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THE INDOORS

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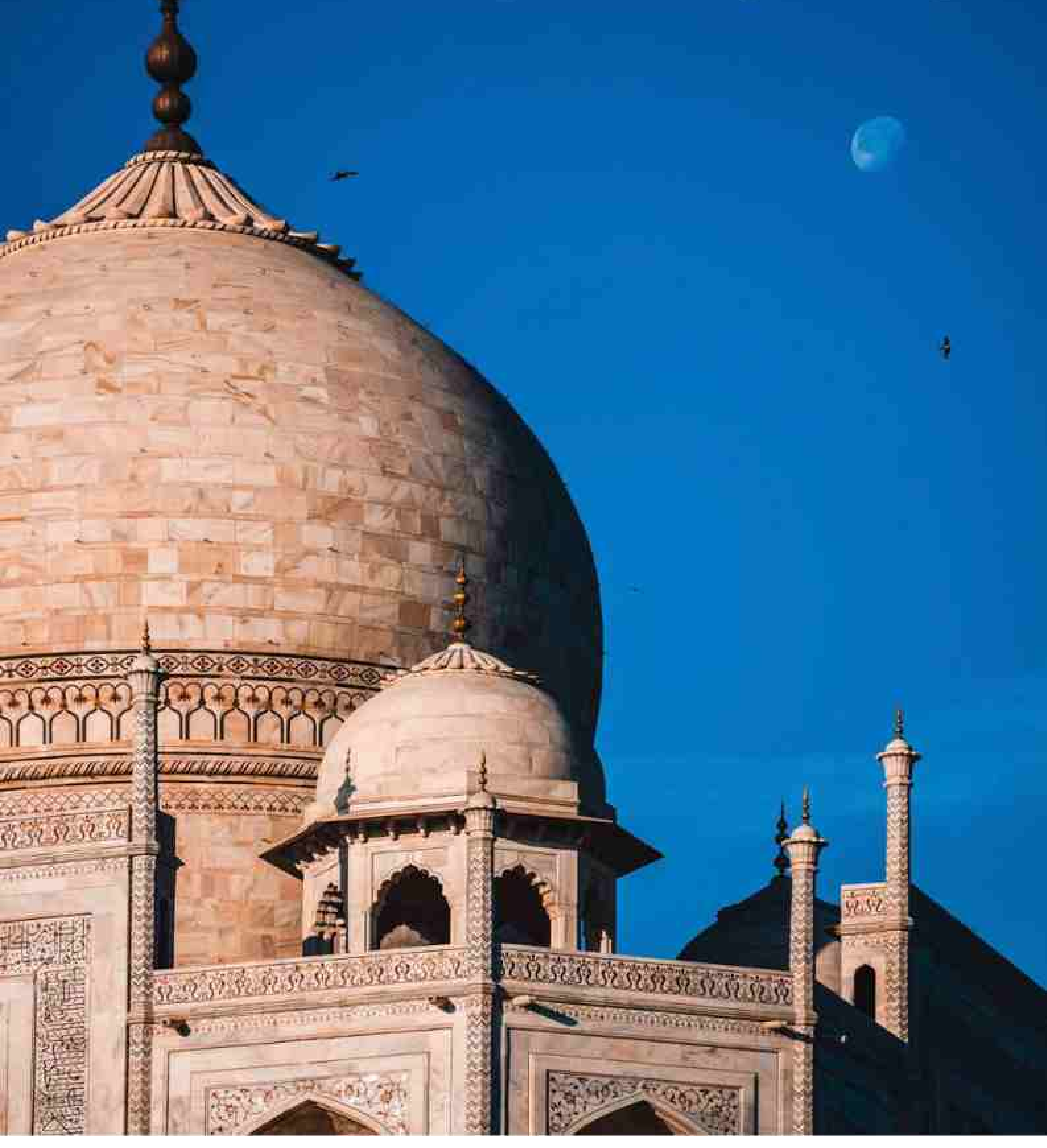

Editorial Note

DR. MUKESH KHARE

Patron, SIE

At the behest, I would like to congratulate SIE Agra chapter for bringing forth the aspects related to Indoor Air Quality (IAQ) from the grassroot level to the policy formulation level. There is a dire need to start understanding the dynamics of indoor air in various microenvironments and the harm that the exposure to these pollutants tend to cause to human health.

Environmental Tobacco smoke (ETS) is also an area which remains less explored in the research on IAQ. Passive smoking is a menace that needs to be tackled. Research has evidently pointed towards the need for having good quality of indoor air in schools, colleges, offices and other public spaces.

Linkages between indoor air and productivity have been well established in the west. However we need to rework on validating this research in Indian subcontinent.

National Clean Air Programme (NCAP) has also outlined the necessity for having guidelines for IAQ in public spaces which has recently been encouraged by NGT (National Green Tribunal) order. Monitoring of indoor air in these public spaces in various cities at different geographical locations across India will be a baby step towards the larger goal of India having its own set of standards for IAQ in near future.

SIE has been working diligently with the government,academia and industry stakeholders to establish an ecosystem of constructive research on IAQ in India.This edition of SIE newsletter is a welcome step from the Agra city chapter to build and assess the IAQ RESEARCH BANK in India.

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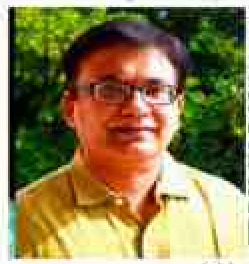

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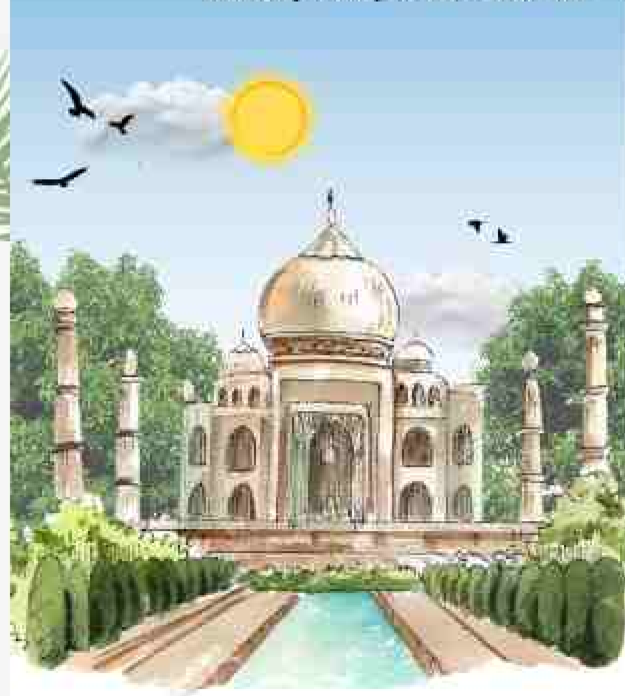

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01 THE IMPORTANCE OF INDOOR AIR QUALITY IN TODAY'S SOCIETY

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Indoor air quality in sensitive areas like homes and public places has caught the interest not only of scientists but of the ultimate public further. Increasing public awareness is specializing during this issue as more and more individuals enjoyed time inside than outside, particularly folks that are most susceptible to the implications of poor air quality, just like the elderly, the young, and folks with poor health. A series of epidemiological studies reported that there are robust associations between short-term and long-term exposure to particulate and other pollutants, they're responsible for harmful effects on human health, including cardiac and respiratory diseases.

Nowadays the best possible importance is attributed to aerosols, especially fine particles because they represent a flowery mixture of organic and inorganic substances with potentially toxic, carcinogenic, inflammatory, allergenic, and other adverse properties. Moreover, diverse sources of PM cause a decent range of particle sizes, i.e., the smaller the diameter size, the more deeply it'll deposit within the tract and at an increasing rate (Massey et al., 2019). Within the nasal-breathing mode, the cilia and so mucus act as an extremely particle deposition within the tract depend not only on particle characteristics, but also on human characteristics, i.e., the person's activity pattern throughout the day, or breathing deeply.

American Cancer Society has noticed that for every 10μg/m3 increase in PM2.5, A 6% of increased risk of mortality and morbidity, which has increased to 10%, resulting in premature deaths, in line with the California Air Resource Board (CARB, 2008, Xing et al., 2016). Studies have reported an association of pupil health with any indoor environment like schools, commercial centers, offices, homes, or any indoor location exposure (Habil et al., 2021). These pollutants may originate from an expansion of sources (building and construction materials and furnishings, building occupants and activities, inadequate building design, lack of maintenance), including the infiltration of doors pollutants, like dust, soil, and fuel-consuming products, and internally from smoking, cooking, incense burning, building, and furniture materials, consumer products shed skin cells and organic fibber's (U.S Department of Health and Human Service).

Personal monitoring is the foremost accurate approach for determining direct exposure to airborne environmental contaminants because it incorporates complex human activity patterns into the exposure assessment (Habil et al., 2016). Limited data is obtainable on personal measurements of fine particles and its characterization of chemical species is lacking in comparative studies for both adult's and children's activity patterns in numerous microenvironments which is important for developing a regulatory outline.

Asia is one of the important regions of the Earth within the context of atmospheric aerosol loading because of the presence of growing economies like India, China, and other Asian countries. Industrialization, the urbanization process, and also the associated increase in energy demands have resulted in the profound deterioration of urban air quality. There's an increased awareness within the occupational and health community leading to possible health effects due to exposure to fine particles. Their size is specified they'll be breathed most deeply within the lungs, which have sulfates, nitrates, acids, metals, and carbon particles with various chemicals adsorbed onto their surfaces (Liu et al., 2016)

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COVID-19 has emerged as a pandemic disease within the boundary between humans and animals and has revealed the importance of interdisciplinary collaborations like the one health initiative.

In comparison to coarse particles, they more easily enter buildings, travel farther, and are more evenly distributed throughout communities, leading to the exposure that is significantly more widespread A study done by Morgan and Morris in 1977, stated that the importance of population exposure measurements in pollution epidemiology makes it imperative that epidemiological studies should include exposure estimates more representative of what people breathe.

They incline to be dangerous once they're generated by the individual's close activity-like activity pattern. Since most people spend approximately all of their time inside a building, indoor pollution might be a big concern. Each indoor micro-environment is uniquely distinguished, as determined by the local outdoor air, specific building characteristics, and indoor activities. Consequently, each individual's exposure is determined by a mix of the local outdoor pollutant levels and thus the various indoor micro-environments to which a private is exposed, and his duration in each. Moreover, the term "fresh air" or "outdoor air" is utilized within the standards and guidelines as a bias for prescribing ventilation rates (Breen et al., 2014). Because not always the quality of the outdoor or fresh air could even be as "fresh" as may are assumed so replacing indoor air with outdoors may not always provide an adequate solution.

Supported this, the rule of 1,000 states that released indoor pollutants is one thousand- fold more likely to reach the lungs than related outdoor pollutants (WHO, 2010). Moreover the foremost notable and scientifically challenging is the evidence suggesting the possible penetrating of particles of this size (fine fraction, <0.1µm) to the brain and central nervous system.

Indoor and outdoor pollutant levels are markedly different in mass, size-specific counts, and composition, influencing the connection between indoor and outdoor air quality.

A significant concern concerning air quantity indoors and outdoors is the effect on the health of particles and other pollutants, particularly those sufficiently small to penetrate the lung (Unicef, 2016). Children have a far higher absorption rate of contaminants than adults. Reports have shown upper respiratory problems and asthma- like symptoms more in young ones as compared to adults.

Besides this, COVID-19 has emerged as a pandemic disease within the boundary between humans and animals and has revealed the importance of interdisciplinary collaborations like the one health initiative. Environmental health, whose role within the individual health concept is well established, has been related to the COVID-19 pandemic via various direct and indirect pathways. Modern lifestyle, temperature change, environmental degradation, exposure to chemicals like endocrine disruptors, and exposure to psychological stress factors impact human health negatively. As a result, many people are in a disadvantageous position to face the pandemic with an already impaired system thanks to their exposure to environmental health hazards (Agarwal et al., 2021). The spread of COVID-19 occurs via droplets or airborne particles. Those who are infected with COVID can release particles and droplets of respiratory fluids that contain the SARS-CoV-2 virus into the air after they exhale (e.g., quiet breathing, speaking, singing, exercising, coughing, and sneezing). The particle sizes diverge across a big range of sizes – from visible to microscopic level. As soon as infectious particles or droplets are respired, they move outward from the individual (the source). These droplets can carry the virus and transmit infection. Indoors, the very fine droplets and particles will still spread through the air within the room or space and may accumulate. Someone will contract COVID-19 if they come into contact with respiratory fluids containing the contagious SARS-CoV-2 virus, which happens when an infected person coughs or speaks close to them. They'll even be exposed by inhaling aerosol particles that are spreading far from the infected person.

Transmission of COVID-19 from inhalation of the virus within the air can occur at distances greater than six feet. Particles from an infected person can move throughout a whole room or indoor space. The particles can even linger within the air after someone has left the area – they will remain airborne for hours in some cases. Someone may also be exposed via splashes and sprays of respiratory fluids directly onto their mucous membranes. Spread may additionally sometimes occur through contact with contaminated surfaces.

The many emerging ecological risks and their subsequent health implications require immediate risk analysis and risk communication strategies, Furthermore, interventions and easy models can be made to view their possible sources. Moreover, future studies can be providing a direct influence of Covid toxicity on the neurological and behavioral activities of occupants with the help of clinical data. There is a need to generate realistic information on the exposure pattern of concern in the environment, and therefore, to develop monitors to determine the part of personal and microenvironment exposure that is derived from different pollution and, better still, from the different sources.

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02 THE IMPORTANCE OF GOOD INDOOR AIR QUALITY IN SCHOOLS

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Indoor air quality (IAQ) a major determinant of personal exposure to pollutants in today's world has direct impact on occupants' health as they spend 80- 90% of their time in indoors. Indoor air pollution (IAP) is 2-3 times more harmful that of ambient and among top five health risks to public health (https://www.epa.gov/report-environment/indoor-air-quality). The comprehensive exposure duration to indoor pollutants and their thousand fold efficacies to reach human lungs (Nazaroff, 2004) than outdoors increases the threat to human health. As per State of Global Air (**SOGA, 2019**) report, IAP has contributed to 1.6 million deaths worldwide in 2017 and World Health Organization in 2018 estimated that IAP may result in ~3.8 million premature deaths annually. The concern increases with delicate population like children as they have notably higher oxygen demand, slender airways, still developing organs and are more physically active leading to breathe more air as compared to their body weights which in turn make pollutants to become more concentrated in their systems (Liu et al. 2018). Further, immature detoxification mechanisms make children prone to exposure of PM (a major determinant of IAQ). Students represent a large population subgroup and they spend 6-8 hours per day in classrooms. The improper ventilation, filtering systems, high children density in a class, proximity to outdoor particle source and challenging maintenance of building schools, improper cleaning of unclean floors and indoor activities like repeated rubbing of chalk dust on blackboards, duster cleaning and continual re- suspension of existing particles lead to high level of PM (Habil et al.2013) and make schools a critical microenvironment for exposure to IAP to children.

Moreover, several studies have reported that children get exposed to higher PM concentrations owing to location of schools near busy roads as pollutants from vehicles seep in classrooms and results in deterioration of IAQ (Habil et al.2013). However, improving ventilation may alter the air exchange rate and improve air quality of classrooms but it is dependable on outdoor air quality as majority of Indian cities are evident of high PM load unexpectedly surpassed the permissible limits (https://www.iqair.com/world-most-polluted-cities). PM's small size and chemical composition determine its toxicity carcinogenity for human health and made it more attentive among other pollutants. Earlier studies mentioned that a rise of 10 µg/m3 in PM10 and PM2.5 leads to increased risk of hospitalization for myocardial infarction and mortality (from 8-18%) respectively (Pope et al. 2004). Additionally, numerous studies also emphasized the association between PM and increase of cardiovascular, cerebrovascular and respiratory mortality and morbidity (Liu et al. 2018). The elevated PM level in indoors creates a sense of discomforts which in turn is responsible for school absenteeism, productivity (Rosofsky et al. 2014, Habil et al. 2015) and leads to numerous adverse health outcomes including dry throat, sneezing, eye irritation, irreversible inflammations in the respiratory and cardiovascular systems, decline in lung function and greater respiratory health impacts on school-going children (Habil & Taneja 2011, Habil et al. 2015). Moreover, reduction in students' cognitive and neurological functions, and hence IQ score and academic performance are the risk of particulate air pollution have been established by Rosofsky et al. 2014 and many others.

Apart from PM, gaseous pollutants (viz. Ozone, NOx, SOx, VOCs etc.) and biological pollutants in classrooms are also of major concern. Long term exposure to elevated concentration of ozone may cause permanent lung damage and as per Levy et al., 2005, an elevation of 10µg/m3 in 1 h maximum ozone leads to a grand mean of 0.21% increase in mortality, without controlling for other air pollutants. Meanwhile, ozone is also associated with school absenteeism as it leads to many respiratory illnesses. The presence of furniture and mould in indoors is associated with asthma symptoms and allergic diseases in children. Reseachers viz. Rosofsky et al.

2014 and many others found association of sign of anxiety, efficiency depletion, poor academic performance, school absenteeism, diminution in ambient comfort of students when exposed to poor IAQ.

This environmental factor (poor IAQ) not only have adverse impacts on individuals growth but also contribute to children's health and poor academic performance but also have societal and economical consequences as school absenteeism intensify social class differences in academic development such that higher attendance rates benefit lower socioeconomic status children the most and parents face challenges in their work attendance whose children get adversely affected from exposure of poor IAQ.

The aforementioned wretched consequences of exposure from poor IAQ have clarify the importance of good quality of indoor air in schools. Although, environmental protection agencies like **WHO**, American Society of Heating, Refrigerating and Air-Conditioning Engineers (**ASHRAE**), Occupational Safety and Health Administration (**OSHA**) and national agencies have formulated benchmark limits of pollutants for indoor micro-environments and WHO have given suggestions that can be adopted to reduce children'sexposure to pollutants yet no information on actions that can be undertaken to actively lower the exposure when the concentration of pollutants cross the acceptable limits.

Furthermore, the official air quality monitoring stations are located away from schools and monitor only ambient level of pollutants. However, these measurements do not work on estimating students' personal exposure (which can vary student to student as per their indoor and outdoor activities) as well as pollutants concentration in schools where they spend their majority of time.

To reconcile the problem of IAQ in schools, continuous and long term monitoring of pollutants as well as parallel sampling of mass and number concentrations of aerosols in schools (which is scarce) is essential to know source, physical and chemical properties of indoor pollutants in school premises which in turn helps in estimating the exposure and sketch methodologies that can be adopted to mitigate and eliminate the exposure.

As a result of it, diminution in adverse health hazards will be observed. Additionally to inhibit the seeping of ambient pollutants, immediate steps by staff and students or long term policy which incorporate updating school premises and equipments during occurrence of steady and high rise in the pollutant's level than permissible must be acquired. Some studies (Martenies & Batterman, 2018 and many others) conducted in classroom in presence of interventions reported improvement in IAQ as well as health benefits suggest that intervention can be employed in school buildings to achieve the goal of better IAQ.

The good IAQ in schools is necessary for betterment of children's health and their academic performance. Hence, better policies and strategies are required for improving IAQ in schools where the future of nation spends their second most time after home.

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03 STRATEGIES TO IMPROVE INDOOR AIR QUALITY IN SCHOOL

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Most people are aware that outdoor air pollution can impact their health, but indoor air pollution can also have significant and harmful health effects. The U.S. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be two to five times and occasionally more than 100 times higher than outdoor levels. These levels of indoor air pollutants are of particular concern because most people spend about 90 percent of their time indoors.

Children breathe more air, eat more food and drink more liquid in proportion to their body weight than adults. Therefore, air quality in schools is of particular concern. Proper maintenance of indoor air is more than a "quality" issue; it encompasses safety and stewardship of your investment in students, staff, and facilities. Unlike other buildings, managing schools involves the combined responsibility for public funds and child safety issues. These can instigate strong reactions from concerned parents and the general community. Many other aspects are unique to schools: Occupants are close together, with the typical school having approximately four times as many occupants as office buildings for the same amount of floor space.

Fig. 1 Air quality solution in school building

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Budgets are tight, with maintenance often receiving the largest cut during budget reductions.
The presence of a variety of pollutant sources, including:

- Art and science supplies
- Industrial and vocational arts
- Home economic classes

A large amount of heating, ventilating, and air-conditioning equipment place an added strain on maintenance staff. Concentrated diesel exhaust exposure due to school buses. (Students, staff, and vehicles congregate at the same places at the same time of day, increasing exposure to vehicle emissions.) Long, daily school bus rides may contribute to elevated exposure to diesel exhaust for many students. As schools add space, the operation and maintenance of each addition is often different. Schools sometimes use rooms, portable class rooms, or buildings that were not originally designed to service the unique requirements of schools. We often find increasing levels of common indoor pollutants in schools.

This is mainly due to poorly constructed building and maintenance, poor cleaning and, most importantly, poor ventilation. This is something that needs urgent attention and rectification as Indoor Air Quality is particularly important for children. In fact, because children are still developing their immune systems, they inhale a higher volume of air per bodyweight than adults. The Scientific Committee on Health and Environmental Risks (**SCHER**), an independent scientific committee managed by the Directorate-General for Health and Consumer Protection of the European Commission, reported that more than 900 different compounds can be detected in indoor air, and most of them derive from human activity.

For example CO_2 which is a product of human respiration. Elevated levels of CO_2 may be reached in crowded indoor environments with inadequate air exchange. Allergens mainly related to dust, damp, pets or insects, but also entering from outdoors – and infectious agents play an important role in indoor pollution. Exposure to indoor pollutants increases the risk of many respiratory/allergic symptoms or diseases such as asthma.

Indoor Air Quality is fundamental in improving the overall quality of life and productivity of children and adolescents, especially if there is already a history is respiratory diseases. The installation of mechanical ventilation and heat recovery systems is an effective solution to reduce airborne allergens. Such a solution may result in a significant decline in respiratory problems, such as breathlessness during exercise, wheezing, and coughing.
There are some ways to improve air quality in schools and the changes you can implement to control air pollutants in your school:

1. Air Purifiers

A lot of different types of air purifiers are available in the market. Most of the air purifiers available today contain HEPA (High-Efficiency Particulate Air) filters. These filters let the air to flow through an ultra-fine mesh that traps air pollutants.

Fig. 2 Air Purifier

It is essential to make sure that your air purifier contains filters that can sift the tiniest particles, which will drastically help to improve the air quality in schools. These microscopic air pollutants can cause lung irritation and are more dangerous to individuals who suffer from allergies or asthma.

While there are a lot of air purifiers available, you might want to learn more about their Clean Air Delivery Rate, which also measures the efficiency of the air purifier. Larger purifiers have higher CADR compared to smaller ones. This is why it is essential to consider the room size before purchasing a purifier. However, just because you have a purifier doesn't mean that the air circulating inside the classroom is clean.

A room full of people is prone to CO_2 build-up, and if that happens, oxygen wouldn't be enough for everyone. Therefore, installing ventilation systems is highly recommended.

2. Whiteboards Over Chalkboards,

A lot of schools have opted to use whiteboards over chalkboards these days, primarily because they are a cleaner option. Chalk dust can be suffocating when inhaled, especially to those who have asthma or allergies.

Fig. 3 Whiteboards over Chalkboards

But some schools still use chalkboards because blackboards are still more accessible and cheaper than whiteboards. Moreover, there are still several people who are not aware of the dangers chalk dust can bring to children.

3. Ventilation Systems

Opening the doors and windows to allow air circulation through classrooms is the most common and simplest method of ventilation. But we only recommend this if you are sure that the outdoor air quality is also good. If your school is located in a busy area where air pollution and traffic are rampant, then we suggest you install ventilation systems that could help you improve school air quality.

Here are some other things you can do to improve ventilation in your school buildings:

- Refrain from turning off HVAC Systems.
- Increase the number of air exchanges per hour to allow fresh air to flow into closed areas.
- Increase the fresh air intake to 100%.

Fig. 4 Ventilation System

4- Weatherstripping

Weatherstripping is the process of sealing gaps on windows and doors to prevent air from leaking through the gaps. Sealing the rooms inside the school building can ensure that the amount of ventilation throughout the room is just enough. This can also prevent moisture from entering the room, which could cause mold. While there are many benefits from weatherstripping, it could also trap polluted air inside the room.

Fig. 5 Lady implementing Weatherstripping

5. Go Green

We all heard it before: plants and trees will save the planet. This is also true when it comes to improving the IAQ within your school building. Plants and trees produce oxygen while removing carbon dioxide, which is dangerous to us humans. Adding more trees and plants is the best option but not the most practical one.

Fig. 6 Group of people planting trees

But if you have enough space and resource. Often, these pollutants are taken for granted. But they shouldn't be. Consistent exposure can be dangerous to your children. To better understand what's at stake, we'll share three ways indoor air pollution impacts students. can affect your children while they're in school.

How Does Indoor Air Pollution Affect School Children?

Indoor air pollution can cause a variety of immediate health effects such as:

- Fatigue
- Coughing and sneezing
- Shortness of breath
- Dizziness and nausea
- Headache
- Allergies
- Irritation of the eyes, nose, throat, and skin
- Carbon monoxide poisoning
- Aggravated asthma

If your children have been complaining of frequent irritation in the eyes, nose and throat after coming home from school, they may have been exposed to some form of air pollution. While most of these symptoms are short-term and treatable, not addressing the cause will only bring back the afflictions after a while. In addition, the likelihood of these reactions may vary depending on factors like age and existing medical conditions. For example, children with asthma are especially vulnerable since their condition can be triggered by indoor exposure to allergens like molds and dust mites. These allergens are also quite common in school settings.

Fig. 7 Students protesting against pollution

Exposure Could Lead to Long-Term Problems

Based on a National Center for Education Statistics report, students spend an average of 1,000 hours in school buildings every school year. That is, roughly a span of 180 days. This number shows just how long your children are exposed to health risks while attending school. Unfortunately, long-term exposure to indoor air pollution may cause serious health effects that could show up years later. These include:

- Respiratory diseases and conditions
- Worsening asthma and allergies
- Heart diseases
- Cancer

First celebrated in 1984, the Asthma and Allergy Foundation of America (**AAFA**) designated the awareness month to generate more recognition for the illnesses. This year, AAFA is offering 31 days of action for the 31 days of May. That's 31 different ways to get involved, take action and learn more about these chronic conditions. Allergies and asthma are, however, certainly not limited to the month of May. And contrary to what some may believe, allergies are not confined to springtime either. Even hay fever (the common allergic response to airborne substances) is a year- round condition for some. Whether you or a loved one suffers from asthma or allergies, it's important to be proactive. Reducing exposure to potential triggers is the key. Though you cannot clear outdoor environments of triggers, you do have control over your indoor environment. Here's why focusing on indoor air quality matters for asthma and allergy patients. One indoor air pollutant, radon, is a naturally occurring gas frequently found in schools and workplaces. It is a known carcinogen and considered the second leading cause of lung cancer by the EPA.

Another known health problem linked to indoor air pollution is Legionnaires' disease. It's a form of pneumonia caused by the legionella bacterium. It's associated with buildings with poorly maintained air conditioning and heating systems.

Indoor Air Pollution Affects Student Success

A student's health and comfort in the classroom impacts their overall learning and productivity. Studies from American University documented significant declines in test scores during days with high levels of indoor particulate pollution. Exposure to poor indoor air quality also impacts students' attendance due to sickness. Asthma, for instance, is one of the leading causes of school absenteeism. Teachers and staff getting sick from exposure can further disrupt the learning environment.

Minimizing indoor air pollutants is paramount to high performance schools, due to the potentially detrimental effects that VOCs, particulate matter including allergens and molds, and combustion gases may have on the health and wellbeing of students. In addition to their capacity to trigger asthma or allergy attacks, some of these pollutants are notorious for causing flu-like symptoms, headaches, nausea, and irritation of the eyes, nose, and throat. Moreover, recent research suggests that a school's physical environment also can play a major role in academic performance.

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• 5 Seriously Simple Ways to Improve Air Quality in Schools - qlair (i-qlair.com)

Fig. 8 Image showing students stressing

However, newer designs, construction practices, and building materials for "green" buildings and the use of "environmentally friendly" products have the promise of lowering chemical exposure. You want to do everything you can to keep your children healthy and happy, but you don't have complete control over the indoor air quality in their educational settings. Getting involved in your local parent-teacher associations and voicing your personal concerns about air quality is a good first step to provide your children with a safe learning environment. Advocating for indoor air quality solutions can make a difference. While most of these symptoms are short-term and treatable, not addressing the cause will only bring back the afflictions after a while. In addition, the likelihood of these reactions may vary depending on factors like age and existing medical conditions. For example, children with asthma are especially vulnerable since their condition can be triggered by indoor exposure to allergens like molds and dust mites. These allergens are also quite common in school settings.

04

TOBACCO SMOKE IN INDOOR ENVIRONMENT AND ITS HEALTH IMPACTS

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Environmental tobacco smoke refers to exposure to tobacco smoke — not from your smoking, but from being exposed to someone else's cigarette, cigar, or pipe smoke. **ETS** can also be described as the material in indoor air that originates from tobacco smoke that originates from tobacco products. According to the World Health Organization, indoor air pollution (**IAP**), also termed as household air pollution (**HAP**), is a major environmental and public health challenge in developing countries [1].

Indoor air pollution (IAP) is highly vulnerable to human health, causing millions of deaths each year. A plethora of pollutants can result in IAP; hence, it is important to conceive a blueprint for the control and improvement of indoor air quality (IAQ) and to recognize its main sources and concentrations. People generally spend most of their time in an indoor environment, which contributes greatly to human wellbeing [2]. Approximately 3.8 million people die annually because of indoor air pollution (IAP), according to the World Health Organization (WHO) [3].

Smoking, cooking, use of electronic machines, or emissions from building materials are some of the occupants' activities which can generate IAP inside offices, buildings, or homes. Particulate matter (PM), aerosol, carbon monoxide (CO), volatile organic compounds (VOCs), harmful pollutants, and biological pollutants are all sources of pollution inside buildings [4]. In cigarette smoke, more than 3,800 compounds have been identified. Sidestream smoke (SS) is the major source of ETS, which is emitted from the burning end of a cigarette in between puffs. ETS residue is primarily composed of gases emitted during smoking through the cigarette paper, exhaled mainstream smoke (MS), and smoke emitted during inhaling a puff from the burning end [6]. SS, ETS, and MS. Each of these mixtures is an aerosol consisting of a vapour phase and a particulate phase. Although the smokes of ETS, SS, and MS differ due to changes in individual constituent concentrations, the phase (vapor or particulate) in which the constituents are present, there are various secondary reactions that physically and chemically alter ("age") the composition of the smoke. Undiluted SS contains higher concentrations of some toxic compounds than undiluted MS, such as volatile nitrosamines, nicotine decomposition products, ammonia, aromatic amines, and volatile amines. In spite of that, where the ETS exposures take place, the concentrations of these SS emissions are considerably diluted in the indoor space.

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The hydrophobic vapour phase part of ETS goes into the lung of the exposed individual, but the hydrophilic vapour phase part is likely to be absorbed in the upper respiratory tract. Particles <2.5 µm dominate the particulate phase of ETS and can be drawn deeply into the lung. For instance, it is known that most of the nicotine shifts from the particulate phase in MS and fresh SS to the vapour phase in ETS. Therefore, indoor air-cleaning systems designed which may alter the concentrations of other toxic component but to remove particles will not greatly alter the nicotine exposure. Indoor radon comes from sources in the environment and decays to short-lived radon daughters, which can become bound to the RSP in ETS.

However, from tobacco itself, long-lived radon daughters come. RSP, benzo[a] pyrene, acrolein, carbon monoxide, nicotine, nitrogen, nitroso-compounds, and oxides are some of the air contaminant compounds studied in the field as indicators of ETS exposure. A majority of field studies have used RSP as an indicator of exposure to ETS because of the substantial emission of RSP in indoor spaces from tobacco combustion. ETS is the dominant contributor to the indoor levels of RSP. Both air monitoring and modelling clearly indicate that RSP concentrations will be elevated over background levels in indoor spaces when even low smoking rates occur.

In conclusion, contaminants in the indoor air environment are important contributing causes of human health hazards.

2. BIOLOGICAL MARKERS

The dose of ETS to the organs or tissues could be measured directly through the use of biological markers that specifically indicate uptake in the organs or tissues by physiological fluids of exposed people. Several chemicals are found in such fluids, and they can be identified and quantified in urine, blood, or saliva. Other suggested biological markers of exposure are nitrosothioproline, N-nitrosoproline, and some of the aromatic amines that are present in high concentrations in SS.

3. HEALTH EFFECTS

Acute, Noxious Effects - ENT irritation and the objectionable smell of tobacco smoke are the most common acute effects associated with exposure to ETS. During exposure to ETS, eye blink rate is correlated with sensory irritation, such as nasal irritation and burning eyes.

Respiratory Symptoms and Lung Cancer

According to WHO exposure to household air pollution is a major risk factor leading to acute lower respiratory infections (ALRI) in children under five and ischaemic heart disease (IHD), stroke, chronic obstructive pulmonary disease (COPD), and lung cancer (LC) in adults [5]. Respiratory symptoms, such as wheezing, coughing, and sputum production, are increased in children whose parents smoked.

Since children exposed to ETS from parental smoking have an increased frequency of pulmonary symptoms and respiratory infections, Exposure to ETS increases the incidence of lung cancer in nonsmokers.

Cardiovascular Disease

There are no significant effects on blood pressure and heart rate in school-aged children or healthy adult subjects, either during exercise or at rest, on exposure to ETS.

Other Health Considerations in Children

When smoking spouses come into contact with nonsmoking pregnant women, they have been shown to produce babies of lower birthweight than nonsmoking women with nonsmoking spouses. Some studies have shown that the growth and development of children of smokers has been reduced, and one study described a dose-response relationship between increasing numbers of cigarettes smoked in the home by either of the parents and reduced height.

4. CURRENT STRATEGIES for MONITORING and CONTROL of IAQ

1. Development of Materials for IAQ Sensors
2. Current Strategies for Monitoring and Control of IAQ
a) Development of Materials for IAQ Sensors
b) Internet of Thing (IoT)-Based Systems.
c) Wireless Sensor Network (WSN)-Based Systems.
3 Air Purification Technologies for IAQ Improvement.
4. Smart Home for IAQ Control.

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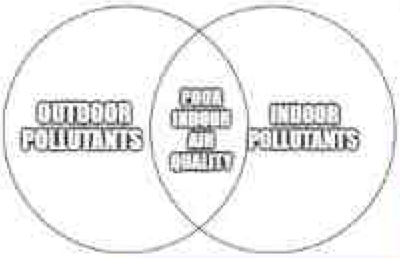

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Day - 1 (24th February 2023)

Key Note Address by Prof. Lidia Morawska, Queensland University of Technology, Australia

Session 1	Session 2	Session 3
IAQ- Monitoring & Assessment Moderator - Dr. Rakesh Kumar (OSD CSIR HQ, Delhi)	**Productivity and Health** Moderator - Dr. Arun Kumar Sharma (Director ICMR - NIIRNCD, Jodhpur)	**Ventilation and Thermal Comfort** Moderator - Dr. Jyotirmaya Mathur (Professor MNIT, Jaipur)
Invited Speaker Dr. S. M Shiva Nagendra (Professor IIT, Chennai)	**Invited Speaker** Dr. Naresh Gupta (Director Professor MAMC, Delhi)	**Invited Speaker** Dr. M.P. Maiya (Professor IIT, Chennai)
Technical Paper Presentations - 3	Technical Paper Presentations - 3	Technical Paper Presentations - 3
Session 4	**Session 5**	**Session 6**
IAQ - Exposure & Health Moderator - Dr. S.K. Goyal (Chief Scientist & Head CSIR- NEERI)	**Lighting and Visual Comfort** Moderator - Dr. Yash Shukla (Center Head & Principal Researcher CEPT Univ.)	**IAQ- Monitoring & Control Technologies** Moderator - Dr. Harsha Kota (Assoc. Professor IIT Delhi)
Invited Speaker Dr. Jolly Rohtagi (Professor UCMS, GTB Hospital)	**Invited Speaker** Dr. Reena M Choudhary (Director ICARE Hospital Noida)	**Invited Speaker** Dr. Sachin Panwar (Founder YOGA)
Technical Paper Presentations - 3	Technical Paper Presentations - 3	Technical Paper Presentations - 3

Key Note Address by Prof. Powel Wargoki - University of Denmak (Ventilation & Themal Comfort)

Day - 2 (25th February 2023)

Key Note Address by Dr. Prashant Kumar - Professor, University of Surrey, UK

Panel Discussion Moderated by Dr. Prasad Modak - MD Environment Management Centre & Ekonnect Mumbai; Panelists: Dr. V.M. Motghare - Joint Director MPCB, Dr. Rameshwar Sorokhaibam Deputy Director, NPCCHH Dr. Madhurima Madhav - Joint Director BIS; Dr. Sudeep Roy - Director MoHUA, Dr. Mili Majumdar - MDGBCI, Prof. Prateek Sharma - Vice Chancelor TERI SAS

Session 7	Session 8	Session 9
IAQ - Monitoring & Assessment Moderator - Dr. S. M Shiva Nagendra (Professor IIT, Chennai)	**IIAQ- Exposure & Health** Moderator - Dr. Anubha Goel (Assoc. Professor IIT Kanpur)	**Productivity & Health Bioaerosols** Moderator - Dr. Shukla Das, (UCMS, Delhi)
Invited Speaker Dr. Suresh Jain (Professor IIT Delhi)	**Invited Speaker** Prof. Ravindra Khaiwal (Professor PGI Chandigarh)	**Invited Speaker** Dr. Neelima Gupta (Professor UCMS Delhi)
Technical Paper Presentations - 3	Technical Paper Presentations - 3	Technical Paper Presentations - 3
Session 10	**Session 11**	**Session 12**
IAQ- Monitoring & Assessment Moderator - Dr. Sunil Gulia (Sr. Scientist CSIR NEERI)	**Productivity and Health (COVID Specific)** Moderator - Dr. Neelima Gupta (Professor UCMS Delhi)	**IAQ - Building Design & Control** Moderator - Dr. Sumantha Chinthala Professor NIT Warangal
Invited Speaker Prof. Ajay Taneja (Prof & Head Dr. Bhimrao Ambedkar Univ. Agra)	**Invited Speaker** Dr. Shukla Das (Director Professor UCMS)	**Invited Speaker** Dr. Roshini Udyavar (Director Roshni Udyavar & Associates)
Technical Paper Presentations - 3	Technical Paper Presentations - 3	Technical Paper Presentations - 3

Key Note Address by Prof. Arsen K Melikov Professor, Technical Univrsity of Denmark

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