AWARENESS PROGRAMME
ON
ENVIRONMENTAL MONITORING
with respect to
AIR, NOISE, WATER & SOIL

By
ENVIS CENTRE, EPTRI

Survey No. 91/4, Gachibowli, Hyderabad - 500 032, India.
ENVIRONMENTAL MONITORING

with respect to

AIR, NOISE, WATER & SOIL

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ENVIS DIVISION
EPTRI
AIR

- The atmosphere is one of the most important components for supporting life on earth
- Average human requires about 12 kg of air each day, which is nearly 12-15 times higher than the food we take. This is why even the small concentration of pollutants in the air matters
- Various pollutants do and will continue to effect the life on this planet
- Air pollution occurs when the air contains gases, dust, fumes or odour in harmful amounts. That is, amounts which could be harmful to the health or comfort of humans and animals or which could cause damage to plants and materials.
CLASSIFICATION OF POLLUTANTS

- **Natural contaminants**
  
  *Ex: Natural fog, Pollen grains, bacteria and volcanic eruption.*

- **Aerosols (particulates)**
  
  *Ex: Dust, Smoke, Mists, Fog and fumes.*

- **Gaseous and Vapours**
  
  *Ex: Sulphur compounds, Nitrogen Oxides, Carbon monoxide*
AIR POLLUTANTS CAN ALSO BE CLASSIFIED INTO TWO GROUPS: PRIMARY AND SECONDARY AIR POLLUTANTS.

<table>
<thead>
<tr>
<th>Primary Air Pollutants are those emitted directly from identifiable source. They are</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Finer particles (&lt;10μ dia)</td>
</tr>
<tr>
<td>• Coarse Particles (&gt;10μ dia).</td>
</tr>
<tr>
<td>• Sulphur compounds</td>
</tr>
<tr>
<td>• Oxides of Nitrogen</td>
</tr>
<tr>
<td>• Carbon monoxide</td>
</tr>
<tr>
<td>• Halogen compounds</td>
</tr>
<tr>
<td>• Organic compounds &amp; Radioactive compounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary pollutants are which produced in air by the interaction among two or more primary pollutants or by reaction with normal atmospheric constituents with or without photo activation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• $O_3$</td>
</tr>
<tr>
<td>• Peroxy acetyl Nitrate (PAN)</td>
</tr>
<tr>
<td>• Photochemical smog</td>
</tr>
<tr>
<td>• Formaldehyde</td>
</tr>
<tr>
<td>• Formation of acid mists (H$_2$SO$_4$)</td>
</tr>
</tbody>
</table>
EMISSIONS MAY BE CLASSIFIED BY SOURCE

Stationary or Mobile, Point source (Large Stationary source), Area Source (Small Stationary Source and Mobile source with indefinite source, Line source (Mobile source with definite roots)

Total sources

Stationary sources

Point Source

1. Industrial processing
2. Power Plants
3. Fuel Combustion (Coal, oil, gas)
4. Solid waste Disposal (Municipal Incinerators, open burning)
5. Miscellaneous.

Mobile sources

Area source

1. Residential By heating (Coal, gas, oil)
2. Institutional and commercial heating. (Coal, oil, gas)
3. On site incineration
4. Open-burning
5. Evaporative losses

Line source

1. High way Locomotives Vehicles.
2. Rail road
3. Channel Vessels.

Area source

1. Motor vehicles. (Light-duty, Medium-duty, heavy-duty)
2. Rail-yard Locomotives
3. Port-vessels.
4. Air-craft.
5. Miscellaneous.
## EFFECTS AND SOURCES OF AIR POLLUTION

<table>
<thead>
<tr>
<th>Air pollutant</th>
<th>Typical source</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust (or) Particulates</td>
<td>Mines and quarries, pottery and ceramics, factory stacks, power stations and</td>
<td>On man – respiratory diseases; diseases like silicosis, etc from Specific dusts; On property – soiling effect and corrosion</td>
</tr>
<tr>
<td></td>
<td>Civil construction works etc.</td>
<td></td>
</tr>
<tr>
<td>Sulphur dioxide</td>
<td>Power houses, Sulphuric acid plants, petroleum industry, oil refining, domestic</td>
<td>On man – suffocation irritation of throat and eye, respiratory; diseases On vegetation – destruction of sensitive crops and reduced yield On property - corrosion</td>
</tr>
<tr>
<td></td>
<td>use of fuel</td>
<td></td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>Acid manufacture, automobile exhaust, explosive industry</td>
<td>On man – irritation, bronchitis, edema of lungs On property - darkening of painted surfaces, corrosion.</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>Viscose rayon plants, petroleum industry, sewage treatment, tanning industry,</td>
<td>On man—irritation of respiratory passages, danger of respiratory paralysis and asphyxiation</td>
</tr>
<tr>
<td></td>
<td>dye manufacture etc.</td>
<td></td>
</tr>
<tr>
<td>Hydrogen fluoride,</td>
<td>Fertilizer industry, chemical industry, aluminum industry, chemical industry,</td>
<td>On man – irritation of fluorosis, motting of teeth, respiratory diseases On vegetation – destruction of crops On animals- fluorosis in cattle grazing on such vegetation</td>
</tr>
<tr>
<td></td>
<td>aluminum industry</td>
<td></td>
</tr>
<tr>
<td>Carcinogenic hydrocarbons</td>
<td>Organic chemical industry, vehicular traffic specially automobiles</td>
<td>On man – cancer</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Fuel gases, automobile exhaust, mines, blast furnaces</td>
<td>On man – poisoning increased accident liability.</td>
</tr>
<tr>
<td>Oxidants</td>
<td>Photo- chemical products from organic irradiated in the presence of Nitrogen</td>
<td>On man – lung irritation On vegetation – destruction of vegetation On property-deterioration of rubber smog formation is not extensive in tropical countries like India.</td>
</tr>
<tr>
<td></td>
<td>dioxide Nitrogen dioxide; by silent electric discharge and by intense UV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiation</td>
<td></td>
</tr>
</tbody>
</table>
Normal Human lung (left) and the lungs of a person who died from emphysema. Prolonged smoking and exposure to air pollutants can cause emphysema in anyone, but 2% emphysema* cases results from a defective gene that reduces the elasticity of the air sacs in the lungs.

* a condition in which the air sacs of the lungs are damaged and enlarged, causing breathlessness.
AMBIENT AIR QUALITY ASSESSMENT

Air quality assessment (AQA) begins with a knowledge of existing air quality conditions that depend on ambient pollutant concentrations, pollutant sources and their locations, meteorology and climatology and local topographical and physical conditions affecting pollutant dispersion.
Air (Prevention and Control of Pollution) Act 1981

Government of India enacted the Air (Prevention and Control of Pollution) Act 1981 to arrest the deterioration in the air quality.

FUNCTIONS OF THE CENTRAL POLLUTION CONTROL BOARD:

- To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the SPCB.
- To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution;
- To lay down standards for the quality of air and emission quantities.

FUNCTIONS OF THE STATE POLLUTION CONTROL BOARDS:

- To plan a comprehensive programme for prevention, control and abatement of air pollution and to secure the execution thereof;
- To advise the State Government on any matter concerning prevention, control and abatement of air pollution.
- To collect and disseminate information related to air pollution.
- To collaborate with CPCB in programme related to prevention, control and abatement of air pollution; and
- To inspect air pollution control areas, assess quality of air and to take steps for prevention, control and abatement of air pollution in such areas.
GUIDELINES FOR MONITORING

Background Information

- **Sources and Emissions**
  vehicles, industries, domestic etc. In an industrial area, type of industries including their number, fuel used, composition of fuel, pollutants emitted etc. vehicles, industries, domestic etc. In an industrial area, type of industries including their number, fuel used, composition of fuel, pollutants emitted etc.

- **Health and Demographic Information**
public complaints, population density, Information on age and socio-economic status of population

- **Meteorological Information**
Meteorological data with respect to temperature, relative humidity, wind speed and direction should be collected. The monitoring stations should be located in areas that are downwind from the sources.

- **Topographical Information**
Local winds and stability conditions are affected by topography. In river valleys there is increased tendency of developing inversions. More number of monitoring stations should be located in areas where spatial variations in concentrations is large. Mountains, hills, water bodies also affect dispersion of pollutants.
Previous Air Quality Information

An area map of a suitable scale is also helpful.

Information on the sources of pollution situated at longer distances and which are likely to contribute significantly to pollution of the area under survey should be collected.

Relevant data regarding physico-chemical behavior in the atmosphere of the particular pollutant to be sampled should also be collected.
LOCATION OF MONITORING STATIONS

In general the location of air quality monitoring stations should satisfy the following:

- The site should be representative of the area selected
- The station should be setup and operated so as to yield data that can be compared with those from stations within the network and
- Certain physical requirements such as available of site for a long period, electrical power supply etc., should be satisfied at the site
METEOROLOGICAL STUDIES

- An Automatic meteorological station, AutoMet (model 466A) is used for monitoring of the micro-meteorological conditions.

- The monitoring equipment has sensors to record wind speed, wind direction, air temperature, relative humidity, rainfall, solar radiation and barometric pressure at predefined intervals ranging from 20 seconds to one hour intervals.

- The data logger provider in the instrument would facilitate downloading of meteorological data onto the computer with the help of the software provided.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Parameters to be monitored</th>
<th>Sampling period and frequency</th>
<th>Total No. of Samples</th>
<th>Measurement Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro-meteorological study</td>
<td>Meteorological: i) Wind speed and direction</td>
<td>Sampling period: one season</td>
<td>2160 for 3 months</td>
<td>Automatic weather station</td>
</tr>
<tr>
<td></td>
<td>ii)Max &amp; Min Temp</td>
<td>Frequency: Hourly observations for one season</td>
<td></td>
<td>Rain Gauge</td>
</tr>
<tr>
<td></td>
<td>iii) Ambient temperature</td>
<td></td>
<td></td>
<td>As per IMD specification</td>
</tr>
<tr>
<td></td>
<td>iv) Relative Humidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>v) Rainfall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>vi) Solar radiation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>vii) Cloud cover</td>
<td></td>
<td></td>
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</tbody>
</table>
Automatic meteorological station
Wind Rose Diagram
# Ambient Air Quality Monitoring

<table>
<thead>
<tr>
<th>Activity</th>
<th>Parameters to be monitored</th>
<th>Sampling period and frequency</th>
<th>Total No. of Samples</th>
<th>Measurement Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air quality (AAQ)</td>
<td>Particulate matter (PM)</td>
<td></td>
<td></td>
<td>Gravimetric (RDS )</td>
</tr>
<tr>
<td></td>
<td>i) Particulate Matter(size less than 10 µ)PM ₁₀</td>
<td></td>
<td></td>
<td>Gravimetric (Ambient Fine dust sampler)</td>
</tr>
<tr>
<td></td>
<td>ii) Particulate Matter(size less than 2.5 µ) PM ₂.₅</td>
<td></td>
<td></td>
<td>Improved West-Geake method.</td>
</tr>
<tr>
<td></td>
<td>Gaseous pollutants (GP)</td>
<td></td>
<td></td>
<td>Modified Jacob-Hochheiser method.</td>
</tr>
<tr>
<td></td>
<td>iii) Sulphur dioxide (SO₂)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>iv) Oxides of Nitrogen (NO₂)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sampling Period: 24 hourly sample for particulate matter(PM ₁₀ &amp; PM ₂.₅) and 8 hourly sample for gaseous pollutants and averaged for 24hours Frequency: Twice a week for one season</td>
<td>PM ₁₀ = 24 samples/station * 10 stations PM ₂.₅ = 24 samples/station * 10 stations GP = 72 samples/station * 10 stations</td>
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</tbody>
</table>
Ambient Air Quality Standards

Respirable Dust Sampler

Ambient Fine Dust Sampler
### NATIONAL AMBIENT AIR QUALITY STANDARDS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Pollutant</th>
<th>Time Weighted Average</th>
<th>Concentration in Ambient Air</th>
<th>Methods of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Industrial, Residential, Rural and other Area</td>
<td>Ecologically Sensitive Area (notified by Central Government)</td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Sulphur Dioxide ($SO_2$), $\mu g/m^3$</td>
<td>Annual* 24 hours**</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide ($NO_2$), $\mu g/m^3$</td>
<td>Annual* 24 hours**</td>
<td>40</td>
<td>30</td>
</tr>
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<td></td>
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</tr>
<tr>
<td>3</td>
<td>Particulate Matter (size less than 2.5$\mu m$) or PM$_{10}$ $\mu g/m^3$</td>
<td>Annual* 24 hours**</td>
<td>60</td>
<td>40</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Particulate Matter (size less than 2.5$\mu m$) or PM$_{24}$ $\mu g/m^3$</td>
<td>Annual* 24 hours**</td>
<td>40</td>
<td>40</td>
</tr>
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<td></td>
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</tr>
<tr>
<td>5</td>
<td>Ozone ($O_3$) $\mu g/m^3$</td>
<td>8 hours** 1 hour**</td>
<td>100</td>
<td>100</td>
</tr>
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<td></td>
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</tr>
<tr>
<td>6</td>
<td>Lead (Pb) $\mu g/m^3$</td>
<td>Annual* 24 hours**</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.No.</td>
<td>Pollutant</td>
<td>Time Weighted Average</td>
<td>Industrial, Residential, Rural and other Area</td>
<td>Ecologically Sensitive Area (notified by Central Government)</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------</td>
<td>-----------------------</td>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Carbon Monoxide (CO) mg/m³</td>
<td>8 hours**</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour**</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>8</td>
<td>Ammonia (NH₃) µg/m³</td>
<td>Annual*</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24 hours**</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>9</td>
<td>Benzene (C₆H₅) µg/m³</td>
<td>Annual*</td>
<td>05</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Benzo(a)Pyrene (BaP) – particulate phase only, ng/m³</td>
<td>Annual*</td>
<td>01</td>
<td>01</td>
</tr>
<tr>
<td>11</td>
<td>Arsenic (As), ng/m³</td>
<td>Annual*</td>
<td>06</td>
<td>06</td>
</tr>
<tr>
<td>12</td>
<td>Nickel (Ni), ng/m³</td>
<td>Annual*</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or, 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year, 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.
Air Quality Monitoring

The Ambient air quality was monitored at five locations surrounding Hussain Sagar Lake. The parameters monitored were Particulate Matter, size less than 10µm (PM$_{10}$), Particulate Matter size less than 2.5 µm (PM$_{2.5}$) and Gaseous parameters viz., Nitrogen di- oxide (as NO$_2$), Sulphur dioxide (SO$_2$), Hydrogen Sulphide (H$_2$S) and Ammonia (NH$_3$). The sample collection and analysis was carried out as per standard methods specified in National Ambient Air Quality Standards (NAAQS), CPCB, November, 2009. Hydrogen Sulphide was collected and analyzed as per Method No.701, Air Sampling Methodology.

The locations are presented in Figure and details in Table

**Table Sampling locations of Ambient Air Quality Monitoring**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Station code</th>
<th>Name of the station</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AAQ-1</td>
<td>Buddha purnima (Lumbini Park)</td>
<td>17°24'32.3&quot; N</td>
<td>78° 28' 25.5&quot; E</td>
</tr>
<tr>
<td>2.</td>
<td>AAQ-2</td>
<td>STP Plant at Balkapur Nalla</td>
<td>17°25'00.0&quot; N</td>
<td>78° 27' 50.7&quot; E</td>
</tr>
<tr>
<td>3.</td>
<td>AAQ-3</td>
<td>Kukatpally Nalla at Necklace road</td>
<td>17°26'14.3&quot; N</td>
<td>78° 28' 12.6&quot; E</td>
</tr>
<tr>
<td>4.</td>
<td>AAQ-4</td>
<td>Sanjeevaiah Park</td>
<td>17°26'02.6&quot; N</td>
<td>78° 28' 39.6&quot; E</td>
</tr>
<tr>
<td>5.</td>
<td>AAQ-5</td>
<td>Buddha bhavan</td>
<td>17°25'39.15&quot;N</td>
<td>78° 29' 13.17&quot;E</td>
</tr>
</tbody>
</table>
Table-3.2 Ambient Air Quality Monitoring

(All values are in \(\mu g/m^3\))

<table>
<thead>
<tr>
<th>Code</th>
<th>PM_10</th>
<th>PM_2.5</th>
<th>SO_2</th>
<th>NO_2</th>
<th>H_2S</th>
<th>NH_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAQ-1</td>
<td>118</td>
<td>65.1</td>
<td>16.9</td>
<td>26.3</td>
<td>16.7</td>
<td>17.2</td>
</tr>
<tr>
<td>AAQ-2</td>
<td>96</td>
<td>57.4</td>
<td>17.0</td>
<td>25.1</td>
<td>26.4</td>
<td>20.4</td>
</tr>
<tr>
<td>AAQ-3</td>
<td>104</td>
<td>62.6</td>
<td>17.2</td>
<td>25.6</td>
<td>23.7</td>
<td>16.0</td>
</tr>
<tr>
<td>AAQ-4</td>
<td>85</td>
<td>50.7</td>
<td>15.9</td>
<td>22.1</td>
<td>12.7</td>
<td>19.0</td>
</tr>
</tbody>
</table>

![Graph](image-url)
Noise Environment

- An undesirable and unwanted sound and a byproduct of modern “mechanised” lifestyle

- It affects human health and well-being and deteriorates environmental quality
  - Noise levels around project site
    - Prediction of noise levels at
      - residential
      - commercial
      - industrial zones
  - Mitigation measures

Effects of Noise Pollution

- Temporary Threshold Shift, (TTS) 80 dB(A) to 130 dB(A) (Temporary hearing loss)

- Permanent Threshold Shift > 150 dB(A) (Permanent hearing loss)
MEASUREMENT OF NOISE QUALITY

Noise measurements were carried out to study the hourly equivalent noise levels as per IS: 4594-1968. Noise levels were measured for 24 hours on hourly basis by using a high precision Integrated Sound Level Meter (B&K 2238) in the study area. The noise is expressed in dB (A).
## Ambient Air Quality Standards in Respect of Noise

<table>
<thead>
<tr>
<th>Category of Area</th>
<th>Limit in dB(A) Leq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day time</td>
</tr>
<tr>
<td>Industrial Area</td>
<td>75</td>
</tr>
<tr>
<td>Commercial Area</td>
<td>65</td>
</tr>
<tr>
<td>Residential Area</td>
<td>55</td>
</tr>
<tr>
<td>Silence Zone</td>
<td>50</td>
</tr>
</tbody>
</table>

- Day Time: 6 am to 10 pm
- Night time: 10 pm to 6 am
- Silence zone: Areas upto 100 m around premises such as hospitals, educational institutions and courts.
- The Silence zones are to be declared by the Competent Authority
The noise levels monitoring was carried out by Central Pollution Control Board during Diwali. The noise data during 2011, 2012, 2013, 2014, 2015 at five places in Hyderabad city at Abids, Jeedimetla, Jubliee Hills, Zoo Park and Punjagutta is depicted below.
## Water Quality Monitoring

<table>
<thead>
<tr>
<th>Activity</th>
<th>Parameters to be monitored</th>
<th>Sampling period and frequency</th>
<th>Total No. of Samples</th>
<th>Measurement Methods</th>
</tr>
</thead>
</table>
| Water Quality comprising both ground and surface water sources (Core and Buffer zone) | Physico-Chemical and Biological Characteristics as per the following standards  
   i) IS: 10500-for Groundwater samples  
   ii) IS: 2296- for surface water samples  
   iii) GSR-801 (E)-for Industrial Effluents, if any | Frequency: One sample per season per station | Groundwater Samples = 5 Nos.  
   Surface water samples = 5 Nos. | Samples for water quality collected and analyzed as per:  
   - IS: 2488 (Part 1-) method for sampling and test of industrial effluents.  
Water Quality Parameters

Physical Parameters
- pH
- Temperature
- Colour
- Turbidity
- Conductivity
- Total Solids
- Suspended Solids
- Total Dissolved Solids

Chemical Parameters: Inorganic Parameters
- Acidity
- Alkalinity
- Hardness
  - Total Hardness
  - Calcium Hardness
  - Magnesium Hardness
  - Sodium
  - Potassium
  - Nitrate
- Ammonical Nitrogen
  - Ammonia
  - Nitrate Nitrogen
  - Nitrite Nitrogen
  - Chloride
- Residual Chloride
  - Sulphate
  - Fluoride
  - Silica
Water Quality Parameters

(ii) Nutrient & Organic Parameters
- Phosphate
- Dissolved Oxygen
- Chemical Oxygen Demand
- Biochemical Oxygen Demand
  - Phenols
  - Oil & Grease

Microbiological Parameters
- Total Coliform
- Faecal Coliform
- Faecal Streptococci
- Total Plate Count
  - Chlorophyll

Elements Including Heavy Metals
- Magnesium
- Calcium
- Aluminium
  - Zinc
  - Iron
- Manganese
- Nickel
- Copper
- Lead
- Chromium
- Cadmium
- Cobalt
Eutrophication is predominantly due to nutrient enrichment. The progresses of trophic state of lakes are oligotrophic, eutrophic and hypertrophic is based on the availability of nutrients in the water body. The natural time scale for the ageing of lakes is of the order of hundred to thousands of years based nutrient inputs, sediments and climatic conditions. The boundary conditions for Classification of lakes and reservoirs are defined by the Organization for Economic Cooperation and Development (OECD) is presented in the Table.

Table -1.0 OECD Boundary values for lakes Classification (1982)

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Parameter</th>
<th>Oligotrophic</th>
<th>Eutrophic</th>
<th>Hypertrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Phosphorus(µg/L)</td>
<td>&lt;10.0</td>
<td>35-100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>2</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>&lt;1.0</td>
<td>8-25</td>
<td>&gt;25</td>
</tr>
<tr>
<td>3</td>
<td>Maximum Chlorophyll –a (µg/L)</td>
<td>&lt;2.5</td>
<td>25-75</td>
<td>&gt;75</td>
</tr>
<tr>
<td>4</td>
<td>Mean Secchi depth (m)</td>
<td>&gt;6.0</td>
<td>3-1.5</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>5</td>
<td>Minimum Secchi depth (m)</td>
<td>&gt;3.0</td>
<td>1.5 -0.7</td>
<td>&lt;0.7</td>
</tr>
</tbody>
</table>
## Comparative Status of Lake Water based on NEERI and EPTRI Studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BOD (mg/L)</td>
<td>42-80</td>
<td>20-48</td>
</tr>
<tr>
<td>2</td>
<td>COD (mg/L)</td>
<td>110-183</td>
<td>76-203</td>
</tr>
<tr>
<td>3</td>
<td>TDS (mg/L)</td>
<td>940-1200</td>
<td>700-1100</td>
</tr>
<tr>
<td>4</td>
<td>Phosphate (µg/L)</td>
<td>410-1540</td>
<td>1500-5000</td>
</tr>
<tr>
<td>5</td>
<td>Mean Secchi depth (m)</td>
<td>0.11-0.30</td>
<td>0.18-0.24</td>
</tr>
<tr>
<td>6</td>
<td>Mean Chlorophyll- a (µg/L)</td>
<td>2-8.3</td>
<td>153-241</td>
</tr>
<tr>
<td>7</td>
<td>Trophic Status</td>
<td>Hypereutrophic</td>
<td>Hypereutrophic</td>
</tr>
</tbody>
</table>

The present studies suggest that the trophic status of the lake remains Hypereutrophic indicating the lake water quality is very fragile and needs attention and human intervention to achieve positive results.
Water and Sediment sampling locations of Hussain Sagar Lake

**INLETS**
- BLK-L1  Balkapur Nallaha
- BJN-L1  Banjara Nallaha
- KP-L1  Kukatpally Nallaha
- PN-L1  Picket Nallaha

**IN LAKE**
- HSL-1  Near Balkapur Nallaha
- HSL-2  Near Banjara Nallaha
- HSL-3  Near Kukatpally Nallaha
- HSL-4  Near Picket Nallaha
- HSL-5  Near Buddha Statue
- HSL-6  Towards Sanjeevaiah Park in between Buddha Statue
- HSL-7  Near BPDA Office
- HSL-8  Viceroy Sailing Club
- HSL-9  At Sailing Club

**OUTLET**
- DL-1  At BPDA Office
- DL-1(I)  At Liberty Office
- DL-2  Near Marriott Hotel

*Map not to scale*
Water samples are collected at nine locations at different depths are analyzed and compared CPCB standards (Class-C).

BOD is high at all the locations indicating organic pollution which leads to water quality problems such as severe DO depletion and fish kill.

0% survival of fish after 96 hours in 100% effluent is found in Bottom layer of HSL -1B & HSL -4B. And in other locations there is 60-70% survival of fish after 96 hours in 100% effluent.

Coliform count is more than 5000 MPN/100 ml in all the locations indicating bacterial contamination which leads to higher risk of pathogens and harmful to the environment by reducing the DO levels which kill fish and other aquatic life.
Water Quality Analysis (Outlets)

- Water samples are collected at two outlets at three locations are analyzed and compared CPCB standards (Class-C).

- BOD is high at all the locations indicating organic pollution indicating organic pollution which leads to water quality problems such as severe DO depletion and fish kill.

- 0 % survival of fish after 96 hours in 100% effluent is found at all locations.

- Coliform count is more than 5000 MPN/100 ml in all the locations which indicates that domestic sewage from various slums are entering the Lake waters.
Soil Quality Monitoring

<table>
<thead>
<tr>
<th>Activity</th>
<th>Parameters to be monitored</th>
<th>Sampling period and frequency</th>
<th>Total No. of Samples</th>
<th>Measurement Methods</th>
</tr>
</thead>
</table>
| Soil quality survey    | i) Soil Depth  
  ii) Particle size distribution  
  iii) Texture  
  iv) Organic matter  
  v) pH  
  vi) Electrical Conductivity  
  vii) Exchangeable Cations and Cations Exchange Capacity (CEC)  
  viii) Alkali Metals  
  ix) Sodium Absorption ratio (SAR) of soils  
  x) Heavy metals in soil viz. Cd, Cr, Pb, Ni, Cu, Zn & Mn.  
  xi) Infiltration rate in mm/Hr  
  xii) Water holding capacity  
  xiii) Porosity  
  xiv) NPK contents etc., | Frequency: One sample per study period per location | 4 samples            | Collected and analyzed as per soil analysis reference book, M.L. Jackson and C.A. Black. |
<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Chemical Properties (1:2 Soil Water Extract)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bulk Density</td>
<td>• pH</td>
</tr>
<tr>
<td>• Particle Density</td>
<td>• Chloride</td>
</tr>
<tr>
<td>• Porosity</td>
<td>• Electrical Conductivity</td>
</tr>
<tr>
<td></td>
<td>• Nitrate</td>
</tr>
<tr>
<td></td>
<td>• Calcium</td>
</tr>
<tr>
<td></td>
<td>• Nitrate</td>
</tr>
<tr>
<td></td>
<td>• Magnesium</td>
</tr>
<tr>
<td></td>
<td>• Sulphate</td>
</tr>
<tr>
<td></td>
<td>• Sodium</td>
</tr>
<tr>
<td></td>
<td>• Alkalinity</td>
</tr>
<tr>
<td></td>
<td>• Potassium</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Cation Exchangeable Properties</td>
<td></td>
</tr>
<tr>
<td>• Exchangeable Cations</td>
<td></td>
</tr>
<tr>
<td>• Calcium</td>
<td></td>
</tr>
<tr>
<td>• Potassium</td>
<td></td>
</tr>
<tr>
<td>• Exchangeable Sodium</td>
<td></td>
</tr>
<tr>
<td>Percentage (ESP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Parameters</td>
<td></td>
</tr>
<tr>
<td>• Water Holding Capacity</td>
<td></td>
</tr>
<tr>
<td>• Organic Carbon</td>
<td></td>
</tr>
</tbody>
</table>
Steps involved in Soil testing

1. Soil sampling or collection of representative soil sample

2. Sample processing

3. Extraction and estimation of available nutrients in the soil

4. Interpretation of the soil test values for making necessary fertilizer recommendation
SAMPLING PROCEDURE

FIELD

ZIG ZAG SAMPLING

15 CM

THIN SLICE

QUARTERING

A B
C D

PACKING
Standards for pH and E.C.

pH:
Slightly acidic = 6.1 - 6.5
Neutral = 6.6 – 7.3
Slightly alkaline = 7.4 – 7.8
Moderately alkaline = 7.9 0 – 8.4
Highly alkaline = 8.5 and above

Electrical Conductivity (EC in dS/m)
Normal = < 0.5
High = 0.5 to 0.75
Harmful = > 0.75
Flow chart for approach to achieving accuracy of analytical results.
Thank You