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Assessment of Ambient Air Quality in Coimbatore City

Vedamadavan
Bharath University, Selaiyur
Chennai – 600073
E-mail:vedamadavan@yahoo.com
Sarithabanuraman
Bharath University, Selaiyur
Chennai – 600073

Abstract

Man is making rapid strides in science and technology. His eagerness to increase his comfort by utilizing the natural resources lead to rapid industrialization and abnormal urbanization which consequently witness excessive air pollution. There are lots of such polluted areas in India and Coimbatore comes into prominence. The Coimbatore city due to its rapid industrial development is experiencing an exponential growth in the vehicular usage and fuel consumption, which increases the air pollution. On the other hand the existing weather pattern of the city is not favorable for the dispersion of air pollutants. An inventory of air contaminants is the first step towards the control of air pollution. The purpose is to study the present air quality status of Coimbatore city and to compare the measured values with the recommended threshold limit values and to determine the air quality index. The study has been carried out in 3 zones viz residential commercial& industrial zone. The major air pollutants selected for analysis are SPM, SO_2, and NO_X. Air quality monitoring has been conducted using a Respirable Dust sampler and analysis was made by means of BIS methods.

Keywords: *Bureau of Indian standards, Suspended particulate matter, respirable suspended particulate matter, sulphur dioxide, oxides of nitrogen, respirable dust sampler.*

1. Introduction

Various contaminants continuously enter the atmosphere through both natural and manmade activities such substances, which interact with the environment to cause toxicity, diseases, aesthetic distress have been labeled as "***pollutants***". According to the Bureau of Indian Standards [IS 4167 (1966)] air pollution is defined as "the presence in ambient atmosphere of substances, generally resulting from the activity of man, in sufficient concentration, present for a sufficient time and under circumstances such as to interfere with comfort health or welfare of persons or with reasonable use or enjoyment of property". The World Health Organization (WHO) defines air pollution is "the presence of material in air in such concentration which are harmful to man and his environment".

The sources of air pollution are broadly classified as natural sources such as dust storm, forest fires, volcanoes, sea spray, plant pollen etc and manmade sources (domestic & industrial).The common air pollutants and their sources are shown in the table below:

Table1.1sources of air pollutants

Pollutant	**Sources**
Sulphur Dioxide	Coal and oil combustion, sulphuric acid plants, biological decay of sulphide, bacteria

Nitrogen Oxides	Coal and oil combustion, automobile exhausts, electrical storms
Suspended Particles (ash, soot, smoke)	Incinerators and almost every manufacturing process, Natural Volcanic eruption, forest fire, sea salt
Carbon Monoxide	Burning of coal, gasoline, motor exhausts, Industrial process mainly for boilers, organic chemical industries
Hydrogen sulphide	Refineries, chemical industries and bituminous fuels, sewage treatment plant
Hydrogen cyanides	Blast furnace, fumigation, chemical manufacturing, metal plating etc,.
Ammonia	Explosives, dye making, fertilizer plants and lacquers
Aldehydes	Thermal decomposition of oils, fats or glycerds
Phosgene or carbonyl Chloride	Chemical and dye making
CFC, (Chloro Fluro Carbon)	Refrigerant, cleaning solvent

Based on the shape of entry of pollutants into the atmosphere, the source of pollutants may be classified into three types as point source, line source and area source. Air quality has relatively more emotional and psychological impact than water or food. The inhalation of gases and particulates through human respiratory system is a direct form of air pollution. Air pollution damage to property covers a wide range-corrosion of metals, soiling and eroding of building surfaces, fading of dyed materials rubber cracking.

Carbon dioxide intercepts outgoing long wave radiation from the earth. The earth is warmed by 0.2ºC to 0.3ºC (green house effect) by every 10% increase in CO_2. Fine particles scatter incoming short wave radiation from the sun and also absorb part of the incoming energy. This causes a cooling of 2º to 3º C in a century. Urbanization increases heat retention making the cities warmer than the countryside. Vaporization from wet cooling towers increases atmospheric humidity. Condensation and freezing nuclei alter cloud precipitation characteristics.

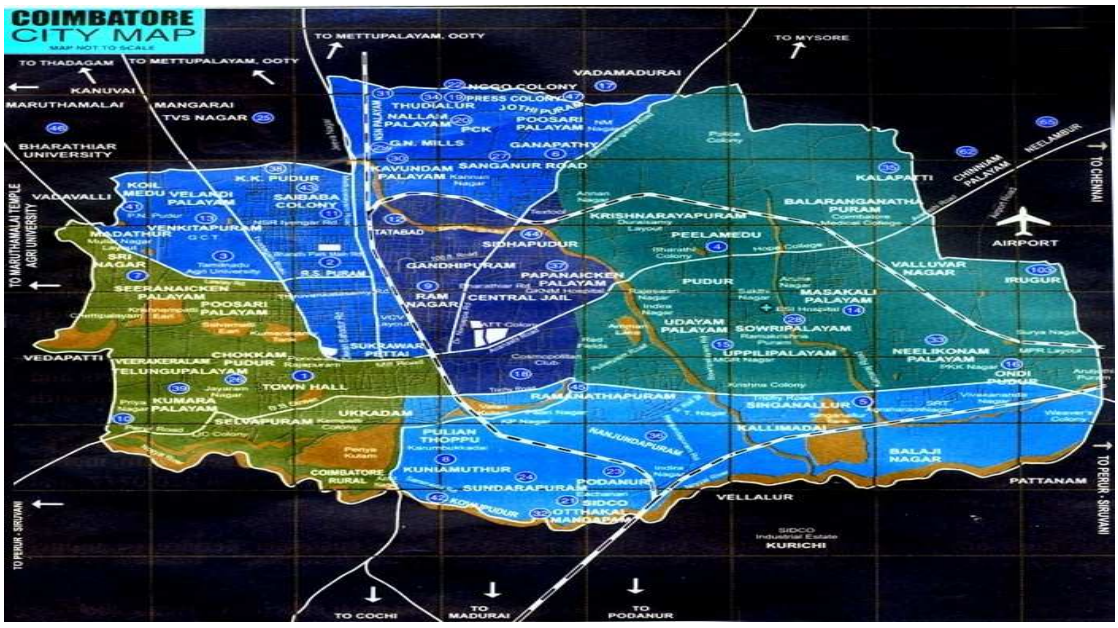
EFFECTS OF METEROLOGICAL PARAMETERS ON AIR QUALITY SURVEY

Meteorology is the branch of science which deals with atmosphere and characteristics of weather. In the weather, the dispersion and the transport of pollutants, which enter the atmosphere from a source, is affected by a number of atmospheric parameters. Usually referred to as meteorological parameters. The basic micro meteorological parameters are rainfall and precipitation, high and low pressure, heat, solar radiation, temperature, environmental lapse rate and atmospheric stability, wind speed, wind direction and mixing height, moisture and relative humidity.

2. MATERIALS AND METHODS:

Ambient air quality monitoring implies that the sample of air is collected at free atmosphere and assessed

for knowing the level of air pollution. It should be carried out long enough and at a rate that allows collection of an analytically measurable and prominently representative sample. Sampling and air pollutant measurement is generally known as air quality monitoring. Through monitoring the current trends in air quality can be evaluated by comparing the data with recommended standards. The obtained information helps in implementing control measure for reducing pollutant concentration to acceptable levels and in assessing the effect of air pollution control strategy. Coimbatore is situated around 11º north latitude, 77º east longitude and 432.00 meters above mean sea level, in western part of Tamilnadu state. While the city is flat, it is surrounded by hilly terrain, and it is situated at the foot of Nilgiri hills.As it is exposed to Palghat gap of Western Ghats, it enjoys a salubrious climate throughout the year. The maximum temperature observed in this city is 34º C and the minimum temperature is around 20º C, April and May are the hottest months in this city. This city is the second largest city in Tamilnadu, covering an area of 105 sq.km with more than 30,000 small, medium and large scale industries and textile mills. The present population of this city is 13 lakhs including the floating population of 1.5 lakhs (2006). A famous cement manufacturing unit in Madukkarai at 10 km from the city and three big textile machinery manufacturing units provide excellent employment opportunities to thousands of people in and around the city. Coimbatore has also attracted investment from hi- tech industries in the recent years, especially in the field of solar energy and computer software. At present, there are three bus stands at Gandhipuram, Ukkadam and Singanallur. This city is also well known for the manufacture of motor pumps and varied engineering goods. Because of the prevailing weather condition, topography and growth pattern, this city has a high potential for air pollution. Due to city specific characteristics, such as infrastructure, microclimate, topography and prevailing type of emission sources, the quantitative relationships between meteorological parameters and air pollutant concentration for every particular urban area might differ. The coimbatore city map is shown below:



STANDARD METHODS USED FOR TARGET POLLUTANTS

Table 2.1 Standard methods used for target pollutants

Particulars	Pollutants			
	SPM	RPM	SO_2	NO_x

Equipment	Respirable Dust Sampler (RDS)	Respirable Dust Sampler	Impingers attached to RDS	Impingers attached to RDS
Analytical method	Gravimetric	Gravimetric	Improved West & Gaeke	Modified Jacobs &Hochheiser
Sampling period	8/24 hourly	8/24 hourly	8/24 hourly	8/24 hourly
Measuring principle	Gravimetric	Gravimetric	Colorimetry	Colorimetry
Sampling frequency	One month continuous (3seasons)	One month continuous (3seasons)	One month continuous (3seasons)	One month continuous (3seasons)

SAMPLING

The numbers of samples collected are 25 samples at each zone for a period of 8 hours and the meteorological parameters such as wind speed, wind direction, temperature and relative humidity are also noted.

METHOD OF SAMPLING FOR PARTICULATE MATTER

Total suspended particulate matter (TSPM) comprises of particles above 10 µ (non Respirable particulate matter) and particles below 10 µ (Respirable particulate matter. TSPM present in ambient air is measured by High volume sampling method by using a Respirable Dust Sampler with a cyclone attachment over a period of 24 hours by sucking a known quantity of air through glass fiber filters. The mass of concentration of SPM is computed by measuring the weight of collected matter in known volume of air sampled.

METHOD OF SAMPLING FOR GASEOUS POLLUTANTS

Determination of Sulphur dioxide in ambient air

The most commonly used method for determination SO_2 is modified West and Gaeke method. In this method SO_2 from a measured quantity of air is absorbed in a solution of sodium tetra chloromercurate to form stable dichlorosulphitomercurate complex. This then reacted with formaldehyde and bleached pararosaniline, yielding magenta color. The color intensity is estimated photometrically at 560nm.

Determination of nitrogen Oxides in Ambient air

Concentration of NO_x in ambient air is estimated by Jacob Hochheiser method. Oxides of nitrogen are collected from bubbling air through sodium hydroxide solution to form stable sodium nitrite. The nitrite ion produced is determined photometrically by reacting with phosphoric acid, sulfanilamide and NEDA at 540 nm.

3. RESULTS AND DISCUSSION

The samples collected from the sampling stations were analysed by BIS Standard Method. The results are shown in table 3.1, 3.2, 3.3

Table 3.1Range of concentration of pollutants at residential zone

LOCATION	**SPM ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**NO_x ($\mu g/m^3$)**

Anna nagar	182.93-203.70	21.58-38.89	5.32-7.64
Sowripalayam	58.05-74.63	16.16-24.69	4.23-5.31
Ganapathy	103.48-147.83	16.58-19.23	4.11-6.11
Saibaba colony	101.23-135.48	18.34-20.46	5.23-15.28
Ram nagar	122.58-140.35	16.23-18.23	5.23-7.12

Table 3.2 Range of concentration of pollutants at commercial zone

LOCATION	**SPM ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**NO_x ($\mu g/m^3$)**
R.S.PURAM	177.03-193.43	19.68-20.73	6.56-7.04
GANDHIPURAM	602.23-638.76	24.53-27.32	15.64-18.93
PEELAMEDU	486.18-530.49	23.14-25.06	17.64-18.20
RAILWAY STATION	586.89-649.18	30.36-40.35	32.76-40.12
UKKADAM	953.36-984.54	40.35-46.96	29.19-31.04

Table 3.3 Range of concentration of pollutants at industrial zone

LOCATION	**SPM ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**NO_x ($\mu g/m^3$)**

KANNAPIRAN TEXTILE MILL	123.19-132.78	23.92-27.71	6.56-7.04
CONSTRUCTION ZONE	131-148.93	22.76-24.69	15.64-18.93
FOUNDRY UNIT	166.67-194.24	35.05-39.59	17.64-18.20
CEMENT FACTORY(ACC)	587.43-602.97	28.05-28.54	25.78-27.72
TEXTILE UNIT(SINGANALLUR)	652.18-743.97	23.92-24.72	17.64-18.23

DISCUSSION

In this study the concentration of air pollutants such as SPM, SO_2, NO_X were monitored in selected five stations for each zone in Coimbatore city. The concentration of SPM ranges from 58.05 µg/m^3 to 984.54 µg/m^3, the concentration of SO_2 ranges from 16.23 µg/m^3 t0 40.96 µg/m^3, the concentration of NO_x ranges from 4.11 µg/m^3 to 39.68µg/m^3.

It was found that there is a wide range of variation in pollutant concentrations of various zones. From this study it shows that the residential zones are classified under low and medium air pollution level, the commercial zones are classified under low , medium and high air pollution level, the industrial zone are classified under medium and high air pollution level.

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