

# Health Risks in Indoor Environment

## Definition

Indoor air quality means the quality of the environment in an office or other building. A definition given by **ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers)** (<http://www.ashrae.org/>), "Acceptable indoor air quality means air in which there are no known contaminants at harmful concentrations and air with which a substantial majority of the people exposed, do not express dissatisfaction".

A poor indoor environment can be caused by:

- Inadequate cleaning
- Insufficient ventilation
- Pollutants emitted inside the building
- Contamination from outside sources
- Biological contamination due to moisture problems

## Inorganic Chemical Pollution

**Carbon dioxide (CO<sub>2</sub>)** the limit for an adequately ventilated room is 0.1%. Above 1% can cause a range of symptoms such as headache, drowsiness and nausea. Higher levels can lead to death due to difficulty breathing. As a consequence of the health risks associated with carbon dioxide exposure, the U.S. Occupational Safety and Health Administration recommends that average exposure for adults, during an eight-hour work day, should not exceed 0.5%.

**Carbon Monoxide (CO)** is a toxic gas which is colourless and odourless. Carbon monoxide combines with haemoglobin to produce carboxyhaemoglobin, which does not allow sufficient delivery of oxygen to tissues. It is a product of incomplete combustion for example in fireplaces, gas appliances and smoking. In the United States, the **OSHA (Occupational Safety and Health Administration)** (<http://www.osha.gov/>) limits long-term workplace exposure levels above 50 ppm.

**Nitrogen dioxide (NO<sub>2</sub>)** is produced during combustion at high temperatures. Sources are tobacco smoke, kerosene heaters, fireplaces and gas stoves. At concentrations above 2ppm, it causes irritation of the mucous membranes and changes in lung function.

**Sulphur dioxide (SO<sub>2</sub>)** is a colourless gas that is poisonous. Indoor concentrations of the gas are considerably lower than outdoor levels; this is due to the chemical reactivity of SO<sub>2</sub> with surfaces and it is neutralised by ammonia produced by humans. Sources of SO<sub>2</sub> are mainly from burning of fossil fuels. Sulphur can also be removed from fuels prior to burning thus preventing the formation of SO<sub>2</sub>. It is absorbed by upper respiratory tract mucosa causing respiratory symptoms. In 2008, the **American Conference of Governmental Industrial Hygienists** (<http://www.acgih.org/home.htm>) reduced the short-term exposure limit from 5 ppm to 0.25 ppm.

**Ozone O<sub>3</sub>** is a pale blue gas that is produced in the Earth's atmosphere. It is also produced by photocopiers and laser printers. It has a sharp odour (chlorine bleach) so it is detectable at levels of about 0.01 µmol/mol. Exposure to these levels produces symptoms of headaches, burning eyes and irritation to the respiratory tract.

## Organic Chemical Pollution

**Volatile organic compounds (VOCs)** are released into the indoor environment by consumer products, furnishings, pesticides and fuels. They cause irritation of the eyes and respiratory tract and depression of the CNS.

**Formaldehyde (HCHO)** is a colourless gas with a characteristic odour. It is found in cigarette smoke, combustion processes, resins, insulation and in hospitals where it is used as a disinfectant or preservative. It is an irritant and in June 2011, the **US National Toxicology Program** (<http://ntp.niehs.nih.gov/>) described formaldehyde as a known carcinogen.

**Polynuclear aromatic hydrocarbons (PAH)** are atmospheric pollutants. They are produced by the combustion of fossil fuels and industrial processes. PAHs are carcinogenic.

## Physical Factors

- Radiation (UV, Ionising)
- Microclimate (temperature and humidity)
- Noise
- Vibration
- Lighting

**Particulate matter:** combustion sources generate fine particles, which contain organic and inorganic material. Tobacco smoke can be a significant source of indoor particles and are especially hazardous due to their chemical composition. The particles can deposit in different areas within the body depending on particle aerodynamic diameter; fine particles deposit mainly in the thoracic region whereas coarse particles deposit mostly in the nasopharyngeal region.

**Asbestos** is found in insulation materials and asbestos plasters. Inhalation of asbestos can cause malignant lung cancer, mesothelioma and asbestosis. The European Union has banned all use of asbestos.

**Man-made mineral fibres (MMMF)** are fibres manufactured from glass. They are used as asbestos substitutes but can cause mechanical irritation of the skin.

**Radon (Rn)** is a reactive noble gas. Main source of radon is the soil; small doses could also come from water or outdoor air. It is known to be a human carcinogen.

 For more information see Radon.

## Biological Factors

**Biological particles** which affect indoor air quality:

- Mites
- Fungi
- Bacteria

People exposed to biological agents may develop allergic problems:

- Rhinitis with hay fever symptoms
- Asthma
- Humidifier fever
- Extrinsic allergic alveolitis
- Atopic allergic dermatitis

## Links

### Related articles

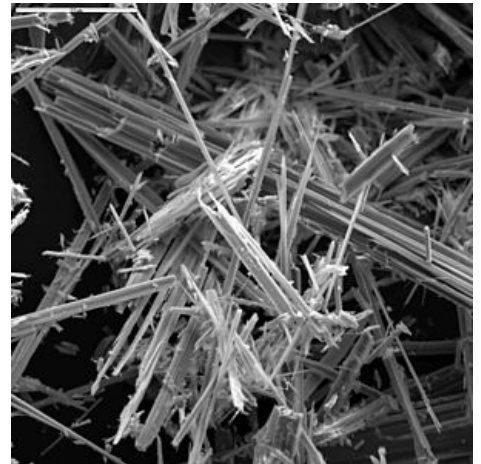
- Carcinogenicity of Substances and Factors in the Environment

### External links

- <http://www.isiaq.org/> (<http://www.isiaq.org/>)
- <http://www.cdc.gov/niosh/topics/indoorenv/> (<http://www.cdc.gov/niosh/topics/indoorenv/>)
- <http://ntp.niehs.nih.gov/> (<http://ntp.niehs.nih.gov/>)
- <http://www.osha.gov/> (<http://www.osha.gov/>)

## Bibliography

- BENCKO, Vladimir, et al. *Hygiene and epidemiology : selected chapters*. 2. edition. Prague. 2008. ISBN 80-246-0793-X.



Asbestos structure (anthophyllite)