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Review of air quality monitoring : Case study of Peenya Industrial area

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ABSTRACT
Increased levels of industrial activity, high growth rates in automobiles and emissions from various sources have caused deterioration in the ambient air around us leaving a deep, harmful impact on our health. In this study we take Peenya industrial area , Bangalore to study meteorological monitoring with different techniques and methodologies, by using advanced sophisticated instruments equipped with digital display and data loggers to produce very accurate data which enables us to provide reports within a short course of time. We are targeting environmental monitoring with respect meteorological monitoring , ambient air and indoor air quality for road projects, hospitals & school/ college premises, pharma industries, MNC's and software companies to take necessary precautionary measurements on what could be basis to reduce the levels of pollutants which cause various health hazards to human beings.
Key words - Meteorological monitoring , ambient air , indoor air .

1. Introduction

Increased levels of industrial activity, high growth rates in automobiles and emissions from various sources have caused deterioration in the ambient air around us leaving a deep, harmful impact on our health. Organizations around the world are initiating coordinated efforts to monitor the various pollutants that are responsible for this degradation 'so as to effectively implement control measures. Thanks to the sustained efforts by the regulatory agencies, voluntary organizations and all stakeholders, we now see a renewed thrust in improving air quality.

Techniques for measuring air quality parameters have evolved over the years. In this paper we study the meteorological monitoring of an industrial area located at Peenya , Bangalore .

Air quality monitoring is the process of assessment of pollutants present in the atmosphere by their quantity and types as per air quality standards. Air quality monitoring helps us to take action based on pollutants present in atmosphere to improve air quality .

In indoor air Quality Measurement process mainly temperature, humidity and airflow (HVAC) are the comfort parameters.For proper Radon, CO_2, Mold, Harmful Chemicals, Dust (Respirable suspended particulate matter RSPM – PM10 and PM2.5), Volatile organic compounds (VOC) and Ozone needs to be monitor. Most of the indoor Environmental quality problems can be resolved by investigating the source of CO_2 and indoor ventilation without measuring specific parameters.

It is important to monitor meteorological conditions at the air quality monitoring site since weather is a significant factor which influences air contaminant concentrations. Measurements of wind speed, wind direction and air temperature are the minimum meteorological parameters to be monitored. Additional measurements that would provide an improved picture of weather conditions during monitoring are: relative humidity, solar radiation, rainfall, and a temperature profile at two heights. Wind speeds are often quoted in different units. The preferred reporting unit is meters per second (m/s).

2. Method and methodologies

There are two types of air quality monitoring in India:

• Ambient air quality monitoring

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• Indoor air quality monitoring

The elements that are monitored during air quality monitoring are substances like CH_4, THC, NH_3, CO_2, H_2S, TSP, PM, RSPM, PAH, SO_2, NO_2, Ozone, VOC's. Presence of these pollutants in atmosphere in a particular city are indexed in such a way that layman can understand air quality based on air quality index.

Test procedure manual :

Sampling and analysis of nitrogen gas

Scope : Scope describes the method for sampling of nitrogen gas for purity of gas and impurities present as per European pharmacopeia, United states Pharmacopeia and ISO:8573

Sampling and preservation : The objective of the sampling is to collect a representative sample of gas from the source. The nitrogen gas sample shall be collected and preserved in tedlar bag/bladders. The opening and sealing of tedlar bag/bladders will be carried out as per manufacturer's instructions. Before sampling, the tedlar bag/bladder will be purged with the sample gas two to three times. Later, the desired quantum of gas will be filled and ensured that there is no leakage and finally, transported to the laboratory for analysis.

Procedure:

Description : A colorless, odorless gas

Solubility : 1 volume dissolves in 65 volumes of water and 9 volumes of alcohol

Odour : Odorless gas

Identification :

First identification: A

Second identification: B, C

A: Examine the chromatogram obtained in the assay. The principal peak in the chromatogram obtained with the substance to be examined is similar in retention time to the principal peak in the chromatogram obtained with reference gas.

B: Hold a burning or glowing splinter of wood while flowing the gas. The splinter shall be extinguished

C: In a suitable test tube place 0.1g of magnesium. Close the tube with two -hole stopper fitted with a glass tube reaching about a cm above the magnesium. Pass the substance to be examined through glass tube for 1 min without heating, then for 15 min while heating the tube to red glow. After cooling add 5 ml of dilute sodium hydroxide solution. The evolving vapours change the colour of moistened red litmus paper to blue.

Carbon dioxide :

Determined using carbon dioxide detector tube :

A fuse sealed glass tube so designed that gas may be passed through it. Contains suitable absorbing filters and support media for the indicators

Measuring range:0.01 to 0.3%

Procedure: Pass gas sample under testing as per detector tube manufacturer instructions through a carbon dioxide detector tube at rate specified for the tube.

Carbon monoxide :

Determined using carbon monoxide detector tube :

A fuse sealed glass tube so designed that gas may be passed through it. Contains suitable absorbing filters and support media for the indicators . **Measuring range :** 1 to 30ppm **Procedure :** Pass gas sample under testing as per detector tube manufacturer instructions through a carbon monoxide detector tube at rate specified for the tube.

Oxygen

a. Equipment used for the oxygen analysis is GC-TCD Mayura

b. Column: Molecular sieve 5A(MYR-SSPC-18),

c. Detector-TCD

d. Oven temp:45 °C (iso thermal)

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e. Injector temp: 60℃
f. Detection temp:60℃
g. carrier gas: Helium

Purity (assay) of N_2

a. Equipment used for the assay of nitrogen analysis is GC-TCD Mayura
b. Column: Molecular sieve 5A(MYR-SSPC-18),
c. Detector-TCD
d. Oven temp:45 ℃ (iso thermal)
e. Injector temp: 60℃
f. Detection temp:60℃
g. carrier gas: Helium

Water vapour test :

Determined using water vapour detector as per the guidelines of ISO:8573(P-1):2010
A fuse sealed glass tube so designed that gas may be passed through it. Contains suitable absorbing filters and support media for the indicators

Measuring range : 1.0 to 30 ppm or 10 to 80 ppm

Procedure : Pass 100 +/- 5ml of the sample analyzed through a carbon dioxide detector tube at rate specified for the tube.

4.0 oil mist :

Oil mist content is measured as per ISO:8573 guidelines by FTIR method for the measuring range of <0.001 mg/m^3, for class 1 and class 2 requirements
OR
By gas detector tube method for range from 0.1-5.0 mg/m^3 for requirements of class 2 and above.

Measuring range : 0.1 to 5.0 mg/m^3

Procedure : Pass gas sample under testing as per detector tube manufacturer instructions through a carbon dioxide detector tube at rate specified for the tube.

4.1 non-viable particle counting test:

Determined using air borne particle counter as per the guidelines of ISO-8573(P-1):2010
This part specifies operating and monitoring of air borne particle counts that can be typically present in gaseous sample. This measurement works on laser beam principle and channel counter for displaying differential and cumulative counts.
Connect the supplied tubing from the sample outlet of the high-pressure diffuser to the sample inlet of the particle counter. Ensure that the filter is installed on the high-pressure diffuser. Start the particle counter, open the gas line to supply process gas to the diffuser. Continue by following the particle counter's recommended setup procedures. Take 05 reading in each sampling point and report the average value. Based on the results obtained from the particle counter, particles are classified as per ISO-8573.

Viable particle counting :

Determined using microbial sample as per the guidelines of ISO-8573(P-1):2010
This method specifies a test methos for distinguishable viable, colony-forming, microbiological organisms (e.g., bacteria, fungi, yeast and endotoxins) from other solid particles which may be present in the gaseous sample. It provides a means of sampling, incubating and determining the number of microbiological particles. For this purpose of microbial sampler with culture
plates used for verifying the presence of viable microorganisms is to expose on culture plates to the gaseous samples. After sampling culture plates are carried to the laboratory and kept for incubation for specific duration prescribed by the standard. Then the surface shall be visually examined to confirm the presence of viable colony-forming micro-organisms. The unit is expressed as CFU (colony forming unit)

Dew point :

Measuring range : -60℃ to +30℃ T

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The pressure dew point tpd is the temperature at which compressed air reaches the saturation state. This value is important criteria for the perfect running of the compressed air plant. This part specifies operating the dew point meter for monitoring of dew point. The dew point meter works based on electrical sensor at pressure of 6-7 bar.

Hydrocarbons :

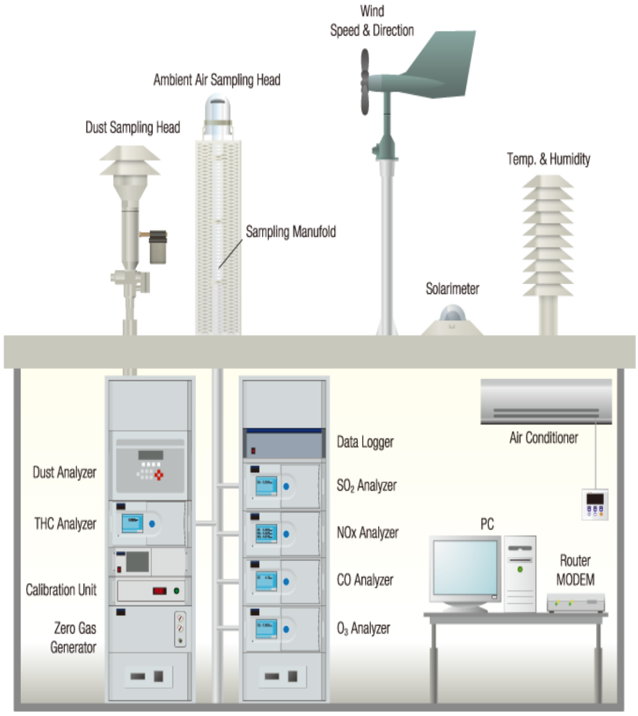
Measuring range : 10 to 5000 ppm

Procedure : Pass gas sample under testing as per detector tube manufacturer instructions through a carbon monoxide detector tube at rate specified for the tube.

Particulate matter :

Measuring range : 0.1-5.0 mg/m^3

Procedure : Particulate matter in compressed air is measured by using compressed air kit assembly. The initially weighed filter paper is placed inside the filter holder and specified amount of air passed through the assembly and the particulate matter gas settled on the filter paper. After this the filter paper final weight taken for final weight and calculated and reported as per gravimetric method .



3. Results

CARBON DIOXIDE GAS TESTING RESULTS

S.No.	Test parameters	Actual results	Acceptance Criteria	Reference	Conformity
1	Ammonia , PPM	Less than 2 PPM	Not more than 25 PPM	USP	Yes
2	Hydrogen Sulphide , PPM	Less than 0.2 PPM	Not more than 1 PPM	EP	Yes
3	Nitrogen monoxide and nitrogen dioxide , PPM	Less than 0.2 PPM	Not more than 2 PPM	EP	Yes
4	Carbon Monoxide , PPM	Less than 1 PPM	Not more than 5 PPM	EP	Yes
5	Sulphur Dioxide ,PPM	Less than 2 PPM	Not more than 2 PPM	EP	Yes

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6	Moisture Content , mg/m^3	20 mg/m^3	Not more than 50 mg/m^3	As per protocol document	Yes
7	Dew point , ^{0}C	-42.6 ºC	≤ -40 ºC	As per protocol document	Yes
8	Minimum line pressure , (bar)	4.90 bar	NMT 8 bar	NA	Yes
9	CO2 gas indentification (Purity)(%)	99.91 %	Not less than 99.5% v/v	EP	Yes
10	Appearance	Colourless gas	Colourless gas	EP	Yes
11	Hydrocarbons , mg/m^3	Nil	≤ 0.1 mg/m^3	ISPE	Yes
12	Oil mist , mg/m^3	Nil	≤ 0.1 mg/m^3	As per protocol document	Yes

NVPC Particle Count							
S.No.	**Grade/Area**	**Actual Results for 0.5 micron size**	**Acceptance Criteria ≤ 0.5 micron**	**Actual Results for ≤5.micron**	**Acceptance Criteria ≤ 5.micron**	**Reference**	**Conformity**
13	Technical area	9109	Grade C ≤ 352000 Grade D ≤ 3520000	0	Grade C ≤ 2900 Grade D ≤ 29000	As per protocol demand	Yes

NITROGEN GAS TESTING RESULTS

S.No.	**Test parameters**	**Results**	**Acceptnce criteria**	**Reference**	**Conformity**
1	Description	A Colourless , Odourless gas	A colourless , Odourless gas	EP	Yes
2	Solubility		1 volume dissolves in 62 volumes of water and about 10 volume of ethanol	EP	Yes
3	Identification Test				
Identification by GC		The principal peak matches with reference gas (b)	The principal peak shall matches with reference gas (b)	EP	Yes
Chemical test		Splinter is extinguished	Splinter shall be extinguished	EP	Yes
Chemical test		The evolving vapours changed the	The evolving vapour changes the colour of	EP	Yes

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		colour of red litmus to blue	moistened red litmus paper to blue		
4	Odour	No appreciable odour is discernible	No appreciable odour is discernible	USP	Yes
5	Carbon monoxide	Less than 1 PPM	NMT 5 PPM	EP	Yes
6	Carbon dioxide	Less than 100 PPM	NMT 300 PPM	EP	Yes
7	Moisture content	30 mg/m^3	NMT 50 mg/m^3	As per protocol document	Yes
8	Dew point	-51.6 ^{o}C	≤ -40 ^{o}C	As per protocol document	Yes
9	Assay	99.93 %	NLT 99.5 % v/v of Nitrogen	EP	Yes
10	Oil mist	Nil	≤ 0.1 mg/m^3	As per protocol document	Yes
11	Maximum line pressure (Bar)	5.63 Bar	NMT 8 bar	NA	Yes
12	Limit of Oxygen	21 PPM	NMT 50 PPM	EP	Yes

OXYGEN GAS TESTING RESULTS

S.No.	Test Parameters	Actual Results	Acceptance criteria	Reference	Conformity
1	Carbon Monoxide , PPM	Less than 1 PPM	Not more than 5 PPM	EP	Yes
2	Carbon Dioxide , PPM	Less than 100 PPM	Nor more than 300 PPM	EP	Yes
3	Moisture content , mg/m^3	Less than 10 mg/m^3	Not more than 50 mg/m^3	As per protocol documented	Yes
4	Dew point , ^{o}C	-48.1 ^{o}C	≤ -40 ^{o}C	As per protocol documented	Yes
5	Maximum Line Pressure , (bar)	4.68 bar	NMT 8 Bar	NA	Yes
6	O_2 gas Identification (Purity) , (%)	99.91 %	Not less than 99.5 % v/v	EP	Yes
7	Appearance	Colourless gas	Colourless gas	EP	Yes
8	Odour	No appreciable odour is discernable	No appreciable odour is discernable	USP	Yes
9	Hydrocarbons , mg/m^3	Nil	≤ 0.1 mg/m^3	ISPE	Yes

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10	Oil mist , mg/m^3	Nil	≤ 0.1 mg/m^3	As per protocol document	Yes

NVPC Particle Count							
S.No.	**Grade/Area**	**Actual Results for 0.5 micron size**	**Acceptance criteria ≤ 0.5 micron**	**Actual Results for 5.0 micron size**	**Acceptance Criteria ≤ 5.0 micron**	**Reference**	**Conformity**
11	Technical area	3956	Grade C ≤ 352000 Grade D ≤ 3520000	71	Grade C ≤ 2900 Grade D ≤ 29000	As per protocol document	Yes

4. Conclusion:

Before starting air monitoring process, background data needed are source and emission, health and demographic, meteorological information, previous air quality information. As discussed earlier, main components that affect air quality are SO_2, emitted through domestic emission of fuel burning, industrial emission, diesel vehicle, etc. NO_2 is formed in atmosphere by reaction of NO, Ozone and Hydrocarbons. High pollution and traffic areas are chosen to study more extensively on the various types of pollutants, RSPM/PM10-for this, diesel vehicles are a major source, i.e., combustion. SPM – soil borne dust results from construction activities. Etc. CO_2, is contributed by vehicles, commercial and high traffic density areas. Ozone, its secondary pollutant, is caused due to reaction of NO, HC in atmosphere.

According to NAAQM, annual average should be computed of 104 measurements taken twice a week of 24 hrs. duration. looking at overall situation of air quality, we have to work hard together to reduce the air pollution by adopting various means such as using public transport instead of private vehicles, creating social awareness, implementation of practical and projects in schools and colleges that are related to study of the air quality and air quality maintenance.

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