**Air quality Analysis – Literature survey**

**Introduction**

The problem of air pollution goes on increasing with increase in urbanisation. While we reap the benefits of innovations in the city. It is also our responsibility to know what we are giving back to it.

We have taken up one of the key factors that defines the life in a place, The Air.

Before getting into the numbers and graphs, we can see, breathe and feel the degradation of the quality of air around us. Although the environmental awareness continues to spread, the air quality continues to degrade.

Our first aim is to use these numbers to identify and learn any sorts of correlations among the pollutants. Thereby, getting some clarity on the causes and help us take precise recovery measures with high accuracy.

Secondly, we intent to build a prediction system that takes the necessary inputs and provides an estimate of the AQI and other concerned pollutant levels.

**Things to know**

**AQI: Air Quality Index**

An **air quality index** (AQI) is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. Different countries have their own air quality indices, corresponding to different national air quality standards.

In India, The National Air Quality Index (AQI) was launched in New Delhi on 17 September 2014 under the Swachh Bharat Abhiyan.

The Central Pollution Control Board along with State Pollution Control Boards has been operating National Air Monitoring Program (NAMP) covering 240 cities of the country having more than 342 monitoring stations.

 An Expert Group comprising medical professionals, air quality experts, academia, advocacy groups, and SPCBs was constituted and a technical study was awarded to IIT Kanpur. IIT Kanpur and the Expert Group recommended an AQI scheme in 2014.

While the earlier measuring index was limited to three indicators, the new index measures eight parameters. The continuous monitoring systems that provide data on near real-time basis are installed in New Delhi, Mumbai, Pune and Ahmedabad.

There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. The proposed AQI will consider eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed.

Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI. Likely health impacts for different AQI categories and pollutants have also been suggested, with primary inputs from the medical experts in the group.

The AQI values and corresponding ambient concentrations (health breakpoints) as well as associated likely health impacts for the identified eight pollutants are as follows:

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| **AQI Category, Pollutants and Health Breakpoints** | | | | | | | | |
| **AQI Category (Range)** | **PM10 (24hr)** | **PM2.5 (24hr)** | **NO2 (24hr)** | **O3 (8hr)** | **CO (8hr)** | **SO2 (24hr)** | **NH3 (24hr)** | **Pb (24hr)** |
| Good (0–50) | 0–50 | 0–30 | 0–40 | 0–50 | 0–1.0 | 0–40 | 0–200 | 0–0.5 |
| Satisfactory (51–100) | 51–100 | 31–60 | 41–80 | 51–100 | 1.1–2.0 | 41–80 | 201–400 | 0.5–1.0 |
| Moderately polluted (101–200) | 101–250 | 61–90 | 81–180 | 101–168 | 2.1–10 | 81–380 | 401–800 | 1.1–2.0 |
| Poor (201–300) | 251–350 | 91–120 | 181–280 | 169–208 | 10–17 | 381–800 | 801–1200 | 2.1–3.0 |
| Very poor (301–400) | 351–430 | 121–250 | 281–400 | 209–748 | 17–34 | 801–1600 | 1200–1800 | 3.1–3.5 |
| Severe (401–500) | 430+ | 250+ | 400+ | 748+ | 34+ | 1600+ | 1800+ | 3.5+ |

|  |  |
| --- | --- |
| **AQI** | **Associated Health Impacts** |
| Good (0–50) | Minimal impact |
| Satisfactory (51–100) | May cause minor breathing discomfort to sensitive people. |
| Moderately polluted (101–200) | May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults. |
| Poor (201–300) | May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease. |
| Very poor (301–400) | May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases. |
| Severe (401–500) | May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity. |

**Pollutants**

**1.PM10** & **PM2.5**

PM10 is particulate matter 10 micro meters or less in diameter, PM2.5 is particulate matter 2.5 micrometers or less in diameter. PM2.5 is generally described as fine particles. By way of comparison, a human hair is about 100 micrometres, so roughly 40 fine particles could be placed on its width.

**Health Effects**

Recent epidemiological research suggests that there is no threshold at which health effects do not occur. The health effects include:

1. toxic effects by absorption of the toxic material into the blood (e.g. lead, cadmium, zinc)
2. allergic or hypersensitivity effects (e.g. some woods, flour grains, chemicals)
3. bacterial and fungal infections (from live organisms)
4. fibrosis (e.g. asbestos, quartz)
5. cancer (e.g. asbestos, chromates)
6. irritation of mucous membranes (e.g. acid and alkalis)
7. increased respiratory symptoms, aggravation of asthma and premature death. The risks are highest for sensitive groups such as the elderly and children.
8. The factors that may influence the health effects related to exposure to particles include:
9. the chemical composition and physical properties of the particles
10. the mass concentration of the airborne particles
11. the size of the particles (smaller particles may be associated with more adverse effects because they can be inhaled more deeply into the lungs)
12. the duration of exposure (short and long term, possibly in years).

**Entering the body**

Particles in the PM10 size range are commonly present in air and may be drawn into the body with every breath. In the lungs particles can have a direct physical effect and/or be absorbed into the blood. Airborne particles, not only the PM10 fraction, may also may be deposited in the mouth, throat or nose and be ingested.

**Exposure**

All people are continuously exposed to some extent except in special filtered environments. Exposure may be higher in urban and industrial areas due to an increase in the number of sources, however high levels may also occur in natural environments.

**Health guidelines**

National Ambient Air Quality Standards:  
Under the National Environment Protection Measure for Ambient Air Quality, Australian governments have set a national ambient air quality standard for PM10 of 50 micrograms per cubic metre (50 µg/m3) in outdoor air averaged over a 24-hour period. The goal, to be met by 2008, is for the standard to be exceeded no more than five days a calendar year.

The Measure was varied in 2003 to include advisory reporting standards for PM2.5. These are: 25 µg/m3 averaged over 24 hours; and 8 µg/m3averaged over one year. The goal of the variation is to collect sufficient PM2.5 monitoring data to allow the development of air quality standards.

Workplace exposure:  
Currently, the eight-hour time weighted average (TWA) exposure limits are 10 milligrams of inspirable dust per cubic metre of air. Consult with your state or territory workplace safety authority to confirm current guidelines for particulate matter.

**Environmental Effects**

PM10 may affect animals in the same way as it affects humans. Particles in general, not specifically PM10 or PM2.5, affect the aesthetics and utility of areas through visibility reduction and may affect buildings and vegetation. The specific effect of particles depends on their composition, concentration and the presence of other pollutants such as acid forming gases.

**Entering the environment**

Particles in the air affect both the quality of the air and visibility. Once in the air particulate matter generally takes a long time to settle. The particulates may be washed from the air by rain or snow. When they settle on land they may settle permanently or be re-entrained. In water particulates may settle, dissolve or both.

**Where it ends up**

PM10 and PM2.5 are very fine and light and are therefore easily entrained into the air by wind or disturbances. Chemical changes may occur, as may reactions with other substances, depending on the composition of the particles. Particles may stick together or break apart, changing the size distribution over time.

**Sources of Emission**

**Industry sources**

PM10 and PM2.5 are produced from a wide range of industrial processes through bulk material handling, combustion and minerals processing. The industries using these processes include brickworks, refineries, cement works, iron and steel making, quarrying, and fossil fuel power plants.

**Diffuse sources, and industry sources included in diffuse emissions data**

Particulates are released from a wide range of diffuse sources. Examples include lawn mowing, wood stoves, fires, and wind generated dust, though this tends to be coarser.

**Natural sources**

Natural sources of PM10 and PM2.5 include bushfires, dust storms, pollens and sea spray.

**Transport sources**

Vehicles will generate particulates either from direct emissions from the burning of fuels (especially diesel powered vehicles) or from wear of tyres or vehicle-generated air turbulence on roadways. Particles may also be generated from the action of wind on the dusty material that the vehicle may be carrying.

**Consumer products**

Particulates are not generally included intentionally in any product but may be present as part of the product, for example as part of talc or other powder products.

**2.NO2**

Oxides of nitrogen are a mixture of gases that are composed of nitrogen and oxygen. Two of the most toxicologically significant compounds are nitric oxide (NO) and nitrogen dioxide (NO2). Other gases belonging to this group are nitrogen monoxide (or nitrous oxide, N2O), and nitrogen pentoxide (NO5).

Nitrogen dioxide is produced for the manufacture of nitric acid. Most nitric acid is used in the manufacture of fertilisers, while some is used in the production of explosives for both military and mining uses.

**Health Effects**

Low levels of oxides of nitrogen can irritate eyes, nose, throat and lungs, possibly leading to coughing, shortness of breath, tiredness and nausea. Exposure can also result in a build up of fluid in the lungs for 1-2 days after exposure. Breathing high levels of oxides of nitrogen can cause rapid burning, spasms and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of tissues, a build up of fluid in the lungs, and maybe even death.

Skin or eye contact with high concentrations of oxides of nitrogen gases or nitrogen dioxide liquid will likely lead to serious burns.

**Entering the body**

Oxides of nitrogen may be inhaled or absorbed through the skin.

**Exposure**

Most people are exposed to oxides of nitrogen by breathing in polluted air. People who live near combustion sources such as coal burning power plants or areas of high motor vehicle usage, or live in households that burn a lot of wood or use kerosene heaters or gas stoves may be exposed to higher levels of nitrogen oxides. Workers employed in facilities that use welding materials, produce nitric acid or certain explosives, may inhale oxides of nitrogen during their work.

Nitrogen dioxide and nitric oxide are found in tobacco smoke.

**Health guidelines**

Workplace exposure:  
Currently, the eight-hour time weighted average (TWA) exposure limits are 31 milligrams of nitric oxide (NO) per cubic metre of air, 45 milligrams of nitrous oxide (N2O) per cubic metre of air and 5.6 milligrams of nitrogen dioxide (NO2) per cubic metre of air. A 15-minute short term exposure limit (STEL) has been established for NO2 at a level of 9.4 milligrams per cubic metre.

Australian drinking water guidelines:  
In 2004, the National Health and Medical Research Council (NHMRC) and the National Resource Management Ministerial Council (NRMMC) established the following guidelines for acceptable water quality:

Based on health considerations, the concentration of nitrates should not exceed 50 milligrams per litre of drinking water for bottle-fed infants up to 3 months of age, up to 100 milligrams per litre of drinking water for adults and children over 3 months of age.

Where a water supply has between 50 and 100 milligrams of nitrate per litre of drinking water, active measures are required to ensure that those caring for infants are aware of the need to use alternative water sources in making up bottle feeds for infants under 3 months of age.

Based on health considerations, the concentration of nitrites should not exceed 3 milligrams per litre of drinking water.

**Environmental Effects**

Excessive levels of the oxides of nitrogen, particularly nitrogen dioxide (NO2), can cause death in plants and roots and damage the leaves of many agricultural crops. NO2 is the damaging component of photochemical smog. Excessive levels increase the acidity of rain (lower the pH), and thus lower the pH of surface and ground waters and soil. The lowered pH can have harmful effects, possibly even death, on a variety of biological systems.

**Entering the environment**

Oxides of nitrogen are part of the biogeochemical cycling of nitrogen, and are found in air, soil and water.

In the atmosphere, the oxides of nitrogen are rapidly equilibrated to nitrogen dioxide (NO2), which eventually forms acid rain. In the stratosphere, oxides of nitrogen play a crucial role in maintaining the levels of ozone. Ozone is formed through the photochemical reaction between nitrogen dioxide and oxygen.

## **Where it ends up**

Oxides of nitrogen are rapidly broken down by reacting with other substances found in the air. Nitrogen dioxide can form nitric acid in sunlight, and is a major constituent of acid rain, tropospheric ozone and smog. Nitrogen oxides react in the soil and the water to nitric acid.

## **Environmental guidelines**

The following ambient air quality standards were established for nitrogen dioxide in 1999:  
Averaging period of 1 hour, a maximum of 0.12 parts per million, with a maximum allowable exceedance of 1 day per year.  
Averaging period of 1 year, a maximum of 0.03 parts per million.

**Sources of Emission**

**Industry sources**

Industrial sources of oxides of nitrogen are electricity supply, mining, oil and gas extraction, manufacturing industries and petroleum manufacturing.

**Diffuse sources, and industry sources included in diffuse emissions data**

A variety of agricultural (both cultivation and animal feeding) and forestry (both "burn-offs" and clearfelling) activities increase the rate of natural processes that produce oxides of nitrogen. Fuel burning activities, such as for heating, and cigarette smoking are also diffuse sources of oxides of nitrogen.

**Natural sources**

The biological cycling of nitrogen includes processes that produce nitric oxide and nitrous oxide as intermediates.

Thermal processes in the atmosphere (during lightning or bushfires/wildfires) produce oxides of nitrogen.

**Transport sources**

Oxides of nitrogen are present in the exhausts of all vehicles, including motor vehicles, lawn mowers, shipping/boating, aeroplanes and railways.

**Consumer products**

Nitrate containing fertilisers contain oxides of nitrogen.

**3.SO2**

As a fruit preserving agent and as a food preservative or additive.  
In the fermentation stage of wine making.  
For bleaching textile fibres.  
In the manufacture of paper.  
As a disinfectant in breweries and food factories.  
As a fumigant for grains, grapes and citrus fruits.

**Health effects**

Exposure to concentrations of 10 to 50 parts per million for 5 to 15 minutes causes irritation of the eyes, nose and throat, choking and coughing.

Exposure of the eyes to liquid sulfur dioxide, (from, for example an industrial accident) can cause severe burns, resulting in the loss of vision. On the skin it produces burns. Other health effects include headache, general discomfort and anxiety. Those with impaired heart or lung function and asthmatics are at increased risk. Repeated or prolonged exposure to moderate concentrations may cause inflammation of the respiratory tract, wheezing and lung damage. It has also proved to be harmful to the reproductive systems of experimental animals and caused developmental changes in their newborn.

**Entering the body**

Sulfur dioxide will enter the body if we breathe in contaminated air. Upon entry, nose, throat and lungs may be affected. Sulfur dioxide can also enter our bodies when we eat or drink food or beverages (wine) which contain sulfur dioxide as a preservative. Sulfur dioxide can enter the body through skin contact.

## **Exposure**

Sulfur dioxide is a common pollutant to which we are exposed at very low levels every day by breathing air in cities and some industrial environments. Higher exposure levels are more likely to be found in the workplace where it is produced as a by-product, such as in smelting and the combustion of coal or oil. Exposure can also happen from the manufacture of fumigants, food preservatives, bleaches and wine making. It can be ingested by eating preserved foods and breathed in causing a risk to asthmatics and other individuals sensitive to its effects.

## **Health guidelines**

National Ambient Air Quality Standards and Goals:

Averaging period 1 hour: Maximum 0.2 parts per million, maximum allowable exceedences: 1 day a year.

Averaging period 1 day: Maximum 0.08 parts per million, maximum allowable exceedences: 1 day a year.

Averaging period 1 year: Maximum 0.02 parts per million, maximum allowable exceedences: none.

**http://www.npi.gov.au/resource/sulfur-dioxide**

**CO**

**http://www.npi.gov.au/resource/carbon-monoxide-0**

**O3**

**NH3**

[**http://www.npi.gov.au/resource/ammonia-total**](http://www.npi.gov.au/resource/ammonia-total)

**Pb**

[**http://www.npi.gov.au/resource/lead-compounds**](http://www.npi.gov.au/resource/lead-compounds)

<http://www.indiaonlinepages.com/population/bangalore-population.html>