

1.7 AMBIENT AIR QUALITY AND EMISSION STANDARDS

Air Quality Index (AQI)

- The Air Quality Index (AQI) is a number used to report the quality of the air on any given day.
- It basically tells you how clean the air is .It measures particles and chemicals in the air that affect people's health.
- The health effects from extreme pollution in places like china can be severe.
- These effects can range from slight irritations, to reduced endurance, to respiratory problems.

Different countries have different AQIs,so it is difficult to compare one location to another on a worldwide scale. Some countries are more safety-conscious than others. The United States uses a 500 point scale to report air quality.

Any rating between 0 to 50 is considered good. A score between 51 and 100 indicates a moderate level of health concern. An AQI number between 101 and 150 is considered un healthy for sensitive groups like the elderly or people with heart or breathing problems. Scores between 151 and 200 are described as unhealthy, while 201 to 300 is considered very unhealthy. And finally, air quality in the 301 to 500 range is deemed hazardous.

AMBIENT AIR QUALITY STANDARDS

- AQI helps in understanding the level at which air is polluted and the associated health effects that might concern.
- EPA calculates the AQI for five major air pollutants :
 1. Ground level ozone
 2. Particulate matter
 3. Carbon monoxide

4. Sulphur dioxide

5. Nitrogen dioxide

- For each of these pollutants, EPA has established national air quality standards to protect public health.
- The EPA has developed the Pollutant Standard Index (PSI) for introducing consistency in providing information regarding the air quality throughout the US. The system is based on a scale of 0-500. Table 1.7.1 Air Quality Index values.

Table 1.7.1 AIR QUALITY INDEX VALUES

Air Quality Index (AQI) Values	Levels of Health Concern
<i>When the AQI is in this range:</i>	<i>..air quality conditions are:</i>
0 to 50	Good
51 to 100	Moderate
101 to 150	Unhealthy for Sensitive Groups
151 to 200	Unhealthy
201 to 300	Very Unhealthy
301 to 500	Hazardous

Good: The AQI value for a community is between 0 and 50 then the air quality is considered satisfactory, and air pollution poses little or no risk.

Moderate: The AQI is between 51 and 100 then the Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people.

Unhealthy for Sensitive Groups: When AQI values are between 101 and 150, members of sensitive groups may experience health effects. This means they are likely to be affected at lower levels than the general public.

Unhealthy: Everyone may begin to experience health effects when AQI values are between 151 and 200. Members of sensitive groups may experience more serious health effects.

Very Unhealthy: AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.

Hazardous: AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

Air Quality Standards:

- **National Ambient Air Quality Standards (NAAQS)**, in the United States, allowable levels of harmful pollutants set by the Environmental Protection Agency (EPA) in accordance with the Clean Air Act (CAA).
- The CAA established two types of standards for ambient air quality. Primary standards concern the minimum level of air quality necessary to keep people from becoming ill and therefore are aimed at protecting public health.
- The primary standards are intended to provide an adequate margin of safety for the public, which has been defined to include a representative sample of so-called sensitive populations, such as the elderly, children, and persons with asthma.
- The secondary standards are aimed at the promotion of public welfare and the prevention of damage to animals, plants, and property.

CLASSIFICATION OF AIR QUALITY STANDARDS:

The air quality standards are classified into two types:

1. Primary standards
2. Secondary standards

1. Primary standards:

Protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly.

2. Secondary standards:

Protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and building.

NATIONAL AMBIENT AIR QUALITY STANDARDS (2009)

Pollutants ($\mu\text{g}/\text{m}^3$)	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by GOI)
Sulphur Dioxide (SO_2)	Annual *	50	20
	24 Hours **	80	80
Nitrogen Dioxide (NO_2)	Annual *	40	30
	24 Hours **	80	80
Particulate Matter, Size less than 10 μm (PM_{10})	Annual *	60	60
	24 Hours **	100	100
Particulate Matter, Size less than 2.5 μm ($\text{PM}_{2.5}$)	Annual *	40	40
	24 Hours **	60	60
Ozone (O_3)	8 Hours *	100	100
	1 Hour **	180	180

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Table 1.7.2 National Ambient Air Quality Standards

AIR QUALITY MONITORING:

- Air quality monitoring help us in better understanding the sources, levels of different air pollutants, effects of air pollution control policy, and exposure of various substances in the air we breathe.
- Air quality monitoring program assists us in improving and developing air pollution control programs to reduce the effect of air pollution.
- The purpose of air monitoring is not merely to collect data, but also to provide the information necessary for engineers, scientists, policy makers, politicians and planners to make informed decisions on managing and improving the air environment.

- Monitoring stations continuously monitor and collect information about the presence and level of atmospheric contaminants as well as the meteorological indices.
- A typical monitoring stations includes sophisticated gaseous pollutant analyzers, particle collectors, weather sensors that are continually maintained and operated.
- In U.S, Environmental Protection Agency (EPA) with the help of state and local agencies monitor air pollution.

Types of Monitoring :

In general air quality monitoring can be grouped into following types:

- **Emissions Monitoring:** This type of monitoring focuses on emissions coming out of natural and manmade sources.
- **Ambient Monitoring:** The emphasis is on ambient air concentration of toxic as well as non-toxic contaminants.
- **Deposition Monitoring:** This type of network measures the dry and wet deposition of atmospheric contaminants.
- **Visibility Monitoring:** Ability to see things is primary focus of this type of monitoring.
- **Upper Air Monitoring:** A look at ambient concentrations in upper atmosphere with the help of satellites, airplanes etc.
- **Health Monitoring:** Recognizes the importance of risk assessment and risk management in public health studies.

Air Quality Monitoring Networks:

Different types of air quality monitoring networks operating today in the world:

- Ambient Air Monitoring Program in the U. S.

- Atmospheric Integrated Research Monitoring Network in the U. S.
- Canadian Air Monitoring Network
- Mexican Network
- Emission monitoring at industrial plants
- Health monitoring program by WHO
- Satellite monitoring by NASA and USEPA

Air Pollutant Instrumentation:

Air pollution instruments are available for the measurement of indoor and outdoor air pollution. The available instruments could be grouped into the following major categories:

- **Concentration Measurement Instruments:** This group includes the instruments available for gaseous and particulate sampling.
- **Continuous Emission Monitoring Systems (CEMS):** Real time monitoring of stack gases is the basic thrust behind such systems.
- **Air Measuring Devices:** This category includes volume meters, rate meters and velocity meters.
- **Meteorological Instruments:** Basic devices used for measuring atmospheric variables are included in this category.



Figure 1.7.1 Air Pollutant Instruments

[Source : <https://images.app.goo.gl/n4kZhrN6E3vjTd578>]

Remediation and Solution:

Efforts to reduce air pollution have largely fallen into three categories:

- Regulatory
- Technological
- Economic or Market-based solutions.

1. Regulatory Solutions

Regulatory solutions involve the passage of laws and establishment of government agencies which attempt to reduce air pollution through government monitoring and punitive measures (usually fines but, in exceptional cases, criminal sentences as well).

2. Technological Solutions

This includes the progress in emissions technology (e.g., reformulated gasoline), pre-warmed catalytic converters, and in the extension of emissions rules to truck, pickups and SUVs

3. Market-based Solutions

These solutions allow firms the flexibility to select cost-effective solutions to achieve established environmental goals.

Emission Inventory:

Emission inventory is an estimate of the amount of pollutants emitted into atmosphere.

Developed by:

- Plant
- Local environmental agency
- National environmental agency

Characterized by the following aspects:

- Type of activities that cause emissions,

- Chemical or physical identity of the pollutants included,
- Geographic location,
- Time period over which emissions are estimated.

Details for development of an emission inventory depend on:

- Area of coverage
- Nature of sources
- Purpose
- Well known emission inventories in the US
- Inventory of criteria pollutants
- Toxic release inventory (TRI)
- Greenhouse gas emissions (first reporting: March 31, 2010)

Emission Rate:

- Emission rate is the weight of a pollutant emitted per unit time.
- Emission factor is an estimate of the rate at which a pollutant is released into the atmosphere per unit level of activity.

To calculate emission rate:

EMISSION RATE = [INPUT] x [EMISSION FACTOR] x [APPLICABLE CORRECTION FACTORS] x [HOURS OF OPERATION] x [SEASONAL VARIATION]

Emission Inventory:

- The EPA estimates emission levels ranging from counties to the nation level.
- The EPA has developed several models to estimate current and future emissions in the atmosphere from different sources.

✚ MOBILE 6

✚ NON-ROAD

These models are computer based applications and are available for free from the EPA's official website.

Steps to Develop Emission Inventory:

Steps Involved in development of an emission inventory are:

- Planning
- Data Collection
- Data Analysis
- Reporting Data

1. Planning

Defines scope and purpose of inventory Major points considered during this step are:

- Pollutants to be enlisted in the inventory are specified along with the methods to collect or estimate data.
- Use of data and geographical area involved are determined.
- Legal authority and responsibility of specific groups to acquire data is considered along with an assessment of cost and resources.

2. Data Collection

Steps to be taken:

- Emissions are classified
- Pollutant sources are located and classified
- Quality and quantity of materials handled, processed, or burned is determined

Collection Methods:

During this stage data may be collected by

- Mail survey
- Plant inspection
- Field surveys

Data from literature:

- Industrial files
- Government files
- Periodicals
- Trade journals
- Scientific publications

Information Collected During Data Collection:

- General source information - location, ownership, and nature of business
- Activity levels - amount of fuel and materials (input)
- Amount of production - output of the plant
- Control device information - type of pollution control devices
- Information required estimating emissions - temperature, tank conditions, and hours of operations, seasonal variation and other data.

3. Data Analysis

- Check accuracy
- Calculation of emission rate is done using:
 - + Monitoring data (most accurate & most expensive)
 - + Emission factors.
 - + Mass balance, and
 - + Engineering calculation

4. Reporting Data

- Information can be filed with the following pollution control agencies:
 - + Local
 - + Regional
 - + National

- In US, data gathered by state agencies are reported to the USEPA
- Emission data are available from the USEPA's web site.

Uses of an Emission Inventory:

The Emission Inventory developed may be used for:

- Identifying types of pollutants emitted from specific sources.
- Determining the magnitude or amount of emissions from those sources
- Developing the emissions distribution in time and space
- Calculating emission rates under specific plant operating conditions
- Finding out the relation of ambient air pollutant concentration with specific sources
- Input data for air quality modeling and risk
- Determine pollution control options for public health
- Estimating cost based on emissions

Emission Standards:

Emission standards are the legal requirements governing air pollutants released into the atmosphere. Emission standards set quantitative limits on the permissible amount of specific air pollutants that may be released from specific sources over specific timeframes. They are generally designed to achieve air quality standards and to protect human life. Different regions and countries have different standards for vehicle emissions.

Regulated sources:

Many emissions standards focus on regulating pollutants released by automobiles (motor cars) and other powered vehicles. Others regulate emissions from industry, power plants, small equipment such as lawn mowers and diesel generators, and other sources of air pollution.

Bharat stage emission Standards:

- Bharat stage emission standards (BSES) are emission standards instituted by the Government of India to regulate the output of air pollutants from compression ignition engines and Spark-ignition engines equipment, including motor vehicles.
- The standards and the timeline for implementation are set by the Central Pollution Control Board under the Ministry of Environment, Forest and Climate Change.
- The standards, based on European regulations were first introduced in 2000.
- Progressively stringent norms have been rolled out since then. All new vehicles manufactured after the implementation of the norms have to be compliant with the regulations.
- By 2014, the country was under a combination of Euro3 and Euro4 based norms, with Euro4 standards partly implemented in 13 major cities.
- As of April 2017, the entire country was under BSIV norms, which is based on Euro4
- It is planned that manufacture and registration of BSIV vehicles will be caused, by April 2020 and June 2020 respectively.
- Skipping Euro5, BS VI will be introduced across the country by the April 1, 2020.