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REVIEW ARTICLE

AMBIENT AIR QUALITY STUDY ON SIPCOT CUDDALORE TAMILNADU IN INDIA

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ABSTRACT

Air pollution is perhaps the commonest form of environmental degradation in urban and rural area of both developed and developing countries. In the environment there are many pollutants which have been observed during different studies regarding air pollution. Among all the pollutants, gaseous and particulate pollutants are more important. In this paper an attempt has been made to study the status and trend of sulphurdioxide (SO_2), oxides of Nitrogen (NO_x), particulate matter (PM_{10},&$PM_{2.5}$), and the industrial area the specific pollutants Methyl Mercapten, Vinyl Chloride in State Industrial Promotion corporation Of Tamilnadu(SIPCOT) Cuddalore. The study has been carried out six months in six sampling station of SIPCOT for the above mentioned pollutants with the help of Tamilnadu Pollution Control Board Cuddalore. Each of Air pollutants are analyzed by using BIS & USEPA methods.

INTRODUCTION

SIPCOT was started 1971-72 in Chennai. After that 19 industrial such complexes has been started various locations in Tamilnadu. SIPCOT Cuddalore has been started in 1985. Initially the complex consist of only five industries. But now the industrial complex running with 26 units in Cuddalore. (6 Major units & 20 small units). Due to that rapid industrialization the pollution level also increased rapidly. According to the CPCB report 2012, the Cuddalore is one of the highly polluted cities in India. So we have taken Cuddalore is our study area for monitoring air quality in different locations from September-2013 to February-2014.

STUDY AREA

SIPCOT Cuddalore is situated about 210kms from southwest of Chennai, in the Cuddalore district. It is one of the east coast road connecting Chidambaram and Cuddalore. SIPCOT Cuddalore is about 40km from Chidambaram and latitude of 11˚40˚N and longitude of 79˚44˚E and altitude of + 20m above MSL. The topo sketch area is shown in Figure 1. The Industrial site is located in between the Uppanar River (back water of Bay of Bengal) and the east coast road. The bay of Bengal is about 2km from Uppanar River. The SIPCOT Industrial area has established over an area of 518acres. Now it has extended upto 2605.8acres.The overall area has equally distributed of phase-I,II.

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Cuddalore SIPCOT is an industrial area consists of about 30 industries comprising of large, medium, small and tiny industries. The location of these industries is at SIPCOT phase I & II. The units located at Cuddalore manufacture sophisticated products ranging from chemicals, pharmaceuticals, paints, textiles and Poly Vinyl Chloride (PVC). The main objective of the work is to determine the Ambient air quality survey in Cuddalore to create awareness among the people of this town.

Details of Air Quality monitoring Station in SIPCOT

Site	Latitude(N)	Longitude(E)	Site Classification	Monitoring Period (08.00 to 05.00)
Pachaiyankuppam	11°41'44"N	79°45'27"E	Industrial area	Sep-2013 to Feb 2014
Kudikadu	11°41'2"N	79°45'14"E	Industrial area	Sep-2013 to Feb 2014
Karaikadu	11°40'34"N	79°44'32"E	Industrial area	Sep-2013 to Feb 2014
Semmanguppam	11°38'48"N	79°44'21"E	Industrial area	Sep-2013 to Feb 2014
Sedapalayam	11°39'49"N	79°43'15"E	Residential area	Sep-2013 to Feb 2014
Thiyagavalli	11°37'6"N	79°44'57"E	Industrial area	Sep-2013 to Feb 2014

The Study Area map of SIPCOT and the sampling stations are pointed in the figure 1.

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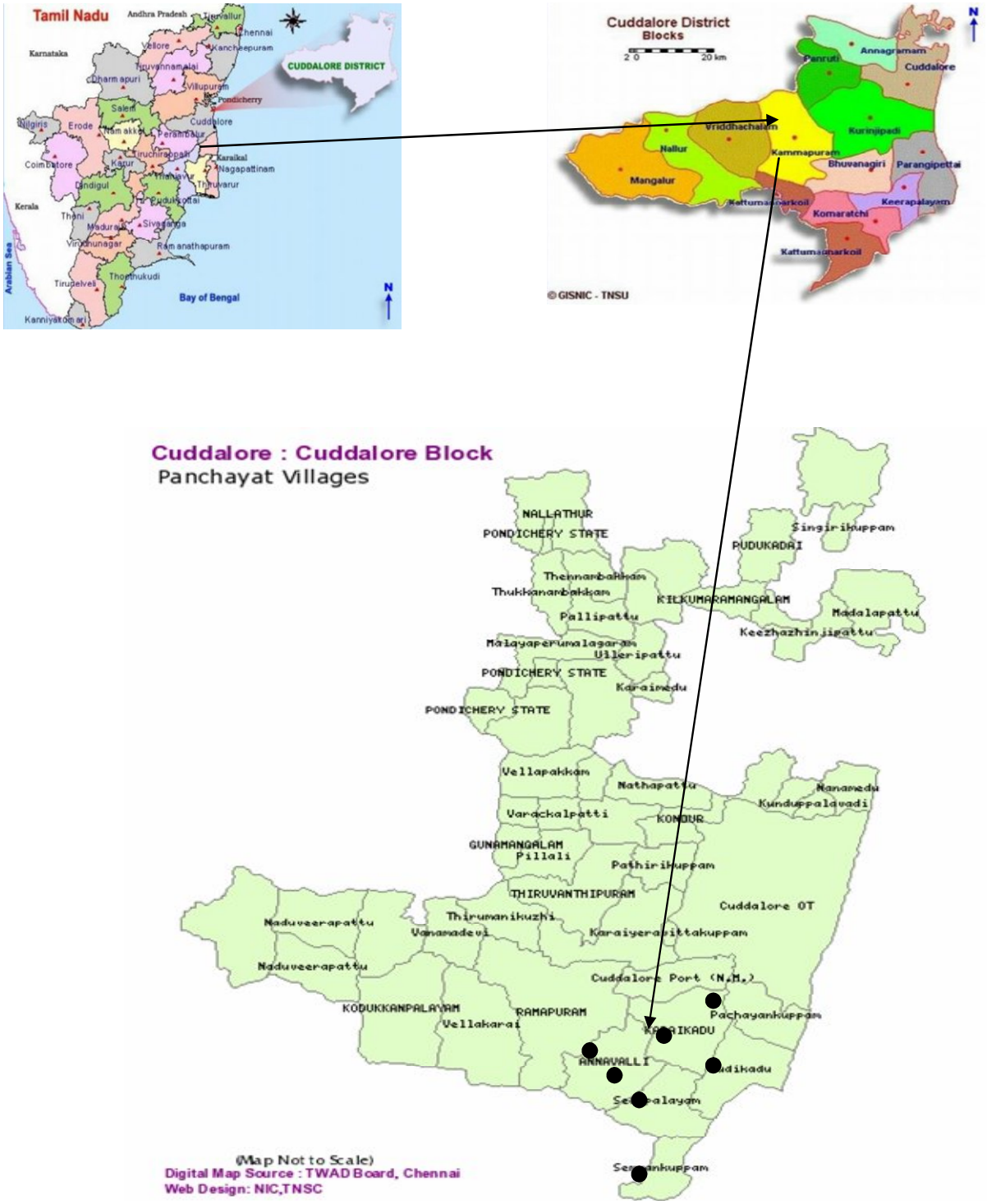


Fig. 1: Sampling locations and map of study area

Point Source Emission Inventory Of SIPCOT Cuddalore

There are lot of pollutants coming from SIPCOT Industrial complex.Cuddalore. But after the emission inventories monitored in the study area we have decided **PM_{10} & $PM_{2.5}$, NOx, SOx, Mcthyl Mercaptan and Vinyl Chloride** as a major air pollutants to be monitored.Other pollutants are under below deduction limit.

Emission Inventory			
S. No.	**Name of the Unit**	**Name of the Product**	**Pollutants**
1	Tanfac Industries	Aluminium Flurides	(1) SO_2, NO_2, PM_{10},$PM_{2.5}$ (2) Hydrogen Flouride (3)Ethyl Acetate
2	Kumar Chemical Corpn.	Aluminium Sulphate/ Calcium Stearate	(1) SPM, NOx, SOx (2)Sulphur trioxide (3)Sulpliuricacid Mist
3	M.A.B. Metals	Aluminium Circles	Not Working
4	Tagros Chemicals-I	AGRO Chemicals (Plant Protection	(l)SOx,NOx, PM_{10},$PM_{2.5}$
5	Tagros Chemicals-II	Intermediates)	(2)AcetonitriIe (3)1,2DichIoroethane
6	Tagros - III	Off-Grade Zinc	(4)Bromomethanc
7	Tagros-IY	AGRO Chemicals	(5)Carbon Tetrachloride (6)Chlroform
8	Tagros-V		(7)Isopropyl Alcohol
9	Pondicherry Alum And Chemicals Ltd.	Aluminium Sulphate	(l)SO_2.NOx. PM_{10},$PM_{2.5}$ (2) Hydrogen gas (3)Amonia
10	Kousalya ICE	ICE	(1)Ammonia (2) CFC
11	Costal Packers	Corrigated Paper Box	(1) SOx.NOx,SPM From Diesal Generator
12	Tamilnad Pigments	CPC alpha blue (organic Pigments)	SOx.NOx PM_{10},$PM_{2.5}$ From DG
13	Shasun Chemicals	Ranitidine	(l)SO.NO. PM_{10},$PM_{2.5}$ (2)Methyl Mercapten (3)n,Butvl Acetate (4)Carbon Tetrachloride
14	Shasun Bulk Drugs	Analgin IP Power	(5)n.Hexane
15	SHASUN	Ranitidine	(6)Dimethyl Sulphide
16	INDO International Fertilizers Ltd.,	DI-Calciam Phosphate	(l)SO_2.NOx. PM_{10},$PM_{2.5}$ (2)Endusulfan Sulphate (3)Phoe;phamidon (4)Benzo(e) pyrene
17	Asian Paints	Pentari Trito	(l)SOx.NOx, PM_{10},$PM_{2.5}$ (2)MethanoI (3)Formaldehyde (4)Acet aldehyde
18	IGLOO Ice Factory	ICE	(l)Ammonia
19	Diamond Ice Cold		(2)CFC
20	Omni Cast Precision	Percision Casting Components	Particulate Emissions PM2.5
21	Loyal Super Fabrics	Textile Process	(l)SPM,SOx.NOx. (2)Biphenyl (3)Dibutyl phthalate
22	DFE Pharma India Ltd	Sodium Carbo Methyl Cellulose	(l)SOx,NOx. PM_{10},$PM_{2.5}$ (2)Metliyl Chloride (3)Iso butylene (4)n-Hexane
23	Sudhahar Chemicals	Paracetamol (2ADBB)	(DSPM.SOx.NOx (2)Nitrobenzene (3)Biphenyl
24	Packaging India ltd.	Copper Plate	(l)SOxNOx. PM_{10},$PM_{2.5}$ From DG only
PHASE-II			
25	Chemplast	PVC	(l) PM_{10},$PM_{2.5}$,SOx,NOx (2)VinylChloride (3)Chloroform (4)Di-oxins
26	Pandian Chemicals	Perchlorates Including Ammonium Perchlorates	(1)SOx.NOx, (2)Ammonia (3)Perchloride acid

MATERIALS AND METHODS

PM_{10},$PM_{2.5}$ (particulate matter) concentrations were measured by finding the sample air volume (m^3) through an orifice meter and the mass (ug) of particulate matter collected in a Watt man grade 1 fiberglass filter paper. Concentrations of SO_2 and NO_2 (μg / m^3 or PPM) were colorimetrically determined using a spectrophotometer. 5 to 20 ml of reagent (sodium tetra chloro mercurate for West and Geake method to find SO_2 and sodium hydroxide for NO_2) filled in a train of impingers of the high olume sampler trap specific contaminant in air. Air flows to the impingers were determined using rota meters. Instantaneous carbon monoxide concentrations were directly recorded using a battery operated portable CO monitor (CO 84 ENDEE make).

Particulate Matter(PM_{10}&$PM_{2.5}$)

Respirable dust air sampler was used for the monitoring of particulates. Before sampling, the watt man filter GFA (20.3cm x25.4cm) of the respirable dust sampler was kept at 15-34 °C, 50% relative humidity for 24-hour and then weighed. The filter paper was placed into the filter holder of the respirable dustsampler and air was drawn through a 410 cm^2 portion of the filter at the flow rate of 1.70 m^3/min. The filter was removed after sampling. The mass concentration of particulates in ambient air, expressed in micrograms per cubic meter, was calculated by measuring the mass of particulates collected and the volume of air sampled.

Nitrogen oxides

Ambient air was continuously drawn into 35ml of sodium hydroxide solution at a flow rate of 2 LPM for 8 hour and Jacobs and Hochhesier method in the laboratory estimated it. Sodium hydroxide solution forms a stable solution of sodium nitrite. The nitrite ion produced during sampling was determined colorimetrically by reacting the exposed absorbing reagent with phosphoric acid, sulphanilamide and N-(1-napthyl ethylene-diamine dihydrochloride producing an azo dye. The absorbance of the colour was read at 540 nm.The range of the analysis was between 0.01 and 1.5 ug/ml.

Sulphur oxides

Ambient air was continuously drawn into 35ml of sodium tetrachloromercurate solution at a flow rate of 1.5 LPM for 8 hour and Sodium tetrachloromercurate method in the laboratory estimated it. Samples for SO_2 are collected using high volume sampler in the impinge containing the absorbing reagent, sodium tetrachloromercurate. After collecting *the* gas in the absorbent, proper volumes and concentrations of sulphamic acid, formaldehyde, and pararosaniline reagent are added to develop the red-purple colour. The intensity of the colour is measured after half an hour by taking optical density at the wavelength of 560 nm.

Vinyl Chloride

(USEPA TO 17 Method)Air samples are collected by drawing known volumes of air through glass sampling tubes containing Carbosieve S-III{ carbon based molecular sieve) adsorbent. Samples are desorbed with a mixture of 99:1 (v/v) carbon disulfid(CS_2)/dimethylformamide (DMF) in the presence of magnesium sulfate. Samples are analyzed by GC using a flameionization detector.

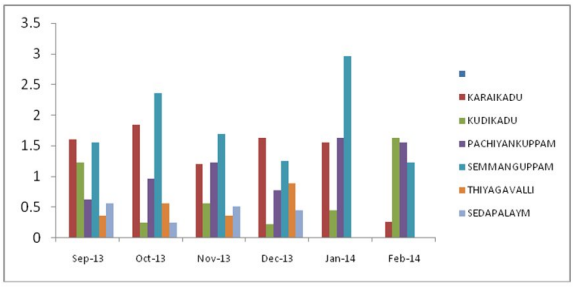
Methyl Mercaptan

Mercaptans(Organic thids) are collected by as pirating a measured volume of air thro[1] an aqueous solution of mercuric acetate-acetic acid. The collected mercaptans are subsequently determined by spectrophotometric measurements of the red complex produced by the reactive between mercaptans and a strongly acid solution of N,N Dimethy-p-Pheylediamine and ferric chloride. The methods determines total Mercaptans and does not differentiate among individual Mercaptans although is most sensitive to lower molecular weight alkanethiols.

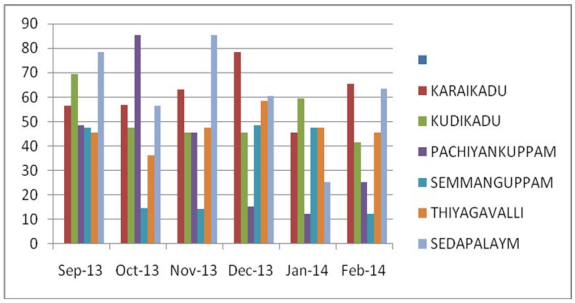
RESULTS

The figure shows the graphical representation of Six Months concentrations of pollutants.

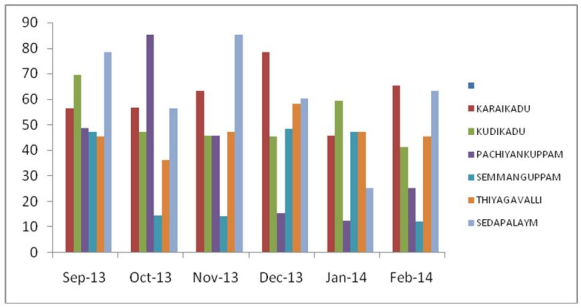
CONCENTRATIONS OF VINYL CHLORIDE(µg/m³)



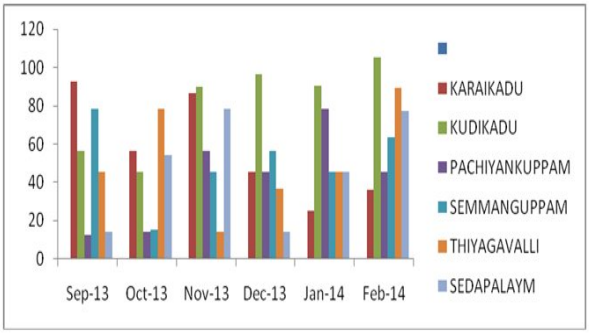
CONCENTRATIONS OF NITROGENDIOXIDES (µg/m³)



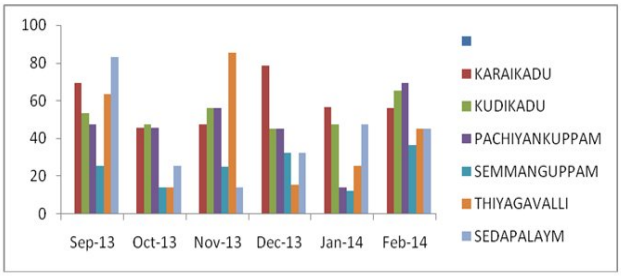
CONCENTRATIONS OF PM $_{2.5}$(µg/m³)



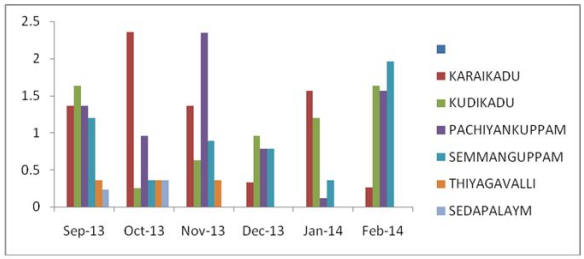
CONCENTRATIONS OF PM $_{10}$ (µg/m³)



CONCENTRATIONS OF SULPHUR DIOXIDES (µg/m³)



CONCENTRATIONS OF METHYL MERCAPTEN (µg/m³)



The minimum and maximum concentrations has been taken from six months readings and statistical approach has done and the readings has showed in the below tables.

Table 2. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS	SAMPLING STATION(KARAIKADU)				
(µg/m³)	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	0.26	1.85	1.055	1.124299782	0.693541635
PM_{10}	25.36	92.36	58.86	47.37615434	48.39679328
$PM_{2.5}$	36.33	59.3	29.9575	16.24224276	46.41518071
METHYLMERCAPTEN	0.26	2.36	1.31	1.48492424	0.783326241
NITROGEN DIOXIDES	45.66	78.36	62.01	23.12239174	59.81569694
SULPHUR DIOXIDES	47.36	78.45	62.905	21.98394983	60.95401545

Table 3. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS	SAMPLING STATION(KUDIKADU)				
(µg/m³)	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	0.23	1.63	0.93	0.989949494	0.612290781
PM_{10}	45.63	105.36	75.495	42.23548804	69.33669159
$PM_{2.5}$	26.36	62.3	38.2125	25.41341772	40.5244124
METHYL MERCAPTEN	0.25	1.63	0.94	0.975807358	0.638357267
NITROGEN DIOXIDES	41.36	69.36	55.36	19.79898987	53.56052278
SULPHUR DIOXIDES	45.36	65.32	55.34	14.11385135	54.43266666

Table 4. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS	SAMPLING STATION(PACHAIYANKUPPAM)				
(µg/m³)	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	0.63	1.65	1.14	0.721248917	1.019558728
PM_{10}	12.36	78.32	45.34	46.64076329	31.11326405
$PM_{2.5}$	15.32	62.33	23.24	33.24108978	30.90138508
METHYL MERCAPTEN	0.12	2.35	1.235	1.576848122	0.531036722
NITROGEN DIOXIDES	12.33	85.36	48.845	51.64000823	32.44208378
SULPHUR DIOXIDES	14.23	36.36	25.295	15.64827307	22.74648984

Table 5. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS	SAMPLING STATION(SEMMANGUPPAM)				
(µg/m³)	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	1.23	2.96	2.095	1.223294731	1.908088048
PM_{10}	15.36	78.36	46.86	44.54772721	34.69307712
$PM_{2.5}$	12.3	58.32	24.4775	32.54105407	26.78312902
METHYL MERCAPTEN	0.36	1.96	1.16	1.13137085	0.84
NITROGEN DIOXIDES	12.3	48.36	30.33	25.49827053	24.38909592
SULPHUR DIOXIDES	12.33	36.23	24.28	16.89985207	21.13565471

Table 6. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS	SAMPLING STATION(THIYAGAVALLI)				
(µg/m³)	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	0.36	1.89	1.125	1.081873375	0.824863625
PM_{10}	14.23	78.36	46.295	4534675788	3339255606
$PM_{2.5}$	14.23	52.12	23.71	26.79227594	27.23357487
METHYL MERCAPTEN	035	0.36	036	0	036
NITROGEN DIOXIDES	36	58.63	47.315	16.00182646	45.94213752
SULPHUR DIOXIDES	15.39	85.36	50.375	49.47626148	36.24486722

Table 7. STATUS OF POLLUTANTS DURING THE PERIOD OF SEP-13 TO FEB-14

POLLUTANTS ($\mu g/m^3$)	SAMPLING STATION(SEDAPALAYAM)				
	Min	Max	Mean	Standard deviation	Geometric mean
VINYL CHLORIDE	0.25	0.56	0.405	0.219203102	0374165739
PM_{10}	14.23	7836	46.295	4534675788	3339255606
$PM_{2.5}$	14	60,33	23.35	32.76025717	29.06234677
METHYL MERCAPTEN	0.35	0.45	0.405	0.06363961	0.402492236
NITROGEN DIOXIDES	25.33	85.23	55.28	4235569619	46.46370519
SULPHUR DIOXIDES	14.23	8336	48.795	48,88229178	34.44144016

AIR QUALITY INDEX

For indexing of the air quality status an assumption is made that all the pollutants are of equal importance. Using observed and standard values calculated the rating for each pollutant and the geometric mean of all the parameters gives the quality index was derived in the manner outlined below. The existing pollution levels of pollutants were compared with ambient air quality standards (with the standard being assumed as reference baseline for each pollutant) and than converted to the concentration of pollutants into ratio of the standard.

$$\mathbf{Q_i = C_i/S_i}$$

Where

Q_i= Quality rating for a particular pollutant.

C_i =Concentration of particular pollutant.

S_i =for quality standard for particular pollutant

A typical rating scale for air quality index (A!I) is given in table 8.

The air quality index attempt to measure the air quality and index value represent the most desirable air quality.

Table – 8

POLLUTANTS ($\mu g/m^3$)	AIR QUALITY INDEX VALUE FOR EVERY SAMPLING STATIONS UNITS IN ($\mu g/m^3$)					
	KARAIKADU	KUDIKADU	PACHAIYANKUPPAM	SEMMANGUPPAM	THIYAGAVALLI	SEDAPALAYAM
VINYL CHLORIDE	0.5	0.44	0.54	0.99	0.53	0.21
PM_{10}	0.58	0.75	0.45	0.46	0.45	0.46
$PM_{2.5}$	0.49	0.63	0.38	0.53	0.32	0.58
METHYL MERCAPTEN	0.62	0.46	0.74	0.53	0	0.02
NITROGEN DIOXIDES	0.28	0.77	0.61	0.37	0.2	0.52
SULPHUR DIOXIDES	0.78	0.69	0.31	0.3	0.61	0.59

Table – 9

Index value	Remark
< 0.3	Least polluted
< 0.3 -0.6	Slightly polluted
> 0.6 – 0.9	Moderately polluted
>0.9-1.2	Highly polluted
>1.2-1.5	Severely polluted
>1.5	Extremely polluted

CONCLUSION

Important observations made from the present study are:

It is observed that the vinylchloride air quality index values of Kudikadu, Karaikadu, Pachiyankuppam, Thiyagavalli Sampling station are falls under slightly polluted region, Sedapalagam was least polluted area and Semmanguppam area comes under moderately polluted region.

The PM_{10}, $PM_{2.5}$ air quality Index values of Karaikadu, Pachiyakuppam, Semmanguppam, Thiyagavalli, Sedapalayam were comes under slightly polluted region, where Kudikadu sampling station falls under moderately polluted region.

The Methyl Mercapten air quality index values of Kudikadu, Semmanguppam sampling station comes under slightly polluted region, Karaikadu, Kudikadu sampling station comes under moderately polluted region where Thiyagavalli, Sedapalayam comes under least polluted region.

The Nitrogen Oxides air quality index values of Kudikadu, Pachiyankuppam sampling station comes under moderately polluted region, Karaikadu, Thiyagavalli station comes under slightly polluted region where rest of stations falls under seast polluted design. The Sulphur Dioxides air quality index values of Thiyagavalli, Karaikadu comes under moderately polluted

region, where rest of the stations falls under slightly polluted region.

REFERENCE

Gunesekaran, R. and K. Kumarasam, Monitoring of ambient air quality in Salem City, Tamilnadu. Internation journal of current research Vol. 4, Issue, 03, pp – 275-280, March 2012

HarikrishnanS, PradeepS, Pradeep . Ambient air quality monitoring and possible health effects due to air pollution in Hosur town, ISSN 0886-0986, volume 2 Issue 4, 256-260.

Pulikesi, M. and D. Elango 2011, Air quality monitoring I Chennai, India, in the summer of 2011, Elsevier B. V. 0304 – 3894.

Trivedi R.C., and Sengupta, B. 2006. Air quality status and trends in India journal of air pollution Control. Vo. VII, March, pp. 71-79.

Vadamadaran, Sarithabanuraman, 2012. Assessment of ambient air quality in Coimbatore city, Civil and Environmental research ISSN 2224-5790, Vol. 2, No.1., 2012.

Vidya Vathana 2012, Ambient concentration of suspended particulate matter in urban area of Madurai city, Journal of research in Biology, 001-006?JRB/2012?Vol 2? No.1.

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