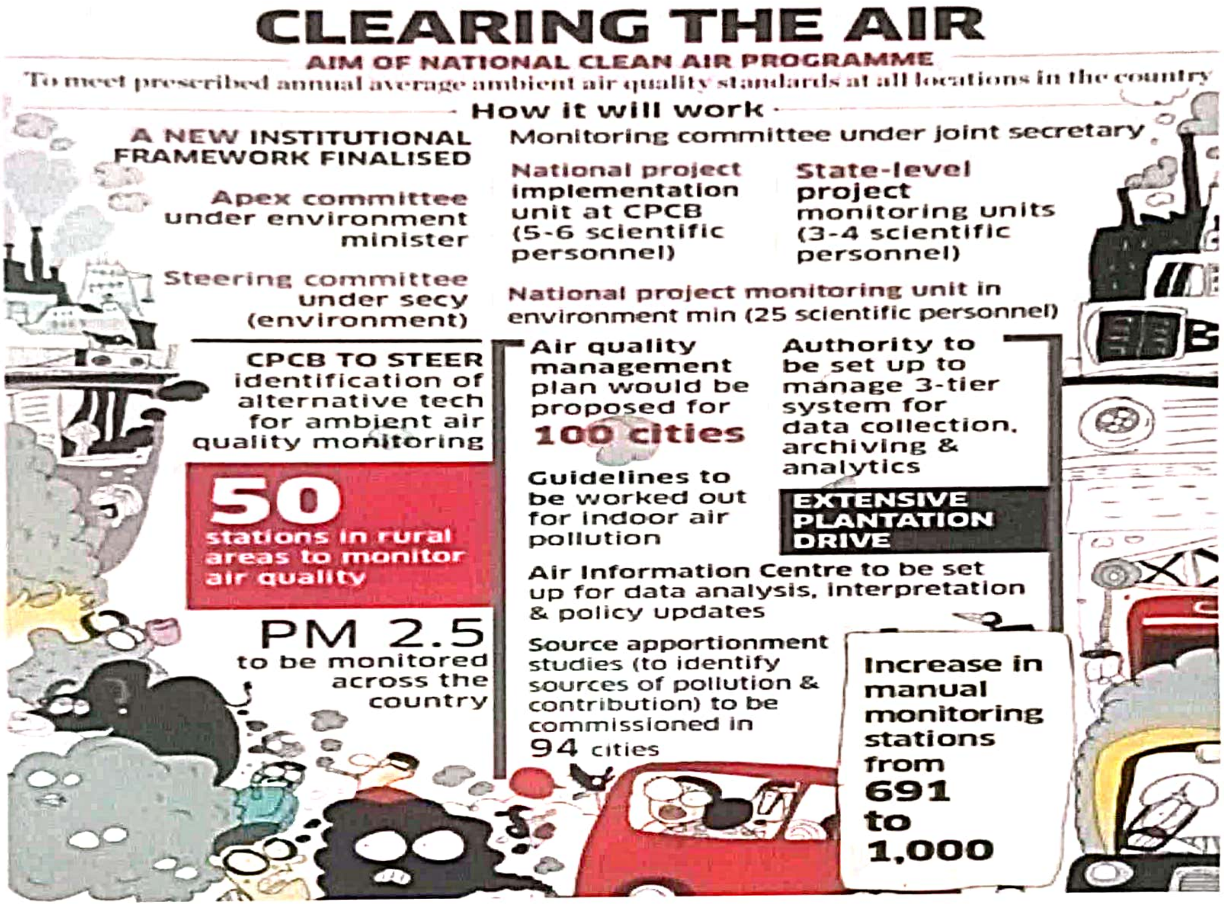


Ministry of Environment, Forest and Climate Change (MoEF&CC) in India launched National Clean Air Programme (NCAP). The NCAP is a mid-term, five-year action plan that includes collaborative, multi-scale and cross-sectoral coordination between relevant Central ministries, State governments and local bodies. The objectives of the plan align with existing policies and programs, including the National Action Plan on Climate Change, initiatives on electric vehicles and the Smart Cities Mission among others.

A budget amounting to Rs 6370 million has been set aside for aiding implementation of the programme. A budget of Rs 3000 million has been allocated for two years to tackle air pollution across 102 cities, that have been identified by the Central Pollution Control Board (CPCB) who do not meet the ambient air quality standards. See the outline of NCAP as depicted below. It may be observed that preparation of guidelines on Indoor Air Pollution has been included in the NCAP. But are the guidelines just enough?



Outline of National Clean Air Programme

Several cities have prepared city level air quality action plans and the approved action plans have been posted on the CPCB website. These action plans essentially address the challenges to combat outdoor or ambient air pollution. None of the action plans address indoor air quality.

We all know that when it comes to the public health, indoor air quality plays an important or perhaps even a dominant role. The action plan needs to address both outdoor and indoor air quality i.e. the plan should be based on an integrated strategy. Afterall, the purpose of preparing clean air quality action plans is to protect the public health. The objective of meeting the ambient air quality standards is only a step in this direction based on a precautionary approach. Mere attainment of outdoor or ambient air quality standards is not assuring or good enough. The question is how to do build such integrated city level air quality action plans.

But first, we have several questions and challenges to address.

We don't know where we are, and we don't know where do we want to go.

For any action plan, one needs to have baseline data and the standards that we want to achieve. On ambient air quality, we have some baseline data (although not necessarily sufficient and reliable) and we have ambient air quality standards prescribed by CPCB. When it comes to indoor air quality, we have neither the baseline data nor the indoor air quality standards. So, we really don't know where we are, and we don't know where we want to go! Remember that limitation is not just the absence of indoor air quality standards, but we require a monitoring protocol for indoor air quality and training given on how to do it. If not done, we will be confronted with a lot of garbage data.

Are Outdoor and Indoor Air Quality Correlated?

There have been numerous studies that show that there is no definitive correlation between indoor and outdoor air quality. Correlations depend on the extent of air exchange, indoor emissions and air circulation inside the house apart from the outdoor air quality. Further, relationships depend on the parameter e.g. correlations are poor for Volatile Organic Compounds (VOCs). So, improving ambient air quality does not necessarily imply a similar improvement in indoor air.

What should be the response strategy? Via Monitoring and Enforcement by Pollution Control Boards or by advocating Normative or Prescriptive Standards?

Given this situation, strategies to manage indoor quality will be to ensure better design of the built structures, reducing of indoor air emissions and installing adequate air circulation and air cleaning systems. You can regulate the above by indoor air quality sensitive architectural and building standards, recommend and discourage certain high VOC emitting materials and install proper air circulation and cleaning systems.

Will this require approval, inspection and monitoring by a State Pollution Control Board? Certainly, this will not be possible and nor practical. For large public places such as theatres, convention centres and sensitive locations such as hospitals, we may ask for a certification on Indoor Air Quality that may state that the place is safe to breath. Commercial complexes like IT parks where the buildings host thousands of professionals, such a certification may be made mandatory. The questions will be what should be the certification criteria, how will the fitness of the built structure for safe indoor air quality be checked, who should be the assessors and certifiers, what will be the certification renewal strategy, and what will be the associated costs? In all the places where such a certificate will be asked, it may be made mandatory to put a real time display of indoor air quality covering key parameters like VOCs, Carbon Dioxide and $PM_{2.5}$, apart from temperature and humidity.

So, how should then the integrated air quality action plan be built? The plan will need some assessment of baseline situation, both ambient and indoor and then identification of prioritized interventions with roles and responsibilities.

For outdoor or ambient air quality, we may look at how to achieve a modal shift to public transport, curb open burning of wastes and industrial emissions, reduce resuspension of road dust, promote cleaner fuels etc. On indoor air quality focus could be enclosed public places (like cinema halls, convention centres), underground metros, schools and hospitals and large commercial complexes. Baseline surveys will have to be done to capture relevant metadata, especially on the potential indoor emissions and on prevalent respiratory illnesses of the occupants. This kind of monitoring will need to get institutionalized to ensure regular upkeep and tracking, something the city administration and pollution control boards are not experienced to do today. We will need to get some of the academic and research institutions involved. That can well be a challenge as we need to do capacity building of these institutions in Indoor air and raise financial resources. The State PCBs who hold substantial funds could fund and agencies like CPCB could provide technical guidance. Organizations like Society for Indoor Environment (SIE) that operate in India can certainly help with its various regional chapters.

Concurrently, we need to evolve national guidelines using NCAP's budget (cited earlier) focusing on indoor air quality. These guidelines should be for architects and builders, interior designers and HVAC system makers. Citizen awareness on indoor air emissions is going to be very important for both mechanically ventilated and naturally ventilated built structures. Information, Education and Communication (IEC) related efforts on this subject should be a part of the city level air quality action plans. Awareness and action could be rather challenging for situations such as congested housing (sometimes called as affordable!) and poorly ventilated slums where dirty fuels are used.

The city level clean action plans may start with indoor air quality certifications as earlier described. Indoor air quality in enclosed public places could be the priority. Such a certification scheme will require a good coordination with all the key stakeholders such as architects and builders, interior designers, HVAC system makers, material suppliers, realty developers and investors, medical doctors, research and academia. The certification schemes will have to established at the national level under NCAP. Each city in their air quality action plans could then come up with its adoption, a roll out plan, listing the "hot spots" and explain how the certification scheme will operate. Let us also know progress on certifications and the impact.

If a cinema hall for instance obtains a certificate on Indoor Air Quality, then it may proudly display on its signage and even print at the backside of the ticket as "Here you can breathe safe". Surely, such a communication will make this Cinema Hall as the preferred theatre by the patrons and people won't mind even paying Rs.10 extra for that assured safety.

To sum up, we need to recognize indoor air quality as an important element in our city level air quality action plans. The approved action plans posted on CPCB's web site today do not address indoor air quality. Let us conduct pilots to demonstrate how to integrate outdoor and indoor air quality, at least in few priority cities as models for other cities to follow.

We need to peep *inside* the box and not just watch the box from outside!

Sometimes, thinking out of the box may not always work!!

challenges, the research advocates adopting air purification systems as a viable and cost-effective solution for immediate IAQ improvement. HEPA filters or electret air purifiers can substantially reduce indoor $PM_{2.5}$ concentrations, representing a practical approach to safeguarding children's health.

Furthermore, the study calls for the widespread implementation of ISHRAE guidelines in schools to ensure a safe learning environment. In the context of increasing respiratory diseases and the COVID-19 pandemic, clean indoor air has become a public health imperative. The economic analysis within the study highlights the affordability of air purifiers, making a solid case for their adoption, especially in schools located in highly polluted areas or near busy roads.

In conclusion, the research presents a compelling argument for urgent action to address IAQ in schools. While mechanical ventilation offers a long-term solution, air purification technologies provide an accessible means to significantly improve air quality in the short term, with considerable health benefits for students. This calls for a concerted effort from policymakers, school administrators, and the community to prioritize investments in air purification technologies, underscoring all students' fundamental right to clean air. As the world continues to confront air pollution and its wide-ranging impacts, studies like this offer invaluable insights and practical solutions to protect vulnerable populations in educational settings, advocating for a healthier, more productive future for our children.

There is a pressing need for further research focusing on the chemical characterization of particles and their health impacts, as well as the influence of meteorological factors and land-use patterns around schools on IAQ. Identifying and implementing sustainable methods to achieve and maintain healthy IAQ will be crucial, emphasizing optimizing air purification strategies and managing outdoor-indoor air exchange effectively. In addressing these challenges, we can make significant strides towards ensuring the well-being and development of students in a clean and conducive learning environment.

This article summarizes the technical paper titled "Health benefits to vulnerable populations by meeting particle-level guidelines inside schools with different ventilation conditions", published with the DOI 10.1080/09603123.2024.2305223. Readers should refer to the DOI link for detailed insights and data supporting the study's conclusions. For further details and a deeper understanding of the study's methodology, results, and implications, readers are encouraged to access the full article via the DOI link.

BIOAEROSOL

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Bioaerosols are airborne particles that originate from biological sources including animals, plants, fungi, bacteria, protozoa, and viruses which may originate from surrounding environment or plant pollen, algae, fungal spores or bacteria .Droplets produced during coughing and sneezing may also contain bacterias and viruses, dust containing insect excreta, animal dander, and fragments derived from each of these sources.

Health Impacts

Diseases Caused by Bioaerosols: Exposures to bioaerosols in the occupational environment are associated with a wide range of health effects with major public health impact, including infectious diseases, acute toxic effects, allergies and cancer.

- Hypersensitivity or Allergic Diseases: result from exposure to antigens (of indoor bioaerosols) that stimulate an allergic response by the body's immune system.
  - Building-related asthma
  - Allergic rhinitis. Can be caused by indoor bioaerosols and airborne fungi such as: (glycoprotein from fungi, proteases (digestive enzymes that cause the breakdown of proteins) or from bacteria or due to ragweed pollen, dust mites and dander from cats.
- Diarrhea & GIT infections
- Bronchopneumonia /COPD
- Opportunistic infections in immunocompromised patients or with malignancy
- Meningoencephalitis

Respiratory symptoms and lung function impairment are the most widely studied and probably among the most important bioaerosol-associated health effects. Workers in livestock feed processing have an increased risk of liver cancer as well as cancers of the biliary tract, salivary gland and multiple myeloma. Exposure to wood dust and various specific cancers, in particular sinonasal cancer in furniture making

Other agents like bacterial cell wall components, endotoxin or peptidoglycans are agents with important pro-inflammatory properties that may induce respiratory symptoms.

Latex allergens have received extensive attention during the last decade with high numbers of health and hospital workers being sensitized due to the use of latex gloves produced from sap from the rubber tree .

Hospital	Community (household)
Covid-19, Influenza	Covid-19, influenza, rhinovirus, chickenpox, measles,
Multidrug resistant bacteria. Legionella	Bacteria, TB
Fungal (yeast, mould)	Fungi (mould)
Particulate matter	Soil parasites
Nitrogen dioxide	Ozone
Heavy metal	Carbon monoxide
Mineral	Nitrogen dioxide
Phthalate	Particulate matter
Anesthetic gases	VOC
Disinfectants	Dust

Important pathogens contained in bioaerosols are:

- SARS CoV 2
- Influenza
- Respiratory syncytial virus
- Diphtheria
- chickenpox
- TB
- Measles
- Mucorales
- Aspergillus

Monitoring methodology

- Not one sample is good for collecting all types of microorganisms
- No sampling device provides for 100% recovery of bioaerosols
- Viability of bioaerosol samples should be maintained in the sampler for subsequent growth and identification
- Efficiency of the sampler depends on the size of the particular organism

Culture-based methods

Airborne exposure to microorganisms in the environment can be studied by counting cultural propagules in air samples (or in settled dust samples). Sampling of cultural bioaerosols is basedon impactor, liquid impinger or air filtration methods. After sample collection, colonies of bacteria and fungi are grown on culture media at a defined temperature over a 3–7-day period. Colonies are counted manually or with the aid of image analysis techniques.

Non-culture-based methods : Sampling of non-cultural bioaerosols is generally based on air filtration or liquid impinge methods .Antibody-based immunoassays, particularly enzyme linked immunosorbent assays (ELISA) are widely used for the measurement of aeroallergens and allergens in settled dust in buildings.

Standards settle plate method is commonly used method in hospitals especially to monitor air quality of Operation Theatres and ICUs .The **ISO 17025** and MCERTS accredited to the Environment Agency's Standard Reference Method: Index of microbial contamination categorizes the IMA into the following category:

IMA: 5: ultra clean room (ortho, surgery, neuro OT)

25: ICU, OT

50: wards, hospital kitchen

75: other facilities

Major areas for monitoring

- Surgery wards, aseptic rooms, Operation Theatres, Medical wards

- If worker exposures are being evaluated, then the samplers should be placed in areas occupied by the workers. If contamination of a ventilation system is being examined, then sampling in the system and at the ventilation louvers would be appropriate.
- Indoor bioaerosol sampling is conducted in occupational (industrial, education, and office environments) and non-occupational (residential and buildings) settings. Outdoor bioaerosol sampling is often performed to provide comparative data for indoor sampling and to help determine possible sources of contaminants.

What are the building types that would require IAQ protocol ?

Bioaerosol monitoring can be important in various types of buildings, especially those where the presence of bioaerosols may pose health risks or impact indoor air quality. The specific building types to be considered for bioaerosol monitoring include:

1. Healthcare facilities- Hospitals, Clinics, Nursing homes, Day Care centres for Oncotherapy, physiotherapy clinics etc.
2. Laboratories- Research laboratories, particularly those working with pathogenic microorganisms or biohazardous materials.
3. Biotechnology facilities- Facilities engaged in bioprocessing, biomanufacturing, or genetic research.
4. Pharmaceutical Production Facilities: In pharmaceutical manufacturing, bioaerosol monitoring is essential to maintain product sterility and prevent cross-contamination.
5. Food Processing Plants: To ensure product safety and prevent contamination by microorganisms especially bacteria and molds.
6. Farms and Agricultural settings- Farms and agricultural facilities may need bioaerosol monitoring, especially in areas where there is a risk of airborne pathogens or allergens from animals, crops, or soil.
7. Wastewater treatment plants- As these facilities can release potentially harmful bioaerosols, design of these buildings and areas should follow a particular protocol.
8. High occupancy and high traffic areas- Airports, bus terminals, and train stations may consider bioaerosol monitoring to reduce the risk of disease transmission in high-traffic areas.

Educational Institutions: Schools, colleges, and universities.

Indoor recreational facilities such as swimming pools, gymnasiums, recreational centres, auditoriums etc. These areas are prone to have high humidity and also poor ventilation.

Industries, manufacturing hubs, malls etc.

Are there any building design aspects to be considered for controlling bioaerosols indoors

Controlling bioaerosols indoors is important for maintaining a healthy and safe indoor environment. The specific measures required will depend on the nature of the activities conducted in the building and the level of bioaerosol risk. Building design and HVAC (Heating, Ventilation, and Air Conditioning) systems can play a significant role in minimizing the spread of bioaerosols. Some aspects which need to be considered are:

1. **Ventilation system**- ventilation system should be such that there is a high rate of air exchange. To dilute the bioaerosols and to be periodically removed from the indoor air. There should be a periodic sufficient intake of outdoor air to dilute the indoor air, at the same time maintenance of a well-sealed building should be considered if required according to the prevailing air quality standards. Specific high bioaerosol areas such as isolation rooms for infectious patients should be negative pressure areas so that contaminants do not go into the adjacent areas.

2. **Airflow management**- In healthcare settings there has to be provision for airflow regulation. The airflow should be designed in a manner that there is minimal recirculation of air from potentially contaminated areas to clean areas. This can include using laminar airflow systems and directional airflow. Creation of Isolation Zones: Distinct zones in a hospital building and laboratories, with varying ventilation and pressurization levels to prevent cross-contamination.

3. **Filtration system**- High-Efficiency Particulate Air (HEPA) Filters to be used which can capture and remove small particles, including bioaerosols. Ultraviolet Germicidal Irradiation (UVGI) systems should be installed to disinfect the air and surfaces to reduce the viability of bioaerosols.

4. **Design and layout of rooms**- Separate infection control zones in healthcare buildings. For example, there can be ante rooms for entry and exit from areas with high bioaerosol risk to prevent the spread of contaminants.

5. **Surface materials to be used**- Easy-to-clean, non-porous surfaces should be used to minimize the accumulation of bioaerosols on surfaces.

6. **Space design according to usage**- The spaces especially the waiting areas should be so designed so as to prevent overcrowding, as higher occupancy can lead to increased bioaerosol generation and transmission.

7. **Installation of Monitoring Systems**- Monitors which effectively display real-time monitoring of air quality, temperature, humidity, and pressure differentials, which can help in early detection of bioaerosol-related issues. With advanced technology the availability of automated control systems can be explored which can adjust ventilation and air treatment processes based on detected bioaerosol levels.

8. **Safe and efficient disposal systems and areas**- In facilities handling biohazardous materials, provide safe disposal systems for contaminated materials, and design spaces to facilitate safe handling and disposal.

Environmental Tobacco Smoke's (ETS) Effects on Pregnancy Studies

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Exposure to tobacco smoke that comes from tobacco products is referred to as environmental tobacco smoke. Similar to how taking heroin and cocaine may lead to addiction, smoking cigarettes and other tobacco products that contain nicotine can also have negative effects. The substance that is mostly to blame for a person's addiction to tobacco products, including cigarettes, is nicotine [C10H14N2], which is found naturally in the tobacco plant. However, tobacco firms purposefully add enough nicotine to cigarettes to foster and maintain addiction. Smoking during pregnancy increases the chance of miscarriage, ectopic pregnancies, preterm births with unusually low birth weights, and other consequences. Additionally, smoking before, during, or after pregnancy increases the chance of Sudden Infant Death Syndrome (SIDS) in an unborn child. The fallopian tubes may constrict as a result of nicotine usage, which may hinder an embryo from passing through. In my lecture, I'll go through several strategies for fending off the impulse to smoke or use tobacco when a craving occurs.

Introduction

Introduction Environmental tobacco smoke (ETS) is the term used to describe being exposed to tobacco smoke from someone else's cigarette, cigar, or pipe, rather than through your own smoking (Maziak et al. 2006). Smoking reduces a baby's oxygen supply, hence ETS is also known as the substance from tobacco smoke that is present in indoor air. A fetus's growth and development are hampered by a shortage of oxygen, which increases the risk of issues including miscarriage, stillbirth, low birth weight, and many more (Grzeszczak et al. 2023). Children born to pregnant non-smokers who were exposed to ETS both inside and outside the house had lower birth weights than those born to mothers who weren't exposed. Therefore, a woman must stop smoking in order to protect both the mother and the child from the potentially fatal effects of smoking (Amos et al. 2012).

Secondhand Smoke

The mixture of smoke from a burning cigarette and smoke exhaled by a smoker is secondhand smoke, also known as passive smoke or ambient tobacco smoke (Schramm et al. 2014).

- Compared to the smoke that the smoker inhales, the smoke that burns off the end of a cigarette or cigar actually includes more dangerous elements (tar, carbon monoxide, nicotine, and others).
- Even if a pregnant woman doesn't smoke, she inhales deadly compounds like arsenic, formaldehyde, and hydrogen cyanide every time someone else in the home smokes, and what mom breaths, her baby breathes.
- The fetus is exposed to many of the same dangers that would arise from the mother's smoking during pregnancy, including low birth weight, early birth, respiratory issues, and an increased chance of SIDS (Ali et al. 2012).

Composition of Cigarette

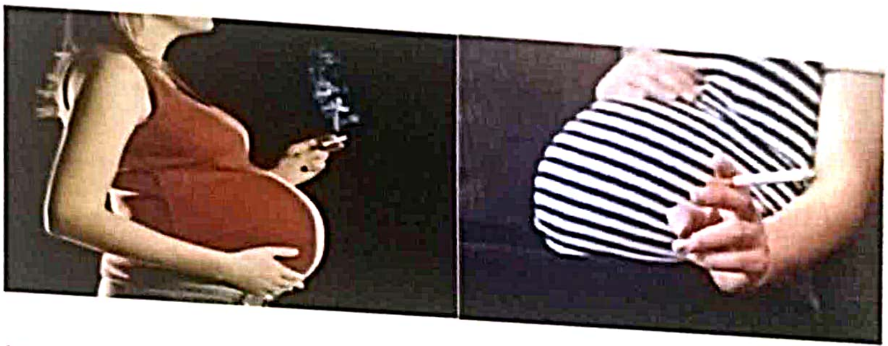
- Nicotine
- Carbon monoxide (CO)
- Irritants
- Tars

Harmful Chemicals Present in Cigarette

- Each cigarette contains more than 4,000 different compounds. Some of the most hazardous are listed below (Ding et al. 2007):
- Ammonia – This increases the pace at which nicotine is absorbed.
- Arsenic – This substance, which is used to protect tobacco plants from pests, is still present in the smoked product.
- Cadmium - Acidic soil is where this metallic component of tobacco is found.
- Formaldehyde – This cigarette smoke byproduct is the same colorless gas that is frequently employed to preserve corpses for burial.

- Acetone is a result of cigarette combustion that is also a component of nail polish remover.
- Butane is a byproduct that is also utilized as a component of lighter fluid to assist in cigarette lighting.
- Propylene Glycol is used to prevent tobacco from drying out and to hasten nicotine absorption in the brain.
- Turpentine: This gives menthol cigarettes a taste.
- Benzene— another result of cigarette combustion, it is present in gasoline and insecticides.
- Lead and nickel are examples of metals (Abdel-Shafy et al. 2016).

Harmful Effect of Smoking in Pregnancy



- Smoking during pregnancy endangers both the mother and the unborn child. Nicotine, CO, and tar are among the hazardous substances found in cigarettes. Smoking greatly increases the chance of difficulties during pregnancy, some of which can be deadly to the mother or the unborn child. Quitting smoking should be a top goal for mothers who wish to become pregnant.
- Smoking can prevent a woman from ever becoming pregnant. Smoking has a negative impact on the health of the unborn child even in the first trimester. In comparison to nonsmokers, smokers are nearly twice as likely to experience reproductive problems in both genders.
- The fetus is equally as vulnerable from secondhand smoking.

- She continued to smoke during the final three months of pregnancy. Nicotine makes problems worse by narrowing blood arteries throughout a woman's body, including the umbilical cord, making quitting the only effective approach to prevent pregnancy difficulties related with smoking (Chidozie et al. 2014).

king Reducing the Risk of Preeclampsia

Smoking is the only environmental exposure that is consistently associated with a lower risk of preeclampsia and gestational hypertension, despite the fact that smoking during pregnancy can have a number of negative consequences, including fetal growth restriction, placental abruption, stillbirth, and premature labor.

- Smoking during pregnancy reduces the incidence of preeclampsia but not the usage of smokeless tobacco (Wikström et al. 2010).

Ways to Help You Resist the Urge to Smoke or Use Tobacco When a Tobacco Craving Strikes

- Nicotine replacement treatments, such as nicotine gum, lozenges, sprays for the nose, or inhalers, can aid in overcoming strong cravings.
- Avoid setting yourself up for a smoking relapse by avoiding triggers. For instance, if you typically smoked while on the phone, bring a pen and paper close by so you may draw instead of smoking.
- Delay: Tell yourself you need to wait 10 more minutes, then do anything to pass the time by diverting your attention. Consider visiting a public, smoke-free area.
- Chew on it – Give your mouth something to do to stave off a need for cigarettes.
- Getting active, like as jogging up and down the stairs several times, can help you conquer your want to smoke. Go for a jog or a walk outside.
- Engage in relaxation activities including deep breathing, muscular relaxation, yoga, visualization, massage, or peaceful music (Wilson et al. 2015).

Smoking Cessation Immediate Health Benefits

- Blood pressure and heart rate, which are excessively high while a person smokes, start to return to normal.
- The blood's concentration of carbon monoxide starts to fall after a few hours.
- (Carbon monoxide decreases the capacity of the blood to transport oxygen.)
- People who stop smoking experience better circulation, decreased phlegm production, and less coughing and wheezing within a few weeks.
- After quitting smoking, patients can anticipate noticeable improvements in lung function within a few months.
- People will have decreased chances of cancer, heart disease, miscarriage, stillbirth, and other chronic diseases within a few years of stopping than if they had continued to smoke (Pezzuto et al. 2023).

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Monitoring Indoor Air PM 2.5 Concentration in Households for Different Cooking Energy Sources using Low-cost Sensors in Surat City, India

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Indoor air quality (IAQ) is a leading public health concern, particularly for households with high pollution levels. The main objective of this study was to measure indoor air $PM_{2.5}$ concentrations in two households (HS1 and HS2) for liquified petroleum gas (LPG) and Electric stoves as cooking energy sources using low-cost sensor monitors in Surat City, India. In the study, both households adhered to a consistent weekly menu with identical cooking times. HS1 used LPG in week 1 and an electric stove in week 2, while HS2 followed the reverse pattern. According to the findings of the household study, both households showed poor indoor air quality, with higher levels of $PM_{2.5}$ during and after cooking. However, the average diurnal variations in indoor air $PM_{2.5}$ were relatively low during night time (00:00H) to morning (09:00H) and around midday (from 16:00 to 19:00H). The mean $PM_{2.5}$ concentrations when using LPG stoves were 71.4 and 73.3 μg/m^3 for households HS1 and HS2, respectively, each week. Conversely, the mean $PM_{2.5}$ concentrations for electric stoves were 64.2 and 65.7 μg/m^3 in the respective weeks. The study shows that using LPG resulted in nearly 10% higher $PM_{2.5}$ concentrations than using an electric stove. This study emphasizes the pressing requirement to tackle indoor air pollution in India and highlights the ability of low-cost sensors to provide information on this vital issue.

Keywords Cooking · Collocation study · Indoor air · Low-cost sensor · $PM_{2.5}$ · Surat city

Introduction

Indoor air quality (IAQ) is an important public health concern, particularly in households with high pollution levels. Poor IAQ can cause respiratory and cardiovascular problems, allergies, and other health problems (Brook et al. 2010; Miller 2018). However, in many parts of the world, including India, indoor air quality monitoring is not widely practiced, and people are often unaware of the potential risks associated with poor IAQ. Unlike national ambient air quality standards in India, there are no indoor air quality standards for IAQ monitoring for indoor environments. Indoor fine particulate matter (PM) concentration, with an aerodynamic diameter less than 2.5 μm ($PM2_{.5}$) in low and middle-income countries is significantly higher than in high-income countries (Chafe et al. 2014; Lim et al. 2022). Additionally, it is worth noting that most of the indoor air quality studies that have characterized $PM_{2.5}$ levels were conducted in developed countries, while there is a scarcity of such studies in low and middle-income countries, including India, which is one of the most populous countries (Bu et al. 2021; Ilacqua et al. 2022). Senior citizens, non-working women, and young children under the age of six, who spend a significant portion of their time indoors, are particularly susceptible to the adverse effects of indoor air pollution (Morawska et al. 2013; Saini et al. 2020).

The fact that PM is increasingly recognized as a main contaminant in indoor and outdoor environments may account for the scientific community's increased interest in this field (Morawska et al. 2017). PM_{10} and $PM_{2.5}$ exposure are well-established contributors to detrimental human health effects, possibly adding to the attraction. $PM_{2.5}$ is known to cause various environmental and health problems, such as heart attacks, reduced lung and cognitive function, and premature death (U.S. EPA 2009; Shah et al. 2013). Additionally, the availability of more affordable, reliable, and user-friendly PM sensors may have contributed to the increased interest in studying this pollutant (Hegde et al. 2020; Giordano et al. 2021; Zaman et al. 2021; Sá et al. 2022; Reis et al. 2023). While they may not provide the same level of accuracy as more expensive professional-grade equipment, low-cost sensors (LCS) can still provide valuable information about IAQ in homes and other indoor environments (Snyder et al. 2013; García et al. 2022; Kortoçi et al. 2022).

Indoor air quality is severely compromised during cooking activities, especially in developing nations. This is due to conventional cooking energy sources, inadequate ventilation, and increasing use of edible oil with frying activities. The dependence on biomass and coal for cooking has significantly reduced in India due to economic growth and government initiatives such as the Pradhan Mantri Ujjwala Yojana (PMUY), which provides free Liquified Petroleum Gas (LPG) connections to families below the poverty line. In India, 95% of households in urban areas use LPG as their primary cooking energy source (Mani et al. 2021). While LPG has emerged as the major cooking fuel in India, indoor air quality has only been moderately improved and still falls far short of the limits prescribed by the World Health Organization. An electric stove is an important cooking energy source that produces nearly zero emissions in indoor environments. The only emissions generated are from the food being cooked itself (Khan 2021). The majority of IAQ studies have been conducted on biomass and LPG as cooking energy sources (Burgos et al. 2013; Li et al. 2016; Islam et al. 2022; Munyao et al. 2022). The electric stove, on the other hand, has received less attention from researchers due to concerns about the production of electric energy using non-renewable sources. However, solar energy and other renewable energy alternatives are becoming increasingly available for household energy use, particularly in developing countries.

The objective of this study was to measure the indoor air PM2.5 concentrations in households for LPG and Electric stoves as cooking energy sources using LCS monitors in Surat City, India. The findings of this study can help raise awareness about the importance of indoor air $PM_{2.5}$ monitoring and provide valuable information to individuals and households about how to improve their indoor air quality.

Methodology:

Study site

The study was conducted in Surat, India's eighth-largest city, on the banks of the Tapi River. Surat City has a population of about 6 million and is well-known for its strong diamond and textile industries. The study was over a two-week period in January 2023. The indoor air $PM_{2.5}$ concentrations were measured in the two households at Raman Bhavan Family (RBF) Hostel (21° 9' 45.15'' N, 72° 47' 18.46'' E), Sardar Vallabhbhai National Institute of Technology (SVNIT) campus, Surat. Also, for ambient $PM_{2.5}$ concentration, we have used the data from the Central Pollution Control Board (CPCB), Continuous Ambient Air Quality Monitoring Stations (CAAQMS) located at the Science Center, Surat (21° 10' 9.15'' N, 72° 47' 45.84'' E). In the two-week study, from 08th to 21st January 2023, indoor air $PM_{2.5}$ concentrations were measured in two households at RBF Hostel in the SVNIT campus, Surat. Each family in this hostel has a single room (approx. 30 m^2) that includes a kitchen, a bedroom, and an attached toilet-bathroom. The two households selected for study are located on the second floor and separated by a 25 m. In both households, there is a family of two nonsmokers.

Low-cost monitor

Factory-calibrated PurpleAir PA-II monitors (cost ~ USD 250) were taken for this study. They can measure particulate matter, pressure, relative humidity, and temperature. PurpleAir monitors are used in many places worldwide as a developing technology because of their good performance at a lower cost (Singer and Delp 2018; Romero et al. 2020; Liang et al. 2021). PurpleAir sensors utilize laser particle counters to compute the number of particles across various sizes, including 0.3, 0.5, 1, 2.5, 5, and 10 µm. By analyzing this count data, the sensors calculate mass concentrations of PM1.0, $PM_{2.5}$, and PM10. The PurpleAir monitor consists of two Plantower PMS5003 sensors, labelled channels A and B, which alternate every 10 seconds to provide 2-minute averaged data. This monitor employs laser counters to measure particulate matter in real time. A laser counter operates by drawing a sample of air through a fan and passing it by a laser beam. Airborne particles reflect light from the laser beam onto a detection plate, similar to dust shimmering in a sunbeam. The detection plate registers the reflection as a pulse, where the pulse duration determines the particle size and the number of pulses determines the particle count (Sayahi et al. 2019; PurpleAir 2022).

Household study

A two-week study was performed in both households using two PurpleAir monitors. PurpleAir monitors were placed 1.5 m above floor level in each household. The two main ventilation sources were the balcony door and a window next to it, both open during the study period. The study was performed using two different cooking energy sources, LPG and Electric stoves. In this study, individual households followed a common cooking menu every week, and the cooking time for breakfast, lunch, and dinner for weeks 1 and 2 was considered the same in both households. Fig. 1 shows the experimental plan for the household study during weeks 1 and 2. Household number 1 (HS1) uses LPG for cooking during the first week of the study and switches to an electric stove for the second week. Likewise, household number 2 (HS2) uses an electric stove during the first week and switches to LPG for the second week. All other activities, such as burning incense sticks and candles, were not performed during the study period.

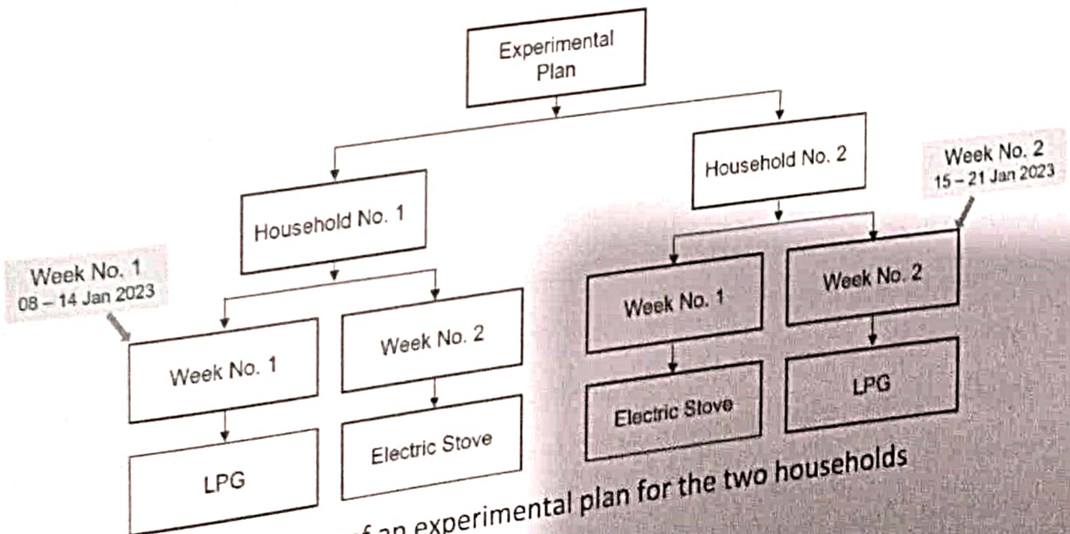


Fig. 1 Summary of an experimental plan for the two households

Results and Discussion

In this section, real-time indoor air PM2.5 concentrations of two Indian households using two different cooking energy sources (LPG and Electric stove) were analyzed. Both PurpleAir PA-II monitors worked without failure with respect to collecting data for a two-week study period except in the HS2 once it was adjusted. In HS2 two hours of data were missing due to a Wi-Fi connectivity issue.

The distribution of $PM_{2.5}$ concentrations resulting from using LPG and electric stoves as cooking fuel in two households is illustrated in Fig. 2. The box represents the interquartile range (IQR), indicating the range within which the middle 50% of the data falls. Whiskers extend from the boxes, depicting the minimum and maximum values within 1.5 times the IQR. Any data points outside this range are considered outliers and are plotted individually. This box plot enables a clear comparison of $PM_{2.5}$ concentrations between LPG and electric stoves, aiding in evaluating their relative impact on indoor air quality and potential health risks in households. The median $PM_{2.5}$ concentration for LPG and electric stoves is similar, as indicated by the horizontal lines within their boxes on the box plot. The interquartile range for the LPG is also wider, indicating greater variability in $PM_{2.5}$ concentrations. The whiskers of the LPG box plot extend to higher values, indicating the presence of outliers with significantly higher $PM_{2.5}$ concentrations. Conversely, the box plot for the electric stove exhibits a narrower interquartile range, suggesting relatively lower and more consistent $PM_{2.5}$ levels.

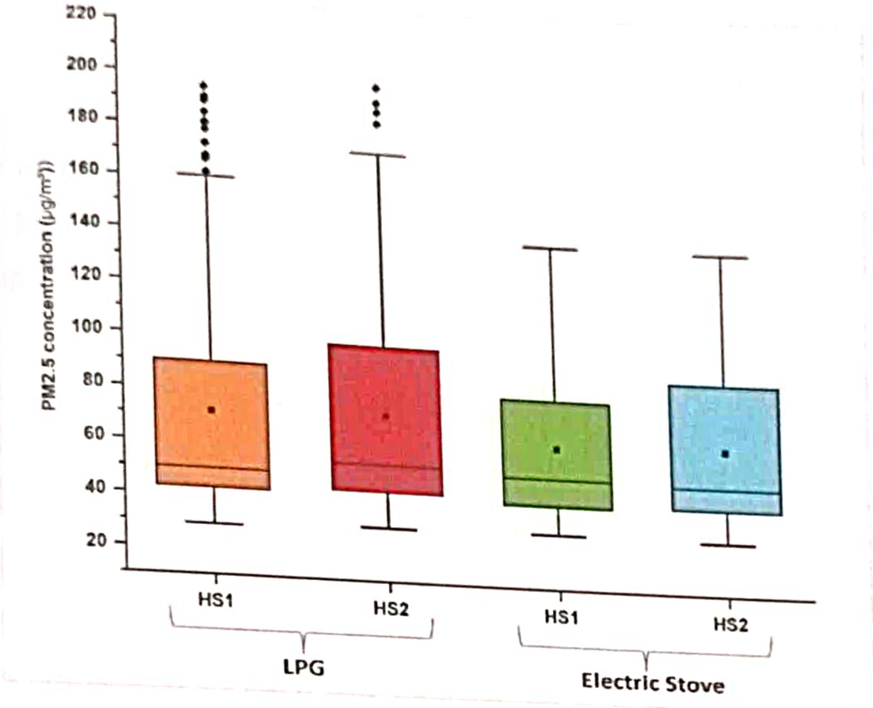
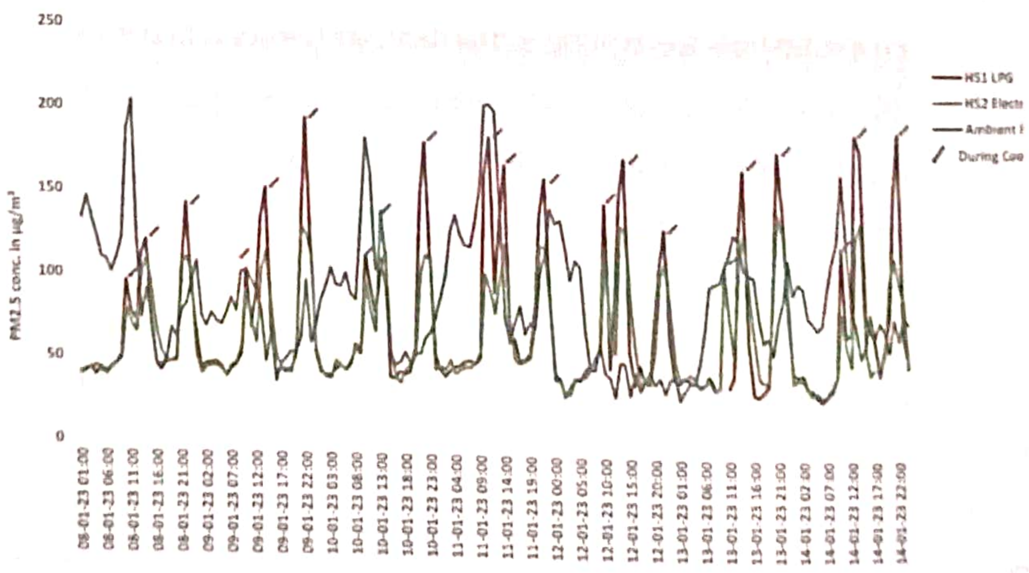


Fig. 2 Summary of $PM_{2.5}$ concentrations.

The boxes indicate the 25th percentile (lower edge), median (solid line), mean (square dot), outliers (rhombus), and 75th percentile (top edge).

Hourly $PM_{2.5}$ concentrations in indoor air (LCS monitors) HS1 and HS2 at RBF hostel and ambient air (CAAQMS) are shown in Fig. 3. The CAAQMS Science center is located 950 meters away from RBF hostel, SVNIT campus. LPG is employed for cooking in the first week of HS1, while in HS2, an electric stove is utilized. The concentration of PM $_{2.5}$ particles can be observed in Fig. 3(a). Similarly, HS1 switches to an electric stove for cooking, whereas HS2 switches to LPG in the second week, as illustrated in Fig. 3(b). Cooking activities are performed during specific time slots: from 09:00 to 09:30 in the morning for breakfast, from 12:00 to 13:00 in the afternoon for lunch, and from 20:00 to 21:00 in the evening for dinner. These timings are maintained consistently for the study duration in both households. This study was conducted during the winter season when ambient air quality in Indian cities is typically at its poorest. Figure 3 demonstrates that indoor $PM_{2.5}$ levels while using LPG are nearly equal to or even higher than ambient $PM_{2.5}$ levels during and after cooking. However, indoor $PM_{2.5}$ levels are considerably lower than ambient levels outside of cooking times. In 2022, India's average ambient air $PM_{2.5}$ concentration would be 10.7 times higher than the WHO annual air quality guidelines (WHO 2021; IQAir AirVisual 2022). This research highlights that people using LPG stoves in both households are exposed to higher PM2.5 concentrations than electric stoves, which poses a significant health risk.

During two weeks, indoor PM2.5 concentration levels were measured in µg/m³, with different cooking fuels and household locations. In Week 1, LPG cooking in Household 1 (HS1) yielded an average PM2.5 level of 71.4 ± 43.01 µg/m³, while an electric stove in Household 2 (HS_2) had a slightly lower level of 65.7 ± 30.15 µg/m³. In Week 2, when HS1 used an electric stove, the $PM_{2.5}$ concentration decreased to 64.2 ± 29.71 µg/m³, and in HS2, where LPG was used,it increased to 73.3 ± 40.25 µg/m³. Figure 3 illustrates that in each household maintaining the same cooking menu both weeks, $PM_{2.5}$ concentrations are higher when LPG is used as the cooking fuel than an electric stove. When considering the average $PM_{2.5}$ concentrations throughout the study period, using LPG resulted in nearly 10% higher $PM_{2.5}$ concentrations than using an electric stove. Li et al. (2022) reported, that replacing LPG/natural gas with electricity is cheaper but only offers a 10-20% environmental benefit, costing 1.5 times more. In India, the government should develop a program that encourages households to use electricity from renewable energy sources for cooking to promote clean energy while reducing the LPG subsidy..



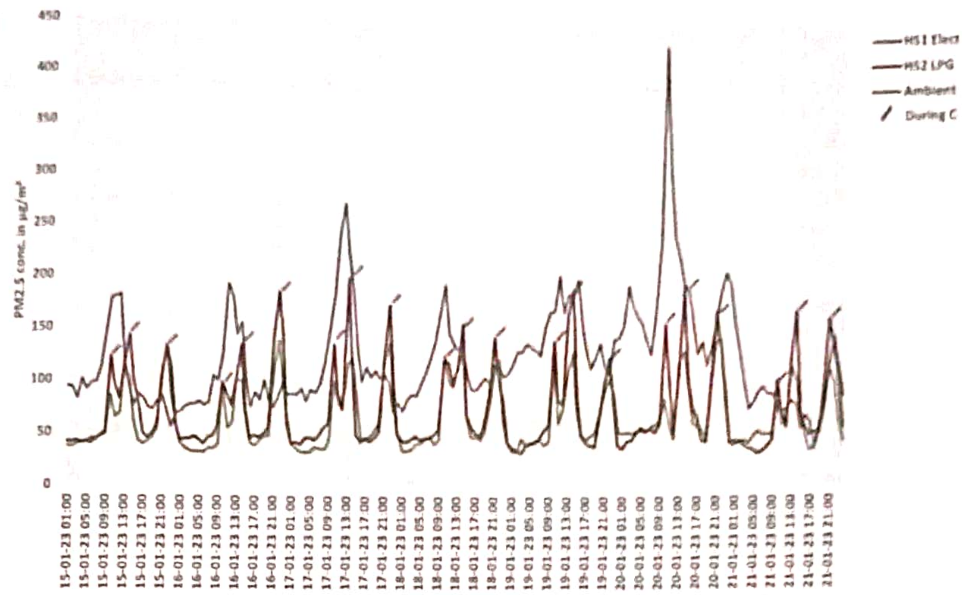


Fig. 3 Hourly variation of $PM_{2.5}$ concentration ($\mu g/m^3$) over the study period representing (a) Week No. 1 and (b) Week No. 2.

Fig. 4 shows diurnal variations in $PM_{2.5}$ concentrations during the two-week study period, using LPG and electric stoves as cooking fuels. It is observed that variation in $PM_{2.5}$ concentrations was relatively low during night time (00:00H) to morning (09:00H) and around midday (from 16:00H to 19:00H). However, high and diverse levels of $PM_{2.5}$ are detected during and after cooking periods, particularly in the morning, at noon, and in the evening. These findings align with the activity patterns of the residents.

Small-volume kitchens (<3 m^3) accumulate particulate matter and carbon dioxide faster due to limited space for dispersion, while large-volume kitchens (>45 m^3) have lower carbon dioxide levels and three times higher ventilation rates, allowing cooking emissions to disperse effectively (Kumar et al. 2022). Approximately 25% of households in India reside in homes with an area smaller than 30 m^2 (NSSO 2023). As a result of the compact size of these homes, households are more susceptible to the pollutants generated from cooking activities, leading to increased exposure. The peaks observed in $PM_{2.5}$ concentrations during cooking activities necessitate effective strategies to minimize exposure and safeguard the health of households. By promoting cleaner cooking fuels, improving ventilation, and raising awareness about the health risks associated with indoor air pollution, citizens can strive towards healthier kitchen environments and ensure the well-being of individuals and families (Haines et al. 2013; Carlsten et al. 2020).

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Breathing Easy: The Transformative Impact of Good Indoor Air Quality on Human Health

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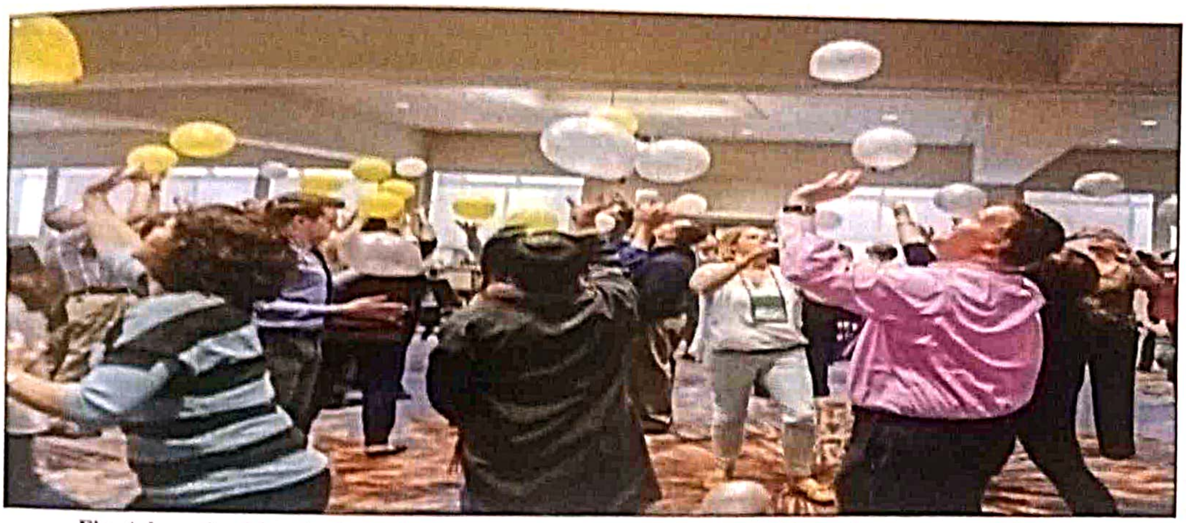


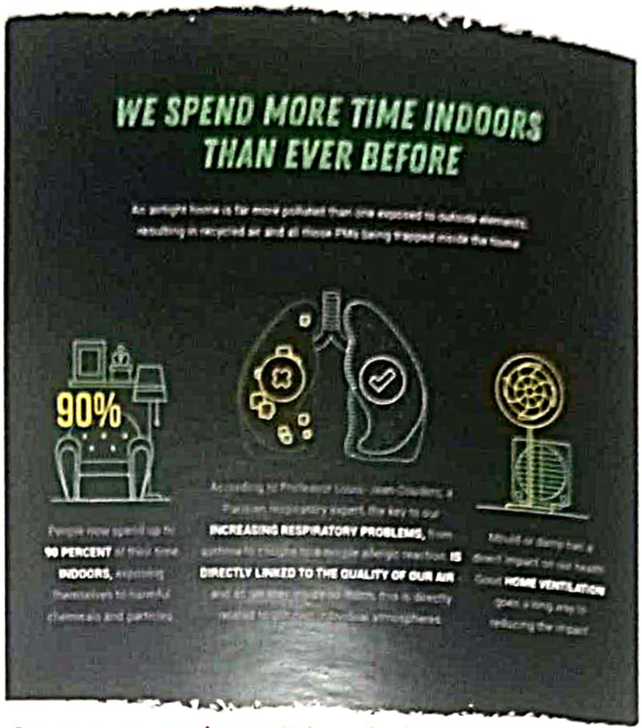
Fig. A breath of fresh air for indoor , Image source **:https://blog.outbackteambuilding.com/**

Introduction: In moment's presto- paced world, where technological advancements and comfort have come central to our lives, we constantly overlook a critical aspect of our well- being inner air quality(IAQ). modern mortal homes are designed to offer convenience and aesthetic appeal because — inner pollution is a truly serious problem and health trouble, not just in India but worldwide ", says Sieren Ernst, author of environmental consultancy Ethics and Environment[1]. — utmost people spend 90 of their time outside, and the exposures that weare getting from that time remain largely unexamined ‖, which means the vast maturity of the 3000 gallons of air we breathe each day comes from the air in our homes, services, and schools[2]. it's particularly interesting over out- of- door air because it's strongly tied to inner exertion. still, people may not notice analogous changes because multitudinous pollutants are white and odorless, while multitudinous seasonings are unnoticeable and routine[3]. We executed in Air, a system that measures and visualizes IAQ that homes applicableand integrate into everyday life. it's an investment in our well- being. In this review, we will explore the implausible goods that quality inner air can have on mortal health, creating a terrain where every breath feels like a boost for our bodies and minds.

Fresh Air for Breath: Imagine entering a position with clean, fresh, and amping air. Good inner air quality guarantees that we breathe in vitality as well as oxygen[4]. Pollutant reduction, similar as flyspeck size and organic unpredictable composites, promotes healthier lungs and general respiratory well- being. Keeping your house well- voiced is one of the most affordable ways to ameliorate air quality athome.However, open them up to allow fresh air and push out the banal air containing adulterants and pollutants, If you have large windows at home

Fig. Fresh Air Inside Your Home
Image source: https://annecohenwrites.com/

Respiratory Harmony: One of the most immediate benefits of bettered inner air quality is that it improves respiratory health[5]. Asthma and mislike victims constantly find relief as allergens and annoyances are removed, allowing them to breathe freely. It's like giving our lungs a comforting gym day, free of the stress of diurnal pollution exposure[6].



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Energy for the Mind: ...an air is good not just for our bodies, b... for our studies. advanced inner air qu... has been linked to advanced cogniti... formance and productivity, accord... multiple studies. Good air quality fos... terrain in which attention is keen, ...ivity flows, and internal health thrives.

Guardian of Cardiovascular Health: The heart of the matter – literally. Inner air quality is a good index of cardiovascular health. We reduce the threat of heart complaint by minimizing the quantum of pollutants present. Every breath of pure airis a step towards a healthier heart, a simple yet significant act of tone- care[7].

Quality Sleep Oasis: A good night's sleep is the foundation of good health. With optimal inner air quality, we produce a sleep oasis where breathing is royal, and the body can completely rejuvenate. It's not just a bedroom; it's a sanctuary for restorative sleep. Your sleep routines and night terrain are most conducive to quality rest.

Recommended evening routines to promote better sleep quality include Cleave to a sleep schedule Include rituals lower lighting and do not do stressful conditioning

- Only sleep at night and count naps
- diurnal exercise
- Do not eat right before sleeping
- Include relaxation habits, similar as reading or contemplation

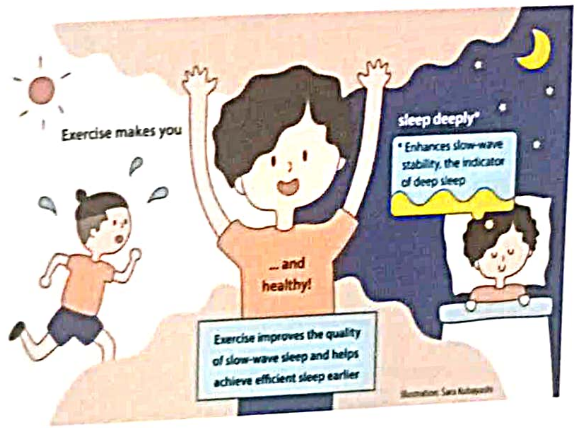

Fig. A good night's sleep is the foundation of good health
Imagesource:https://www.asiaresearchnews.com/content/

Harmony for All Ages: Good Inner air quality does not distinguish by age. From the youthful to the oldest, everyone benefits. Children grow and develop in an terrain that supports their respiratory and cognitive growth. The senior find solace in an atmosphere that promotes cardiovascular health and overall well- being8. Good IAQ increase productivity and decreases absenteeism as well as displeasure towards work. therefore makes for a happy and profitable plant or home or theater etc[8]

Fig. Harmony for all Ages
Image-source: https://everydayreading.com/indoor-picnic-ideas/

Conclusion: Investing in healthy indoor air quality improves our health and happiness. Monitoring the indoor air quality is the first step to make an efficient occupational health and safety management plan and It transforms our living spaces into havens, where every breath is a step toward a better, more vibrant existence. So, let us open our windows to clean, fresh air and enjoy the benefits it brings into our homes: a breath of fresh air that fuels our bodies, and minds,and the delight of living well.

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Assessing Classroom Ventilation: Strategies and Challenges in Natural Airflow Settings

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Indoor Air Pollution

How it affects us and our respiratory system

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INTRODUCTION

World's population, mostly from developing countries, use solid fuel for domestic purposes and are exposed to very high concentrations of harmful air pollutants with potential health effects such as respiratory problems, cardiovascular problems, infant mortality and ocular problems. The evidence suggests that, although the total percentage of people using solid fuel is decreasing, the absolute number is currently increasing. Exposure to smoke from solid fuel burning increases the risk of chronic obstructive pulmonary disease (COPD) and lung cancer in adults, and acute lower respiratory tract infection/pneumonia in children.

HEALTH EFFECTS FROM EXPOSURE TO SOLID FUEL SMOKE

It is estimated that 1.9 million people die prematurely due to exposure to smoke from solid fuel burning. According to WHO, exposure to smoke from solid fuel burning is ranked as the top environmental risk factor worldwide, being responsible for 3.3% of all mortality and 2.7% of all disability-adjusted life- years per year.

Long-term exposure to solid fuel smoke is clearly associated with chronic obstructive pulmonary disease (COPD), increased risk of acute respiratory infections/pneumonia, lung cancer, tuberculosis (TB) and cataracts. The evidence is weaker for end-points such as asthma, adverse pregnancy outcomes, cancer of the upper aero digestive tract, interstitial lung disease and ischemic heart disease. Some of the health effects associated with solid-fuel smoke exposure are acute, and include oxygen desaturation

COPD

Tobacco smoking has been recognized as a major risk factor associated with COPD for over five decades, but this was largely because most research was conducted in high income countries. As more studies from(Low middle income countries) LMICs were conducted it became apparent that non-smoking risk factors were more important in these parts of the world. Wood, animal dung, crop residues, and coal, typically burned in open fires or poorly functioning stoves, may lead to very high levels of household air pollution. Household air pollution exposure is associated with an increased risk of developing COPD in LMICs although the extent to which household air pollution versus other poverty-related exposures explain the association is unclear. Almost three billion people worldwide use biomass and coal as their main source of energy for cooking, heating and other household needs, so population at risk is very large. We need strong research to know more about household pollution related COPD and interventions that could reduce the risk of developing it.

Asthma

There is a wide variation in the prevalence of asthma worldwide. Asthma has been less widely studied in developing countries compared with developed countries, and understanding of the very different set of risk factors in these countries associated with its development, notably indoor environment and lifestyle, is limited. The overall evidence possibly supports a role for biomass exposure being causally related to asthma in children, but formal, well-designed studies are needed to confirm this possibility.

Acute respiratory tract infection

Population exposed to indoor air pollution has been found to have more incidence of respiratory tract infection. Possible mechanism related to respiratory infection from acute exposure to PM from biomass burning might be due to reduced muco-ciliary clearance, and long-term exposure increasing susceptibility to bacterial and viral lung infections. Evidence is strong in children regarding development of pneumonia on exposure to solid fuel smoke.

Lung cancer

Lung cancer is one of the leading causes of death worldwide. While smoking is the major risk factor, as many as a quarter of cases are not attributable to tobacco use. Lung cancer in never-smokers is more common in females than males, although there is considerable regional variation in the proportions of non-smoking females with lungcancer; for instance, in east and south Asia, up to 83% of female lung cancer cases are never-smokers, compared with 15% in the USA. Emissions from combustion of solid fuels have been shown to have high concentrations of PAHs, BaP and PM2.5, which in turn have been associated with high lung cancer rates .

Protecting yourself :- How to prevent adverse effects of indoor air pollution

1. Ventilation: Ensure proper ventilation by opening windows and using exhaust fans to circulate fresh air throughout your living space.
2. Air Purifiers: High-quality air purifiers have been found beneficial in latest evidence in improving quality of life of people suffering from respiratory diseases
3. Regular Cleaning: Regularly clean and dust your home, including carpets, curtains, and furniture, to minimize the accumulation of indoor pollutants.
4. Avoid Smoking Indoors.
5. Stop using solid fuel for cooking and shift to gas based cooking.
6. Regular HVAC Maintenance: Schedule regular maintenance of your heating, ventilation, and air conditioning (HVAC) system to ensure proper functioning and air filtration.
7. Monitor Indoor Air Quality: Use indoor air quality monitors to track pollutant levels and take necessary actions to improve air quality when needed..

Society for Indoor Environment
IEQ 2024
Indoor Environmental Quality 2024
NATIONAL CONCLAVE

2nd March 2024, Research and Innovation Park (RNI) - IIT DELHI

"Transitioning from Outdoors to Indoors"

ESTEEMED SPEAKERS

Prof. Pawel Wargocki
Technical University of Denmark

Prof. Mukesh Khare
Patron-SIE & Emeritus Professor at Department of Civil Engineering at IIT Delhi

Dr. Rakesh Kumar
PRESIDENT, SIE,
OSD, CSIR

Ashish Rakheja
Vice President
ASHRAE

Dr. Naresh Gupta
Prof. & Head of Department of Medicine.
Head HDCC, MAMC, LNH New Delhi

Richie Mittal
Managing Director
OVERDRIVE ENGINEERING Pvt. Ltd.
& Fellow ASHRAE

Dr. Amita U Athavale
Prof. & Head, Chest Research & Environmental Pollution,
KEM Hospital

Dr. Sourabh Pahuja
Consultant
Pulmonary Medicine
Amrita Hospital Faridabad

Mili Majumdar
Managing Director
GBCI India and Senior Vice President,
Research and Innovation, USGBC

Dr. VSKV Harish
Assistant Professor
NSUT Dwarka Delhi

Event Themes

- Monitoring and Modelling Priority Indoor Air Pollutants.
- UN Sustainable Development Goals 2030 and Indoor Environmental Quality.
- Collaborative Mitigation Strategies for Improvement of Indoor Environmental Quality.

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TIME	SESSION	SPEAKER
09:00 - 10:00	Registration and Tea	
10:00 - 11:30	Inaugral Session	
	National Anthem	
	Welcome address by Conference Chair -	Dr. Ravindra Khaiwal, Chair IEQ 2024, SIE
	Watering the plant	
	About SIE and its Initiatives by SIE President	Dr. Rakesh Kumar, President, SIE
	Address by Guest of Honour	Dr. J.S. Sharma, Member - Expert Appraisal Committee, Industry - II, Ministry of Environment, Forest & Climate Change
	Address by Chief Guest	Dr. B.Sengupta, Former Member Secretary, CPCB
	Launch of IEQ 2024 Compendium	Dr. Shukla Das, Joint Secretary (Publications) SIE
	Felicitation of Guests	
	Vote of Thanks by SIE Vice President	Dr. Sri Harsha Kota, Vice President SIE
11:30 - 12:10	Technical Address	Prof. Pawel Wargocki, Denmark Technical University, (Online)
12:10 - 01:30	**Technical Session I : United Nations SDGs and IEQ**	Mr. Ashish Rakheja, ASHRAE Vice President
		Ms. Mili Majumdar , GBCI
		Dr. V.S.K.V Harish, NSUT Delhi
		Q & A
13:30 - 14:15	LUNCH	
	SKIT on Indoor Air Quality by Students of Delhi University	
14:15 - 15:45	**Technical Session II: IEQ-Monitoring, Productivity and Health**	Prof. Mukesh Khare, Patron, SIE
		Dr. Amita Athavale, KEM hospital (Mumbai)
		Dr. Sourabh Pahuja (Amrita Hospital, Faridabad)
		Dr. Neelima Gupta, SIE Chair - Website and Social Media
14:45 - 16:00	TEA	
16:00 - 16:45	**Panel Discussion - IEQ in India: Way forward for guidelines and Implementation** Moderator - Dr. S.K Goyal, Head, CSIR- NEERI Delhi Zonal Lab	Dr. Rakesh Kumar, President SIE Dr. Naresh Gupta, Ex Prof. Maulana Azad Medical College Mr. Richie Mittal, MD, Overdrive Engineering Dr. Ankush Tewani Scientist D, CPCB Dr.Ojha Techknowgreen Solutions Ltd
16:45 - 17:00	Felicitation and Vote of thanks	

Office Bearers

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