



Air Quality in India

“The Right to Healthy Indoor Air (2000)”

The World Health Organization (WHO) report states:

- *“Indoor air quality is an important determinant of population’s health and wellbeing.*
- *Exposure to hazardous airborne agents present in many indoor spaces causes adverse effects such as respiratory disease, allergy and irritation of the respiratory tract.*
- *That is why our responsibility is to provide healthy indoor environment for occupants.”*

Fresh Outdoor Air

A scenic view of Sangla Valley, HP, India. The foreground is dominated by a vast field of bright yellow mustard flowers. In the middle ground, there are green hillsides and a valley floor with scattered rocks. The background shows more mountains under a blue sky with white clouds.

Sangla Valley, HP, India

Outdoor Air in Delhi

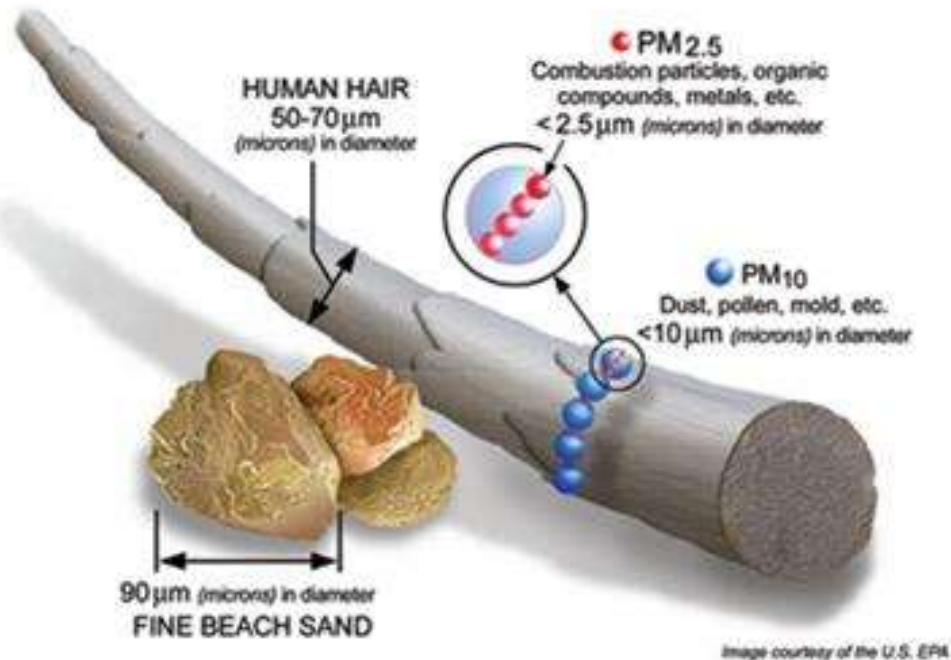


January 2014, Delhi

Main Ambient Air Pollution in India

- Particulate matter (dust, fine and ultra-fine):
 - Traffic (especially diesel cars);
 - Energy production (especially coal power plants);
 - Chullahs and other open fire cooking;
 - Stubble burning;
 - Burning of waste;
 - Industrial process emissions.
- Gases (SO_2 , NO_2 , O_3 , etc.)
 - Traffic;
 - Industrial processes;
 - Open sewage systems.

Ultra-fine Particulates (PM_{2.5} and smaller) are the Health Risk



- The size of particles is directly linked to their potential for causing health problems.
- Ultra-fine particles less than 2.5 micrometres in diameter pose the greatest problems, because they can get deep into your lungs and into your bloodstream.
- Larger particles are of less concern, although they can irritate your eyes, nose, and throat.

WHO: Ambient air pollution in cities database 2014

PM_{2.5} Annual average 2012 (µg/m³)

- **Top 5 most polluted cities in USA:**

– Fresno, CA	45
– Riverside-San Bernardino-Ontario, CA	21
– Los Angeles-Long Beach-Santa Ana, CA	20
– Fairbanks, AK	19
– Hanford-Corcoran, CA	17

2-5 times
higher

- **Top 5 most polluted cities in India:**

– Delhi	153
– Patna	149
– Gwalior	144
– Raipur	134
– Ahmedabad	100

10-15 times
higher

WHO Target: < 10 µg/m³

Health Effects of Ultra-fine Particulates

- **Long-term exposures**, such as those experienced by people living for many years in areas with high particle levels, have been associated with problems such as reduced lung function and the development of chronic bronchitis—and even premature death.
- **Short-term exposures** to particles (hours or days) can aggravate lung disease, causing asthma attacks and acute bronchitis, and may also increase susceptibility to respiratory infections.

<http://www.epa.gov>: Particulate Pollution and Your Health, 2003

WHO: Particulate Pollution Carcinogenic

WHO October 17, 2013 – Outdoor air pollution “causes lung cancer” and increases the risk of bladder cancer.

The International Agency for Research on Cancer, IARC, placed outdoor air pollution in Group 1, a category used only when “there is sufficient evidence of carcinogenicity in humans.”

Particulate matter, a major component of outdoor air pollution, was evaluated separately and was also classified as carcinogenic to humans.

Health effects caused by long-term exposure to fine particles (PM2.5), which is based on an annual standard, also include:

- Premature death, especially related to heart disease
- Cardiovascular effects, such as heart attacks and strokes
- Reduced lung development
- Development of chronic respiratory diseases, such as asthma, in children

The Endpoint of the Toxic Risk is Cancer

- In India over 700,000 new cases and 300,000 people are set to die every year, estimates the National Cancer Control Programme (NCCP).
- NCCP's forecast – by 2026, more than 1.4 million people will be falling in the grip of the disease.
- NCCP has listed greater exposure to environmental carcinogens as one of the most important reasons.
- Mitigation strategy must reduce environmental risk from all factors – and air pollution is an important factor

Source: http://www.cseindia.org/userfiles/top_killers-anumita.pdf

UNEP: Economic Cost of Air Pollution

- Worldwide over 3.5 million people die each year from outdoor air pollution.
- Between 2005 and 2010, the death rate rose by 4% worldwide, by 5% in China and by 12% in India.
- Cost of air pollution to society in 2010 was estimated at USD 1.4 trillion in China and USD 0.5 trillion in India according to a recent study by the OECD.
- In US about 85% of the economic benefits would be due to fewer premature deaths linked to reducing PM_{2.5} in the outdoor environment.

Annually in India INR 30,000,000,000,000
INR 25,000 per person

Relation Between Outdoor and Indoor Air Quality

- Outdoor air is the biggest indoor air pollution source
 - if air is not properly filtered and purified before taken indoors;
- Other indoor air pollution sources are:
 - Tobacco smoking;
 - Copy machines and printers;
 - Cleaning products;
 - Moisture damages and mould growth;
 - Paints, solvents and other construction materials;
 - New furniture;
 - Scents (perfumes, temple sticks, etc.);
 - Other people.



Main Problems in Indoor Environment

- HVAC-system:
 - Poor or no air filtration;
 - Non-balanced ventilation system;
 - Non-operational fans, pumps etc.;
 - Dirty or non-operational fan coil units;
 - Uninsufficient dehumidification.
- Building:
 - Emissions from construction materials;
 - Moisture damages;
 - Air leakage through envelope (doors, windows etc.);
 - Poor solar shading;
 - Insufficient lighting (control, type);
 - Poor sound environment.
- Users:
 - Emissions from furniture, plants, scents, copy/printing machines, etc.;
 - Noisy behaviour;
 - Eating in open-plan office.

Holistic Approach to Improve IAQ

- 1. Study** first in order to understand all potential problems related to indoor air quality:
 - Walk-through in building;
 - Thermal comfort and IAQ measurements (temperature, RH, velocity, PM_{2.5}, CO₂, SO₂, NO₂, O₃, VOCs);
 - User survey – users' are the best experts of their own environment;
 - Technical review of ventilation and cooling systems.
- 2. Set** targets using professional advice.
- 3. Plan** comprehensively to solve all problems at once.
- 4. Implement** improvements with skilled professionals and validate work quality continuously.
- 5. Verify** the results with measurements.
- 6. Create** a system for user complaints and feedback.
- 7. Measure** Indoor Air Quality systematically.
- 8. Maintain** technical systems and building.