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Comparison of Air Quality in Sipcot at Walajha Town and Sipcot at Narasingapuram- Ranipet, Vellore District, Tamil Nadu, India.

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Abstract: Air pollution is one of the basic problems being faced in urban areas. This project deals with the ambient air quality monitoring at the Walajha town and Ranipet town (India). The ambient air quality is analyzed with the ambient air quality standards of CPCB (CENTRAL POLLUTION CONTROL BOARD). Ambient air sampling was carried out in near tanning industry area at Walajha and in near Sipcot industrial region area at Narasingapuram, Ranipet(24 hours) , the mass concentrations of PM_{10}, $PM_{2.5}$, SO_2, NOx and CO were estimated. An 'Air Quality Index'(AQI), is calculated for the two regions and whether the pollution is heavy or severe air pollution is found.
Keywords : $PM_{2.5}$, PM_{10}, SO_2, NO_x,NH_3, Cr, Pb, CO, CPCB, Ambient air quality, Vellore district, Air pollution, Ranipet, Walajha.

I. Introduction

The natural resources have been exploited by the man for meeting his needs from the dawn of civilization. However, the acceleration of exploitation has been increasing at a high rate and in non-judicious manner during past few decades especially with the advent of industrial revolution. It has also brought in its wake up many unwanted substances and social problems. One of these problems is the degradation of the environment. These environmental problems are becoming threats to the very existence of the living beings[1]. The environment upon which our life is most dependent, has fallen victim of pollution brought by man himself through unplanned and unscientific urbanization, industrialization and mineral exploitation. Literally environment means surrounding. Environment influences all aspects of life[2].. Air pollution has become an extremely serious problem for the modern industrialized world. Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that may produce undesirable effects on man and ecosystem. These substances include gases (sulphur dioxide, nitrogen oxides, carbon monoxides, Carbon dioxide, hydrocarbons, etc.), particulate matters (smoke, dust, fumes, aerosols, etc), radioactive materials and many others[3].

Air pollution mayor will have harmful effects on living things and materials. It may interfere with biochemical and physiological processes of plants to an extent, which ultimately leads to yield losses (Heck et al., 1988).Air pollution was earlier considered as a local problem around large point sources. But due to use of tall stacks and long range transport of pollutants, it has become a regional problem[4]. The Trans boundary nature of pollutants was clearly evident when areas remote from sources of air pollution also showed higher concentrations of air pollutants. Uncontrolled use of fossil fuels in industries and transport sectors has led to the increase in concentrations of gaseous pollutants such as SO2, NOx; etc. Many developing countries including

India have experienced a progressive degradation in air quality as a result of rapid pace of development over the last three decades[5]. During this period newly industrialized countries underwent unparallel economic growth, swelling urban populations and generated excessive emissions from automobiles, factories and refuse burning. Much of the 20th century witnessed an increasing trend in urbanization in developing countries[6]. The general state of the environment, including air quality, is deteriorating in many cities of the developing countries. World Bank studies in selected cities of developing countries *have shown that swelling urban populations and the growth of industrial activities and automotive traffic in Asia have caused* serious air pollution[7].

The chemical composition of the atmosphere is being altered/changed by the addition of gases, particulates and volatiles substances, which may be toxic to living beings. The adverse effects of air pollution have been associated with three major sources: sulphur dioxide and solid particulates from fossil fuels; photochemical oxidants and carbon monoxide from motor vehicles and miscellaneous pollutants such as hydrogen sulphide, lead and cadmium emitted by smelters, refineries, manufacturing plants and vehicles. Increased numbers of motor vehicles, power generation, industries, domestic fuel use, refuse burning and other miscellaneous sources contribute to the problem of urban air pollution in India. While industrial air pollution is localized, mobile sources have emerged as the most significant contributor to regional air pollution[8].

Air pollution has become an extremely serious problem for the modern industrialized world. Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that may produce undesirable effects on man and ecosystem[11]. These substances include gases (sulphur dioxide, nitrogen oxides, carbon monoxides, hydrocarbons, etc.), particulate matters (smoke, dust, fumes, aerosols, etc), radioactive materials and many others. Air pollution mayor will have harmful effects on living things and materials. It may interfere with biochemical and physiological processes of plants to an extent, which ultimately leads to yield losses[12].

Until 1980, air pollution was primarily the problem of urban and industrial regions in India. But in the last two decades, due to changes in pattern of air pollutant emissions, greater pollutant impacts have also been experienced even in rural and more remote areas. A high rate of economic growth in India has resulted in mass scale influx to urban areas thus increasing the urban population[13]. Urban air pollution has a direct impact on per urban agriculture as pollutants disperse in all directions along the wind. During transportation a variety of reactions occur among primary pollutants to form secondary pollutants causing greater adverse effect in per urban areas. In Indian cities concentrations of phototoxic air pollutants often exceed the toxic limits (CPCB, 2009).

Rapidly growing cities, more traffic on roads, use of dirtier fuels, reliance on outdated industrial processes, growing energy consumption, and lack of industrial zoning and environmental regulations are all contributing to the bad urban air quality and deteriorating public health Keeping in view the information that urban air pollution may be a serious threat to agricultural productivity in areas around urban centers and there exist variations in pattern of pollutants due to interactions during transport, the present review focuses on the trend of emissions and concentrations of major gaseous pollutants, SO2, NO2 and secondary pollutant O3 and their effects on agricultural crops[14].

Exposure to Ambient air pollution has been associated with a number of different health outcomes such as, skin irritation, respiratory and cardiovascular diseases. The main constituents of air pollution path of the urban atmosphere are emission and transmission of air pollutants resulting in the ambient air pollution. All emitted pollutants are dispersed and diluted in the atmosphere and these processes are strongly affected by meteorological conditions, such as rainfall, air temperature, wind speed (WS), and wind direction (WD). Air Quality is calculated at Walajha town and Narasingapuram-Ranipet in Vellore District, Tamil Nadu, for a period of three months (Dec 2014 – March 2015) which represents cool season of the year, where these two locations caused a major pollution problem in this district(Tamil Nadu)[15].

Air Pollutants

The pollutants those are under study, in this project are:- (i) PM_{10} (ii) $PM_{2.5}$ (iii) Sulphur dioxide (iv) Oxides of Nitrogen and (v) Lead (vi) Cr (vii) Carbon monoxide.

Table 1: **Source of Aip Pollution**

Air Pollutants	MajorSources
NOx	Vehicles;industry
SO_2	Vehicles, Industry
PM_{10},$PM_{2.5}$	Vehicles;industry
CO	Vehicles(burning of Carbon)
NOx	Vehicles;industry
Pb	Tanneries
NH_3	Taneeries
Cr	Tanneries

Materials and Methods

Collection of particulates was performed using standard protocols and using particulate sampling equipments in the near SIPCOT industrial area at Narasingapuram, Ranipet and near tanning industry area at Walajha.

The Study Area –

Description:

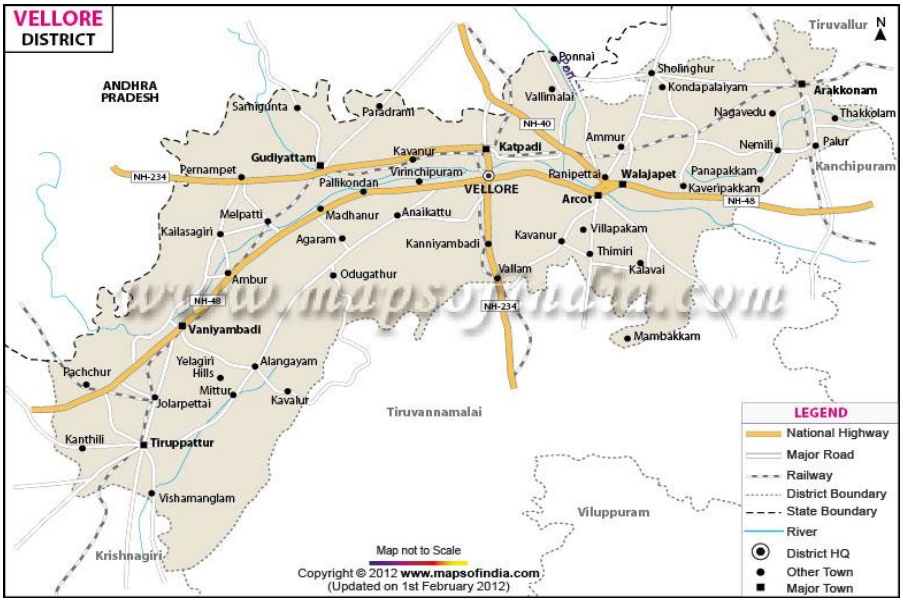
The study areas are tannery industry accumulated places of Vellore district, which include near SIPCOT industrial area at Narasingapuram, Ranipet and near tanning industry area at Walajha.

Sampling located at these areas only. Due to unregulated population growth, these two towns experiences an exponential growth in the vehicular usage, tanneries activities, other industrial industries and fuel consumption, which results in an increased concentration of particulate matter and other gaseous pollutants in the surrounding air[16].

Sampling Location:

Based on the tanneries and industrial pollutions density, were selected in the city. Point sources and Non-point sources around the selected location, responsible for emission of particulates were analyzed.

Location-1 : Sipcot at Narasingapuram, Ranipet, Vellore district
Location-2 : Sipcot at Walajha Town, Vellore district.



Sampling period:

The sampling was done continuously on a 8 hr basis for one day for a period of two months (Nov 2014 – Dec 2014), which represents the cool seasons of the year.

Sampling duration:

The samples were collected 8 hours continuously for a period of one day per month.

Collection of Sample and Analysis

Suspended particulate matter (SPM)

It consists of different solid and liquid particles that are suspended in the atmosphere and includes soil, soot, lead, asbestos and sulphuric acid droplets. Smaller particles are inhaled into the respiratory system and can cause health problems[12].

Gaseous pollutants (GP)

Major sources are coal fired power plant, Tanneries and diesel powdered motor vehicles. Ambient concentration of SO_2,

NO_2, and CO were usually highest in center city areas and around industrial areas[13].

Air Quality Indices (AQI)

An ' Air Quality Index be defined as a scheme that transforms the values of individual air scheme that transforms the values of individual air pollution related parameters (for example, SO2 concentration of particulate matters) into a single number or a set of numbers. For example, in the major pollutants in a city atmosphere are particulate matter, Sulphur dioxide and Nitrogen dioxide, then,

$$\mathbf{AQI = 1/6 [PM_{10}/S_{PM10} + PM_{2.5}/S_{PM2.5} + SO_2/S_{SO2} + CO/S_{CO} + NO_X/S_{NOX} + NH_3/S_{NH3}]}$$

Where, S_{PM10}, $S_{PM2.5}$,S_{so2} S_{co} and S_{NOx} represents the ambient air quality standards for particulate matter, carbon monoxide, Sulphur dioxide and Nitrogen dioxide respectively.

Table – 2 (Air Quality Index)

Air Quality Index	Remarks	Health effect
0 – 20	Clean Air pollution (CAP)	None or Minimal health effect
21 – 50	Light air Pollution(LAP)	Possible respiratory and cardiovascular symptoms and illnesses
51 – 75	Moderate air pollution(MAP)	Increasing like hood of respiratory and cardiovascular symptoms and illnesses
76 – 100	Heavy air pollution(HAP)	Aggravation of heart or lung disease. Increased risk of death in children.
> 100	Severe air pollution(SAP)	Serious aggravation of heart or lung disease; increased risk of premature death. Serious risk of cardio respiratory symptoms in general population.

Table -3 : Air pollution parameters data at location-1 and Location -2

S. N.	Locations Name	Time	Pollutants in µg/m3								
			PM_{10}	PM2.5	SO_2	NO_2	CO	NH_3	Cr	Pb	Remarks
1	SIPCOT AT NARASINGA PURAM, RANIPET	6.00 am To 2.00 PM	21.0	15.4	14.89	7.89	0.092	5	BDL(D.L -0.5)	BDL(D.L -0.5)	MAP
		2.00 pm To 10.00 pm	20.5	15.1	18.94	10.12	o.083	8	BDL(D.L -0.5)	BDL(D.L -0.5)	LAP
		10.00 pm To 6.00 am	20.6	15.6	19.56	17.89	0.076	3	BDL(D.L -0.5)	BDL(D.L -0.5)	MAP
Average pollutant			20.7	15.36	17.79	11.96	0.083	5.33	BDL(D.L -0.5)	BDL(D.L -0.5)	MAP
2	SIPCOT AT NARASINGA PURAM, RANIPET	6.00 am To 2.00 PM	19.4	13.3	13.90	6.88	0.084	4	BDL(D.L -0.5)	BDL(D.L -0.5)	LAP
		2.00 pm To 10.00 pm	21.0	14.4	17.55	9.10	0.071	7	BDL(D.L -0.5)	BDL(D.L -0.5)	MAP
		10.00 pm To 6.00 am	20.5	15.2	18.45	16.78	0.065	2	BDL(D.L -0.5)	BDL(D.L -0.5)	MAP
Average pollutant			20.3	14.3	16.6	10.92	0.072	4.33	BDL(D.L -0.5)	BDL(D.L -0.5)	LAP
CPCB Standards			100	60	80	80	2	100	BDL(D.L -0.5)	BDL(D.L -0.5)	LAP

CAP – Clean Air Pollution, **HAP** – Heavy air pollution, **SAP** – Severe air pollution, **LAP** – Low air pollution, **MAP** – Moderate air pollution

Location-1: Sipcot, Narasingapuram, Ranipet, Vellore district
Location-2: tanning industry area at Walajha, Vellore district

Location:2 -Detection of Ambient air quantity at Sipcot, Narasingapuram, Ranipet, Vellore district (24 hours)

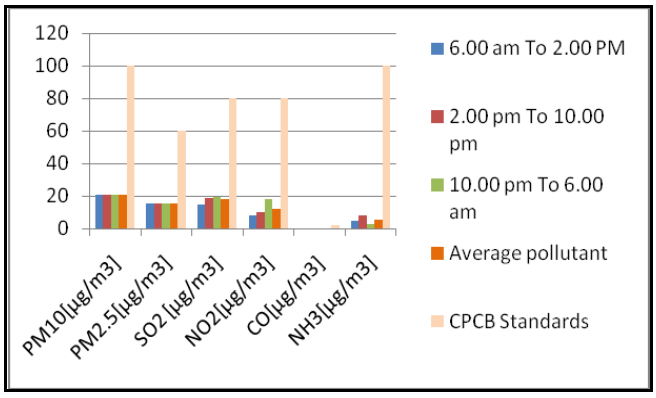


Fig:1

Location:2 -Detection of Ambient air quantity in near tanning industry area at Walajha (24 hours)

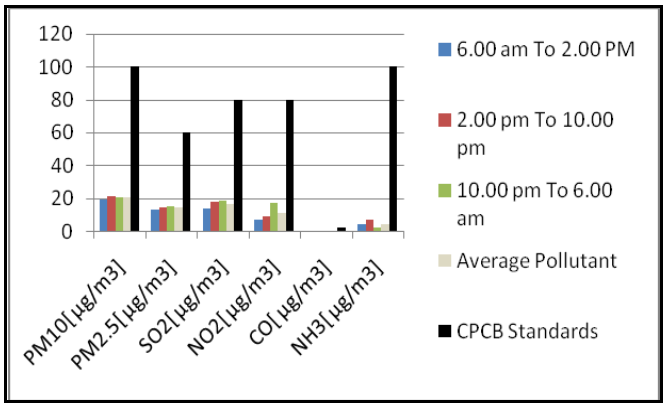


Fig:2

Analysis of Particulate Contaminants:

The values of PM_{10} are 21.0 µg/m^3 , 20.5 µg/m^3 and 20.6 µg/m3 at the location-1 where average PM_{10} concentration is 20.1 µg/m^3. Similarly the values of PM_{10} are 19.4 µg/m^3, 21.0 µg/m^3 and 20.5 at the location-2 where average PM10 Concentration is 20.3 µg/m^3. Form this analysis PM_{10} concentration of location-1 is slightly lesser than PM_{10} concentration of location-2.

The average value of $PM_{2.5}$ is 15.36 µg/m^3 at the location-1,where as $PM_{2.5}$ value of location-2 is 14.3 µg/m^3 which is lesser than location-2 concentration of $PM_{2.5}$.

Analysis of Gaseous Contaminants*:*

The concentration of the gaseous contaminants SO_2, NO_2 and CO present in the ambient air were estimated using spectro photometric analysis and is presented in Table3. The values of gaseous pollutants like SO_2, NO_2 and CO are 17.79 µg/m^3, 11.96 µg/m^3, 0.083 µg/m^3 at the location-1 and 16.6 µg/m^3, 10.92 µg/m^3, 0.072 µg/m^3 at the location-2. Small amount of Chromium and Lead were present in both location.

Comparing with CPCB air quality standard, it can be confirmed that the ambient level of PM_{10}, $PM_{2.5}$, SO_2 , NO_2 and CO with the prescribed limits at the location-1 and location-2 somewhat exceed the prescribed limits. Whereas not exceed the CPCB standard level.

Discussion

In this study the mass concentration of particulate matters PM_{10} and $PM_{2.5}$ were monitored. Gaseous pollutants such as SO_2, NOx, and CO were monitored in the selected Sipcot at Walajha town and Sipcot at Ranipet town. It was found that PM_{10}, $PM_{2.5}$ and CO concentrations not exceed the threshold limits. The higher industrial density is one of the main reasons for this level concentration of gaseous pollutants.

Air quality was calculated for the gaseous pollutants and for particulate matters. The results show that the selected locations come under Moderate and light Air Pollution. The Air Quality was computed for the respective Monitoring stations taking the average monthly Air quality values for each location separately. From the results, it was found that the monitoring station near Ranipet and Walajha Sipcot region recorded the average air quality values indicating Low Air Pollution. The monitoring station near Walajha Sipcot location and Ranipet- Narasingapuram Sipcot locations indicating Severe Air Pollution.

V. Summary

The ambient air quality was analyzed with the ambient air quality standards of CPCB. Ambient air sampling was carried out in Walajha and Ranipet town industrial areas, the mass concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, Pb, Cr, NH_3 were estimated. It was found that PM_{10} , $PM_{2.5}$ and CO concentrations not exceed the threshold limits. This moderate vehicular density and industrial activities are one of the main reasons for the higher concentration of these gaseous pollutants. Air Pollution Index was calculated for the gaseous pollutants and for particulate matters. The results shows that the Walajha and Ranipet industrial town locations come under Moderate and Low Air Pollution. But overall average pollutants of Sipcot, Narasingapuram, Ranipet, Vellore district (24 hours) Somewhat greater than tanning industry area at Walajha (Table:3).

Conclusion

From the results obtained from the analysis of particulates and gaseous pollutants in ambient air, it is concluded that the areas under investigation is getting polluted at Moderate and Low. Even though moderate and low air pollutants it may cause harmful ill effects to public and also the environment. The exponential increase in industrial activities and fossil fuels still makes this level worsen day by day. Necessary steps must be taken in order to mitigate the particulate emissions from various sources, particularly from industries (such as Tanneries), which contribute the major source of particulates.

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