MAPLE TREE PUBLISHING HOUSE

INTERNATIONAL RESEARCH JOURNAL OF MULTIDISCIPLINARY TECHNOVATION (IRJMT)

http://www.mapletreejournals.com/index.php/IRJMT
Received 04September 2019 ISSN 2582-1040
Accepted 26 October 2019 2019; 1(6); 677-683
Published online 02 November 2019

# Ambient Air Quality Monitoring Studies in Four Specific Location of Tamilnadu, India

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*Doi: https://doi.org/10.34256/irjmtcon96*

## ABSTRACT

A comprehensive study on the air quality was carried out in four locations namely, Tiruchengode Bus Stand, K.S.R College Campus, Pallipalayam Bus Stop and Erode Government Hospital to assess the prevailing quality of air. Ambient air sampling was carried out in four locations using a high volume air sampler and the mass concentrations of PM10, PM2.5, SO2, NOX and CO were measured. The analyzed quality parameters were compared with the values suggested by National Ambient Air Quality Standards (NAAQS). Air quality index was also calculated for the gaseous pollutants and for Particulate Matters. It was found that PM10 concentration exceeds the threshold limits in all the measured locations. The higher vehicular density is one of the main reasons for the higher concentrations of these gaseous pollutants. The air quality index results show that the selected locations come under moderate air pollution.

***Keywords: Air Quality Monitoring, Air quality index, Particulate matter pollution.***

## 1. INTRODUCTION

Air supplies us with oxygen which is essential for our body to live. Air is 99.9% of Nitrogen, Oxygen, Water vapors and inert gases. Air pollution may be described as contamination of the atmosphere by gaseous, liquid, or solid wastes or by-products that can endanger human health and welfare of plants and animals ( Meenakshi and Elangovan 2000). Although some pollutants are released by natural sources like volcanoes, coniferous forests, and hot springs, the effect of this pollution is very small when compared to that caused by emissions from industrial sources, power and heat generation, waste disposal, and the operation of internal combustion engines (Avnish and Mayank, 2010). Fuel combustion is the largest contributor to air pollutant emissions, caused by man, with stationary and mobile sources equally responsible. The air pollution problem is encountered outdoor as well as indoor.

The major pollutants which contribute to outdoor air pollution are sulfur dioxide, carbon monoxide, nitrogen oxides, ozone, total suspended particulate matter, lead, carbon dioxide, and toxic pollutants (Barman et al. 2008). The air quality in India now appears to be even worse with one new study finding that excess pollution is reducing the life expectancy of 660 million Indians by 3.2 years, on average. In India, pollution has become great topic of debate at all levels and especially the air pollution because of the enhanced anthropogenic activities such as burning fossil fuels, i.e. natural gas, coal, oil to power industrial process and motor vehicles. Among the harmful chemical compounds the burnings put into atmosphere are Carbon monoxide (CO), Nitrogen oxides ($NO_X$), Sulfur dioxide ($SO_2$) and tiny solid particles including lead from gasoline additives

called Pollutants. In India, in most of the 23 Indian cities with a million plus population, air pollution level exceeds World Health Organizations (WHO) recommended health standards (Meenakshi and Saseetharan 2003). In every city, the levels are getting worse because of rapid industrialization, growing number of vehicles, energy consumption and burning of wastes.

With this background, the present study has been carried out to evaluate the ambient air quality in four important locations where air pollution is of major concern. The air quality index is also calculated for the results obtained and the values were compared with standard values. The output of this study will be useful in identifying the pollution status of immediate atmosphere and their effects on human health in the selected areas.

## STUDY AREA

Collection of Particulates was performed using standard protocols and using Respirable Dust Sampler (RDS) in the four selected sites namely, Tiruchengode, KSR College Campus, Pallipalayam and Erode. Tiruchengode is located at 11°22′49.8″N and 77°53′42.45″E at about 750 meters from the mean sea level. Thiruchengode is a city and municipality located in Namakkal District, in the southern Indian state of Tamil Nadu. Due to unregulated population growth and Educational institutions development, Tiruchengode experiences an exponential growth in the vehicular usage and fuel consumption, which results in increased concentration of particulate matter in the surrounding air. Based on the traffic density, Tiruchengode Bus Stand was selected. Point Sources and Non Point Sources around the selected locations responsible for emissions of particulates were analyzed.

K.S.R College Campus is located at 11°36′30″N and 77°82′80″Eatabout 550 meters from the mean sea level. K.S.R Institutions is located in Tiruchengode, Namakkal (DT) in the Southern Indian State of Tamil Nadu. Due to increase in admission of students year by year K.S.R Institutions experiences an exponential growth in the vehicular usage and fuel consumption, which results in increased concentration of particulate matter and Carbon monoxide in the surrounding air. Based on the vehicular movement K.S.R Campus Main Entrance was selected.

Pallipalayam is located at 11°36′46″N and 77°74′79″E at about 158 meters from the mean sea level. Pallipalayam Municipality is located in Namakkal District in the Southern Indian State of Tamil Nadu. Due to unregulated population growth and Industrial development, Pallipalayam experiences an exponential growth in the vehicular usage and fuel consumption, which results in increased concentration of particulate matter in the surrounding air. Based on the traffic density Pallipalayam Bus Stop was selected. Erode GH is located at 11°35′00″N and 77°73′33″E at about 171.91 meters above the mean sea level. Erode GH is located near the Erode Bus Stand in the Southern Indian State of Tamil Nadu. Due to unregulated population growth and Industrial development, Erode experiences an exponential growth in the vehicular usage and fuel consumption, which results in increased concentration of particulate matter in the surrounding air.

## METHODOLOGY

The sampling was carried out for 24 hours and the samples were collected for analyzing the particulate matter concentration.

### Baseline Sampling

The various Baseline parameters considered of importance in the ambient air sampling project are point sources contributing to emission of particulates. point source include hotel and bakeries and non point source include vehicle. A brief survey was conducted around location and hourly inflow of vehicles was analyzed by direct observation.

### $PM_{10}$ Sampling

The particulates in the ambient air are collected by using Reparable Dust Sampler (RDS). Air is drawn through the sampler filter at a controlled flow rate by a pump located downstream of the sample filter. The instrument operated for 23 hours per day. The mass concentration can be calculated measuring the weight of collected matter in known volume of air sampled.

### $PM_{2.5}$ Sampling

The fine particles in the ambient air collected using ambient fine dust sampler. Air is drawn through the sampler filter at a constant flow rate by a pump located downstream of the sample filter. The flow of air through the sampler must be at a flow rate to ensure that the site cut-off at 2.5 microns occurs. The instruments are operated for 23 hours per day.

The coarser particles get trapped in the impact or and the fine particles are collected on the PTFE filter. The mass concentration is calculated by measuring the weight of collected matter is known volume of air sampled parameters such as temperature. Barometric pressure and other meteorological parameter are recorded simultaneously.

### Gaseous Sampling

The gas inlet should be kept on the pipe after the cast minimum aluminum hopper but before the blower. There can be three inlets for different gases or one inlet through a manifold. A calibrated rotameter (0 to 3 lpm) shall be provided for checking the flow rate. The instrument calibration curve is given in the annexure

## MEASUREMENTS OF METEOROLOGICL PARAMETERS

### Wind Direction

The instrumentused for measuring wind direction is a simple one, which employs the conventional wind value to sense the direction.

### Wind Speed

Instruments for measuring wind speed are called anemometers. The rate of reaction of the shaft to which the cups are attached the wind speed. It employs a four cup anemometer. The motion of the cup is transferred after reducing the speed by a gear system to a scale which shows the numerical value of wind speed in kmph.

### Temperature

Temperature is directly calculated by the wet and dry bulb thermometer.

### Cloud cover

Cloud cover is measured in oktas. (from the Greek / Latin octo-8).It is an estimate of how much of the sky is covered by cloud. A clear sky is oktas. In summer day sky with fluffy clouds but lots of sky cloud will be 1-3 oktas.

### Rainfall

Rainfall is usually measured by first collecting it in a gauge. These specials drums are then to record the depth of the water inside .Rain gauges are usually about 50 cm tall and are placed on the ground just high enough to avoids splashes. Rain water that is caught in a funnel on the runs down into a measuring cylinder below- where can be recorded.

## AIR QUALITY INDEX (AQI)

An "Air Quality Index" can be defined as a scheme that transforms the values of individual air pollution related parameters (for example $so_2$, concentration or particulate matters) into a single number or a set of number (Tippayawong et al. 2008). For example, in the major pollutants in a city atmosphere are particulate matter, sulfur dioxide and nitrogen dioxide, then

$$AQI = \frac{1}{3}\left[\frac{PM10}{SPM10} + \frac{PM2.5}{SPM2.5} + \frac{SO2}{SSO2} + \frac{CO}{SCO} + \frac{NOX}{SNOX}\right] X\ 100$$

Where $S_{PM2.5}$, $S_{PM10}$, $S_{SO2}$, $S_{NOX}$ represents the ambient air quality standards particulate matter, sulfur dioxide, carbon monoxide and nitrogen dioxide respectively. The air quality index values and their corresponding quality criteria are given in Table 1.

***Table 1. Interpretation of the air quality index (AQI) value***

| S.No. | Index Value | Remarks | Air Quality |
|---|---|---|---|
| 1 | 0-25 | Clean Air | Clean air, signifying positive message about the air quality |
| 2 | 26-50 | Light Air Pollution | Light air pollution, signifying that the daily air quality is acceptable from the public health perspective, but every day in this range could result in potential for chronic health effects |
| 3 | 51-75 | Moderate Air Pollution | Moderate air pollution, provides health messages for sensitive groups |
| 4 | 75-100 | Heavy Air Pollution | Heavy air pollution, signifying potential for severe effects to sensitive and general citizens |
| 5 | 100 | Severe Air Pollution | Severe air pollution, with warnings of emergency conditions |

***Table 2. Vehicle Count at Sampling Locations***

| Sampling Location | Two Wheeler | Three Wheeler | Lmv | Hmv |
|---|---|---|---|---|
| Tiruchengode Bus Stand | 14375 | 1858 | 4257 | 1963 |
| K.S.R College Campus | 1152 | 8 | 120 | 320 |
| Pallipalayam Bus Stop | 12458 | 1215 | 3952 | 1622 |
| Erode GH | 14375 | 1858 | 4257 | 1963 |

### Baseline Data Analysis

The vehicle count was taken for reference at the monitoring station during the sampling period. The observations of traffic survey was given in Table 2

### Microscale Meteorology

Microscale Meteorological parameters are recorded and are presented in Table 4.2. The ambient Temperature ranges from 23ºC to 37ºC. The wind speed ranges from 10Km/h to 19Km/h. The observed data are given in Table 3.

*Table 3. Meteorological Data*

| Sampling location | Air Temperature (ºC) | | Wind Speed (KM/H) | Wind Direction | Barometric Pressure (HPA) | Maximum Humidity (%) | Rainfall |
|---|---|---|---|---|---|---|---|
| | Max | Min | | | | | |
| Tiruchengode Bus Stand 17.02.2015 | 37 | 23 | 12 | SSE | 1014 | 74 | 0.0 |
| K.S.R College Campus 18.02.2015 | 37 | 24 | 12 | SSE | 1012 | 70 | 0.0 |
| Pallipalayam Bus Stop 19.02.2015 | 37 | 24 | 10 | SE | 1015 | 66 | 0.0 |
| Erode GH 20.02.2015 | 37 | 26 | 10 | SE | 1011 | 67 | 0.0 |

## National Ambient Air Quality Standards (NAAQS)

NAAQS set national levels for acceptable concentrations of specific pollutants in outdoor air known as "criteria pollutants". NAAQS consist of pollutant concentrations in air that may not be exceeded.

## Analysis of Particulate Contaminants

The mass concentrations of particulates were estimated from the difference of the final and initial weight of the filter paper used for air sampling. They are expressed as weight of particulates collected per cubic meter of air sampled (µg/m3). The particulate mass concentration of $PM_{10}$ and $PM_{2.5}$ are tabulated in Table 4.4. The value of $PM_{10}$ ranges from 106.56 – 115.58 µg/m3. The value of $PM_{2.5}$ ranges from 48.55 – 59.52 µg/m3. The obtained values of mass concentration of particulates are compared with standards prescribed by the National Ambient Air Quality Standards (NAAQS).

The ambient concentration of $PM_{10}$ was found to exceed the permissible limit at all four sampling locations.

## Traffic Survey

Traffic Survey was conducted by direct observation and recording the inflow of vehicles towards the sampling location during the sampling period.

## Analysis of Gaseous Contaminants

The concentration of the gaseous contaminants are $SO_2$, $NO_2$present in the ambient air were estimated using Spectrophotometric analysis and is presented in Table 4. Comparing with the National Ambient Air Quality Standards, it can be confirmed that the ambient level of both $SO_2$, $NO_2$ and CO lies with the prescribed limits at Tiruchengode Bus Stand, K.S.R College Campus and Pallipalayam except Erode GH.

*Table 4. Pollutant Concentration at Sampling Locations*

| LOCATION | $PM_{10}$ (µg/ $m^3$) | $PM_{2.5}$ (µg/ $m^3$) | $SO_2$ (µg/ $m^3$) | $NO_X$ (µg/ $m^3$) | CO (µg/ $m^3$) | AQI |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Tiruchengode Bus Stand | 120 | 30 | 40 | 35 | 1020 | 54 |
| K.S.R College Campus | 110 | 27 | 24 | 14 | 950 | 30 |
| Pallipalayam Bus Stop | 145 | 45 | 47 | 32 | 1250 | 56 |
| Erode GH | 158 | 47 | 60 | 40 | 1400 | 60 |
| Threshold limits | 100 | 60 | 80 | 80 | 2000 | -- |

## AIQ QUALITY INDEX (AQI)

Air Quality index is defined as a scheme that transform the (weighted) values of individual air pollution related parameters into single or set of numbers. The Air pollution index was calculated and the results were tabulated in Table 5.

***Table 5 Air Quality Index***

| Sampling Location | $Pm_{10}$ | $Pm_{2.5}$ | $So_2$ | $No_x$ | Co | Aqi | Ambient Air Quality |
|---|---|---|---|---|---|---|---|
| Tiruchengode Bus Stand | 120 | 30 | 40 | 35 | 1020 | 54 | Moderate Air Pollution |
| K.S.R College Campus | 110 | 27 | 24 | 14 | 950 | 30 | Light Air Pollution |
| Pallipalayam Bus Stop | 145 | 45 | 47 | 32 | 1250 | 56 | Moderate Air Pollution |
| Erode GH | 158 | 47 | 60 | 40 | 1400 | 60 | Moderate Air Pollution |

## DISCUSSION

In the study the mass concentration of particulate matters $PM_{10}$ and $PM_{2.5}$ were monitored Gaseous pollutants such as $SO_2$, $NO_X$ and CO were monitored in the selected locations. It was found that $PM_{10}$ concentrations exceed the threshold limits. The higher vehicular density is one of the main reasons for the higher concentration of these gaseous pollutants. Air Quality Index was calculated for the gaseous pollutants and particulate matter. The result shows that the selected locations come under moderate air pollution.

The Air Quality Index (AQI) was computed for the respective monitoring station taking the average monthly AQI values of the location. From the results, it was found that the monitoring station near Tiruchengode Bus Stand, K.S.R College Campus, Pallipalayam, and Erode GH recorded the maximum AQI value of 51 indicating moderate air pollution.

Traffic survey indicates a high vehicular usage. The prime sources for particulate emission ($PM_{10}$& $PM_{2.5}$) were found to be from automobiles.

## SUMMARY

A comprehensive survey of air quality was carried out in Tiruchengode Bus Stand, K.S.R College Campus, Pallipalayam Bus Stop and Erode GH to assess the prevailing the air quality. The ambient air quality was analyzed with the ambient air quality standards of NAAQS. Ambient air sampling was carried out in Tiruchengode Bus Stand, K.S.R College Campus, Pallipalayam Bus Stop and Erode GH and the mass concentrations of PM10, PM2.5, SO2, NOX and CO were estimated. It was found that PM10 concentration exceeds the threshold limits. The higher vehicular density is one of the main reasons for the higher concentrations of these gaseous pollutants. Air Quality Index was calculated for the gaseous pollutants and for Particulate Matters. The results show that the selected locations come under moderate air pollution.

## CONCLUSION

From these results obtained from the analysis of particulates and gaseous pollutants in ambient air. It is concluded that the all the four locations are getting polluted and may cause harmful ill effects to public, students in college and also the environment. The exponential increase in vehicular usage and fossil fuels still makes this level worse day by day. Necessary steps must be taken in order to mitigate the particulate emissions from various sources, particularly from automobiles, which contribute the major source of particulates.

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**Conflict of Interest**

None of the authors have any conflicts of interest to declare.