

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

ADVERSE EFFECTS OF INDOOR CHEMICAL POLLUTION ON ENVIRONMENT AND ASSORTMENT OF CAUSES

Seema Agrawal

Shri Jain Diwakar Mahavidhyalaya, Indore (M.P.) INDIA

ABSTRACT

In present paper author has tried to provide a deep study on the causes of chemical pollution, It has been realized that pollutants found inside homes, i.e. indoor pollutants can be equally dangerous. Our homes are stocked with dangerous chemicals, pesticides, detergents, and various other substances as they form part of the normal cleaning of today's homes. It's true that outdoor air pollution can damage health, but many of us are unaware of the fact that indoor air pollution is equally harmful for health. Many studies have demonstrated how exposure to chemical pollutants in indoor air has adverse effects on health and comfort. Volatile organic compounds (VOCs), formaldehyde, ozone, particulates, fibers and environmental tobacco smoke have all been implicated. VOCs include a wide range of chemical substances which irritate mucosa. Many are neurotoxic and some are suspected or known to be carcinogenic e.g. benzene. Formaldehyde, the simplest and most common aldehyde in indoor air, is a powerful irritant to the skin, eyes, nose and upper airways. Given its close association with nasal-pharyngeal tumours, it has recently been classified as a certain carcinogen for humans. Exposure to ozone may cause airway irritation and inflammation, reduce the ventilation function and increase reversible bronchial reactivity. In the general population it increases the mortality rate and the number of hospital admissions for respiratory diseases. Airborne particles, a mixture of organic and inorganic substances, are powerful irritants for the eyes and mucosa and can cause adverse cardiovascular effects.

Keywords- Indoor Pollution, formaldehyde, Pesticides, Airborne particles, Volatile organic compounds (VOCs).

I. INTRODUCTION

As per the studies done by environmental protection agency on the human exposure to air pollutants, indoor level of pollutants may be sometimes 100 times and generally 2-5 times higher than outdoor levels. This requires immediate attention as most of the people spend about 90% of their total time indoors.

As so far, being noticed the main attention related to air pollution is based mainly on outdoor air pollutants but it has been observed in recent years that indoor pollutants are equally dangerous as the outdoor pollutants. One can see many dangerous chemicals in the form of chemicals, pesticides, detergent setc. in the house which are kept for cleaning purpose. The concentrations of such indoor pollutions is too high sometimes even exceeding the standard set for outdoor concentrations. This happens as they are emitted into small volume of a room from where they cannot escape out easily. Most people are aware that air pollution can damage their health but many do not know that indoor air pollution can also have significant health effects. Environmental protection Agency studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels.

II. IMPACT OF POLLUTION ON HUMAN HEALTH

The sources of indoor pollution are various in number. This may include cooking, painting, cigarette, smoking, heating, use of aerosol, spray, cans etc. To some extent we are responsible for bringing these pollutants into the homes and offices. for example, gas stoves in kitchen emit high levels of CO, and NO₂. If the furnace is not maintained properly it may produce CO₂ & SO₂ in large quantities. Cigarette smoking provides an indoor source of pollutants including CO, formaldehyde (HCHO) benzopyrene and organic particulate matter. Exposure to HCHO at concentrations of 0.05 ppm – 0.5 ppm can burn eyes and irritate upper respiratory passages depending upon

environmental conditions such as temperature and humidity. Apart from indoor environments, exposure to asbestos fibers has been associated with an increased risk of respiratory diseases such as pneumoconiosis lung cancer and mesothelioma. Synthetic mineral fibers cause transient irritation and inflammation of the skin, eyes and upper airways. Recent observations have confirmed that exposure to environmental tobacco smoke, which is widespread in workplaces, increases the risk of lung cancer, irritative respiratory and ocular symptoms and cardiovascular diseases. We usually think of air pollution as being outdoors, but the air in your house or office could also be polluted. Sometimes a group of people have symptoms that seem to be linked to time spent in a certain building. There may be a specific cause, such as Legionnaire's disease. Sometimes the cause of the illness cannot be found. This is known as sick building syndrome.

Usually indoor air quality problems only cause discomfort. Most people feel better as soon as they remove the source of the pollution. However, some pollutants can cause diseases that show up much later, such as respiratory diseases or cancer.

Making sure that your building is well-ventilated and getting rid of pollutants can improve the quality of your indoor air.

Sources of indoor pollution include

- Mold and pollen
- Tobacco smoke
- Household products and pesticides
- Gases such as radon and carbon monoxide
- Materials used in the building such as asbestos, formaldehyde and lead

III. INDOOR CHEMICALS USED

Table 1 Sources, Concentrations, Occurrences, and Possible Health Effects of Indoor Air Pollutants (Ref. 4)

Pollutant	Source	Guidelines	Possible Health Effects
Asbestos	Fireproofing; insulation, vinyl floor, and cement products, vehicle brake linings	0.2 fibers/mL for fiber larger than 5 μ m	Skin irritation, lung cancer
Biological aerosols/ microorganisms	Infectious agents, bacteria in heating, ventilation, and air-conditioning system; allergens	None available	Disease, weakened immunity
Carbon dioxide	Motor vehicles, gas appliances, smoking	1,000 ppm	Dizziness, headaches, nausea
Carbon monoxide	Motor vehicles, kerosene and gas space heater, gas and wood stoves, fireplaces; smoking	10,000 μ g/m ³ for 8 hours; 40,000 μ g/m ³ for 1 hour	Dizziness, headaches, nausea, death
Formaldehyde	Foam insulation; plywood, particleboard, ceiling tile, panelling and other construction materials	120 μ g/m ³	Skin irritant, carcinogen
Inhalable particulates	Smoking, fireplaces, dust, combustion sources (wildfires, burning trash, etc.)	55-110 μ g/m ³ annual; 350 μ g/m ³ for 1 hour	Respiratory and mucous irritant, carcinogen
Inhalable particulates Nitrates Sulfates	Outdoor air Outdoor air	None available 4 μ g/m ³ annual; 12 μ g/m ³ for 24 hours	

Metal particulates Arsenic Cadmium Lead Mercury Nitrogen dioxide	Smoking, pesticides, rodent poisons Smoking, fungicides Automobile eshaust Old fungicides; fossil fuel combustion Gas and kerosene space heaters, gas stoves, vehicular eshaust	None available 2 ug/m ³ for 24 hours 1.5 ug/m ³ for 3 months 2 ug/m ³ for 24 hours 100 ug/m ³ annual	Toxic, carcinogen Respiratory and mucous irritant
Ozone	Photocopying machines, electrostatic air cleaners, outdoor air	235 ug/m ³ for 1 hour	Respiratory irritant, causes fatigue
Pesticides and other Semivolatile organics	Sprays and strips, outdoor air	5 ug/m ³ for chlordane	Possible carcinogens
Radon	Soil gas that enters buildings, Construction material, groundwater	4 pCi/L	Lung cancer
Sulfur dioxide	Coal and oil combustion, kerosene Space heater, outside air	80 ug/m ³ annual; 365 ug/m ³ for 24 hours	Respiratory and mucous irritant Irritant
Volatile organics	Smoking, cooking, solvents, paints, varnishes, cleaning sprays, carpets, furniture, draperies, clothing	None available	Possible carcinogens

Sources: N.L. Nagda, H.E. Rector, and M.D. Koontz, 1987; M.C. Baechler et al., 1991; E.J. Bardana Jr. and A. Montaro (eds.), 1997; M. Meeker, 1996; D.W. Moffatt, 1997.

Trichloroethylene

Trichloroethylene (TCE) is a commercial product found in wide variety of industrial uses. Over 90 percent of the TCE produced is used in the metal degreasing and dry cleaning industries. In addition, it is used in printing inks, paints, lacquers, varnishes, and adhesives, in 1975 the National Cancer Institute reported that an unusually high incidence of hepatocellular carcinomas was observed in mice given TCE by gastric intubation and now considers this chemical a portent liver carcinogen.

Benzene

Benzene is a very commonly used solvent also present in many common items including gasoline, inks, oils, paints, plastics, and rubber. In addition, it is used in the manufacturing of detergents, explosives, pharmaceutical, and dyes. Benzene has long been known to irritate the skin and eyes. Benzene is a widely used industrial chemical. Benzene is found in crude oil and is a major part of gasoline. It is used to make plastics, resins, synthetic fibers, rubber lubricants, dyes, detergents, drugs and pesticides. Benzene is produced naturally by volcanoes and forest fires.

Formaldehyde

It is used in consumer paper products, which have been treated with UF resins, including grocery bags, waxed papers, facial tissues and paper towels. Many common household cleaning agents contain formaldehyde. UF resins are used as stiffeners, wrinkle resisters, water repellents, fire retardants and adhesive binders in floor covering, carpet backings and permanent-press clothes. Other sources of formaldehyde include heating and cooking fuels like natural gas, kerosene, and cigarette smoke.

Formaldehyde irritates the mucous membranes of the eyes, nose and throat, it is also a highly reactive chemical which combines with protein and can cause allergic contact dermatitis.

IV. USE OF INDOOR EQUIPMENTS

Air-conditioners, refrigerators and coolers

Air-conditioners and refrigerators are the source of ozone depleting pollutants, the CFC_s. Air-conditioners even do more than keeping the room cool in hot summer months. They cause many air borne diseases. Desert coolers also constitute the source of allergens, which in the atmosphere of the room can cause a syndrome called **hypersensitivity pneumonitis**.

Detergents

The detergents used for cleaning articles is not totally washed out from the hands. It remains cringed to it and cannot be completely removed even when rinsed in hot water. The utensils cleaned by detergents further makes them transfer the poisonous substances present in the detergents to the food we eat. It has been researched that sometimes we may consume 2 mg of detergents through our everyday food. This may have cumulative effects in the long run. These detergents may result into various skin problems like skin irritation, itching etc.

Asbestos Products

Asbestos products have been banned in US since 1966, however, in India; we still continue to use them. Asbestos dust when inhaled causes the growth of fibrous tissue in lungs.

Pesticides

The use of pesticides has also increased enormously in the recent past. These pesticides find their way into lakes and rivers and contaminate them. Most of these chemicals are toxic in nature. These chemicals get progressively concentrated in the food chain. These chemicals can cause long-term damage to the health of human beings. These pesticides find also enter our bodies directly if the food articles to which these chemicals are sticking are not thoroughly washed before consuming.

DDT and other chlorinated hydrocarbons, which have long been used as pesticides, have been found to be toxic. DDT is a highly stable compound. It is not easily metabolised (broken down) by animals. It is deposited and stored in the fatty tissues. Since DDT is not easily biodegradable, there is a resultant build up of this toxic chemical within the animals, soil and water over a period. Investigations have revealed that people living in some of the urban areas of our country have alarming amounts of DDT in their bodies. DDT and other non-biodegradable pesticides are now being replaced with biodegradable pesticides.

Our daily diet includes parts of pesticides and their residue used during agriculture to kill the pests and insects. These get accumulated in our body which may cause chronic toxicity. Also, pesticide fumes can cause sneezing, coughing especially in children.

Chemical pollution can affect animals -- including humans -- when ingested, breathed in or absorbed through the skin. Short-term exposure to some **chemical** pollutants can impair the immune, endocrine and reproductive systems. Pollutants may cause lesions, alter liver function or darken the skin.

Others

Paints, including epoxy latex paints, flexible plastics such as shower curtains and pillow and mattress covers are indoor pollutants.

Hair sprays, electrical equipment's, depilatories, antiseptics, drain, oven and lavatory cleaners, polishes, bleaches, some tooth paste, non-stick pans, moth repellents, air fresheners, radiations from various sources especially from colored television, when watched at close quarters. Many air purifiers, containing the pesticide paradichloro-benzene are in use today. The vapours produced by this insect-repellent can accumulate to toxic levels in the environment. Hair sprays used to keep hair in place in place and well-groomed, cause eye damage as well as respiratory problems.

Table 2 Some Symptoms of Indoor Air Pollution(Ref. 4)

Symptoms	ETS ^a	Combustion Products ^b	Biologic Pollutants ^c	VOCs ^d	Heavy Metals ^e	SBS ^f
Respiratory Inflammation of mucous membranes of the Nose, nasal congestion	YES	YES	YES	YES	NO	YES
Nosebleed	NO	NO	NO	YES	NO	YES
Cough	YES	YES	YES	YES	NO	YES
Wheezing, worsening asthma	YES	YES	NO	YES	NO	YES
Labored breathing	YES		YES	NO	NO	YES
Severe lung disease	YES	YES	YES	NO	NO	YES
Other						
Irritation of mucous membranes of eyes	YES	YES	YES	YES	NO	YES
Headache or dizziness	YES	YES	YES	YES	YES	YES
Lethargy, fatigue, malaise	NO	YES	YES	YES	YES	YES
Nausea, vomiting, anorexia	NO	YES	YES	YES	YES	NO
Cognitive impairment, personality change	NO	YES	NO	YES	YES	YES
Rashes	NO	NO	YES	YES	YES	NO
Fever, chills	NO	NO	YES	NO	YES	NO
Abnormal heartbeat	YES	YES	NO	NO	YES	NO
Retinal hemorrhage	NO	YES	NO	NO	NO	NO
Muscle pain, cramps	NO	NO	NO	NO	NO	NO
Hearing loss	NO	NO	NO	NO	YES	NO

- Environmental tobacco smoke.
- Combustion products include particles, NO_x, CO, and CO₂.
- Biologic Pollutants include molds, dust mites, pollen, bacteria, and viruses.
- Volatile organic compounds, Including formaldehyde and solvents.
- Heavy metals include lead and mercury.
- Sick building syndrome.

Source: Modified from American Lung Association, Environment Protection Agency, and American Medical Association, "Indoor Air Pollution- An Introduction for Health Professionals, "523-217/81322 (Washington, D.C.: GPO, 1994)

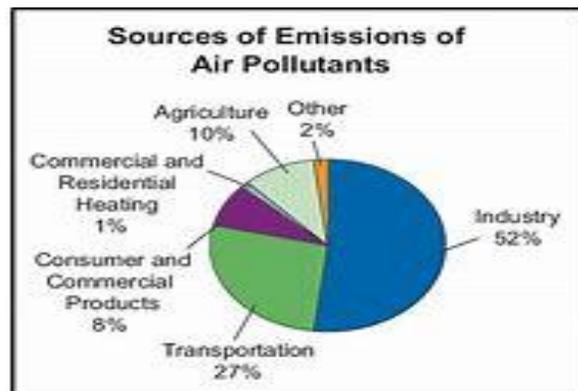
V. HOW TO CHECK INDOOR POLLUTION

The measures suggested to check indoor pollution are as follows:

1. Air-conditioners and refrigerators should not leak as the refrigerant is CFC. Pads and water in desert cooler should be changed well before they get contaminated with fungi or other microorganisms.
2. Boracic powder can be used on cockroaches. This is extremely effective but harmless to human beings and pests.
3. Children's room and bedroom should never be sprayed with pesticide or any type of aerosol; Children below 5 years are easy victims of pesticide poisoning.
4. Colour T.V. should be viewed at eight feet away from the place of location.
5. Detergent powders not more than the requisite quantity should be used to prevent undue skin damage. While using, extreme care should be taken to see that inhalation of the powder dust is strictly avoided

and skin contact minimized by putting hand gloves. It is also essential to rinse away as much detergent as possible finally. No utensil or container used for preparing or storing foods for babies and children should be washed with detergents. Only good soaps should be used for the purpose.

6. Dry-cleaned clothes should be aired thoroughly outside the house, before wearing or hanging them in wardrobes.
7. Fluoride-containing toothpaste should not be used in areas where soil and water have high concentration of this substance.
8. Kerosene stoves, kitchen range and gas cylinders should regularly be get checked.
9. Paint or distemper on walls should be free from any pesticide or fungicide.
10. Pesticides, detergent, deodorants, aerosol spray, electric appliances, cosmetics, etc. should be used with extreme care and caution.
11. Smoking should be avoided as far as possible in a closed room or space such as car, bus, railway compartment, aircraft, restaurant or hotel rooms and service centers.
12. While using hair sprays, eyes as well as mouth should be covered with a thick towel to avoid inhalation and eye contact. Also, as soon as the spraying is over, the person should leave the place where the spray was used.



VI. ENVIRONMENTAL CONTROL EQUIPMENT

- Air-washers
- Bin Vents
- Cartridge Dust Collectors
- Compact Pulse-Jet Bag houses including top loading, bottom loading, horizontal loading, low profile designs
- Downdraft Tables
- Dust Collectors featuring the world's most efficient pulse-jet collectors
- Environmental Booths
- Evaporative Coolers
- High-Pressure, High-Vacuum Tank Filters
- Humidifiers and, Process Coolers 2,000 to 50,000 CFM
- Industrial vacuum systems including portable vacuums and central vacuum cleaning systems for industrial applications
- Patented Industrial Scrubbers
- Pneumatic Conveying Systems, Vacuum and Pressure type Special Application Dust-Lint Filters

VII. CONCLUSION

Indoor pollution is very harmful for health but we can save ourselves by using indoor plants. Indoor plants may provide a valuable weapon in the fight against rising levels of indoor air pollution. Those plants in your office or home are not only decorative, but NASA scientists are finding them to be surprisingly useful in absorbing potentially harmful gases and cleaning the air inside modern buildings.

NASA and the Associated Landscape Contractors of America (ALCA) have announced the findings of a 2-year study that suggest a sophisticated pollution-absorbing device: The common indoor plant may provide a natural way of helping combat Sick Building.

NASA research on indoor plants has found that living plants are so efficient at absorbing contaminants in that some will be launched into space as part of the biological life support system aboard future orbiting space stations.

REFERENCES

- [1] Anjaneyulu Y., *Introduction to Environmental Science*, BS Publication, Hyderabad, Page 371-375.
- [2] Purohit S.S., *Green Technology*, AGROBIOS Publication, India, Page 393-400.
- [3] Nurugesan A.G., Rajkumari C., *Environmental Science and Biotechnology*, MJP Publishers, Chennai, Page 265-286.
- [4] Botkin B. Daniel and Keller A. Edward, *Environmental Science*, John Wiley and Sons Publication, Page 564-571.
- [5] Anjaneyulu Y., *Environmental impact Assessment methodologies*, BS Publication, Hyderabad, Page 245-246.