A CASE STUDY:

Assessment of ambient air quality in Virudhunagar Town, Tamil Nadu

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The seasonal variations in spatial distribution of SO_2, NO_x, SPM, RPM, CO, HC emissions were investigated on three selected areas in Virudhunagar.The study areas consisted of residential area, sensitive area are industrial area. The objective of this study was to compare the ambient air quality in different selected areas of the town. The study identified the areas that were more affected due to air pollutants and the type of pollutants that concentrated in the selected areas. An effort has been made to study the air quality in Virudhunagar and the air quality can be described by Air Quality Index (AQI) based on four pollutants sampled at three locations in study area and the sampling was carried out using dust sampler at sampling sites. Results were compared with ambient air quality standard laid down by Ministry of Environment and forests Government of India. The data were discussed as to present the status of ambient air quality of the study session and Air Quality Index calculated by ORAQI.

The air quality in urban and semi-urban areas are deteriorating due to rapid urbanization and industrial development. Though, there has been undoubted economic growth as a result of these activities, they have caused severe environmental problems like water, air, land and noise pollution (Ahmed *et al*., 2004). Road vehicles emit various pollutants and this continuous discharge of pollutants create a problem where nature no longer is able to disperse, absorb or dispose off unwanted residue in the natural sinks of the environment.This demands for making provision and efficient use of pollution control measures to minimize the adverse environmental impacts (Mohanty, 1998).

The Virudhunagar town is situated in the southern part of Tamil Nadu and this is the administrative head of Virudhunagar district. Total vehicular population on April, 2009 was 29,726 and witnessed a tremendous increase of registration of vehicles from 2005 to 2009. Drainage construction,damaged roads are the other main sources of severe dust pollution in this area and these cause problems like nasal and throat infection, continuous cold and asthma. Keeping all these in consideration, a study was initiated to monitor air quality status of different sites in Virudhunagar town.

Virudhunagar town spreads over an area of about 6.600 sq.km as per 2001 survey and 50 km south from Madurai city. The total population of Virudhunagar is estimated as 72,081 as per 2001 census. The town basically a trade centre, having various small scale industries which are in the vicinity of the township (Fig. 1).

Monitoring was carried out at three locations in the town of Virudhunagar classified into three categories as Residential, Sensitive, Industrial. All these locations are prominent places in Virudhunagar town and the frequency of monitoring for SPM, RPM, SO_2, NO_x were 24/8 hourly. The details of monitoring locations are given in the Table 1.

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, asbestosand sulphuric acid droplets.Smaller particles are inhaled into the respiratory system and can cause health problems. Lead and asbestos particles are especially harmful (Naveen *et al.*, 2008).

Respirable particulate matter (RPM):

Particulates were mainly produced from coal combustion, diesel engines, construction and industrial activities.

Sulphur dioxide(SO_2):

Major sources are coal fired power plants and diesel powered motor vehicles.Ambient concentrations of SO_2 were usually highest in central city areas and around industrial areas

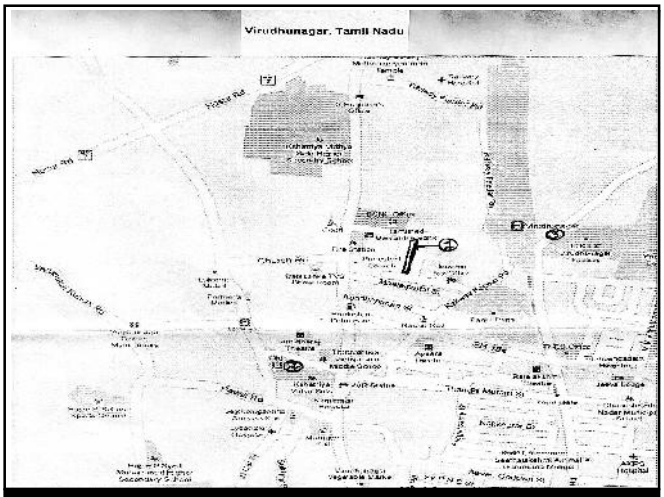

Fig. 1 : Sketch map showing sampling sites of Virudhunagar town.

Table1 : Details of monitoring locations

Site no.	Site	Location description	Category
1.	Madura coats colony	Residential area of upper and middle class people	Residential area
2.	Pavali	Schools and hospitals.	Sensitive area
3.	Perali	Industries,factories, Railway station.	Industrial area

(VijayRatan and Surendra Kumar, 2005).

Nitrogen oxides(NOx):

Nitrogen oxide gas produced by the chemical interactions between the nitrogen oxygen. They consisted mainly of nitric oxide,nitrogen dioxide, and nitrous oxide which inhibit plant growth and aggravate health problems such as asthma (Naveen *et al*., 2007).

Sampling technique:

The location of sampling station should be in the free atmosphere without any interferences. Since sampling constitutes the main part of the examination of air quality,it is very important to know various factors such as location of sampling station, size of the sample,duration and rate of sampling. It should be located at a minimum height of 1.5 m but not exceeding 15m from the ground level.

Data collection:

Data collection programmes were held in twice a week at every study location. The duration of the programme from 8h to 20h. Meteorological parameters continuously monitored in each locations. SPM and RPM were collected by a standard high volume sampler fitted with respirable dust sampler.Sampling was conducted in 3 different locations using three sets of respirable dust sampler (RDS,Envirotech model, APM460) and high volume samplers (HVS,Envirotech model APM410) at each sampling sites simultaneously. Samples of RSPM and SPM were collected through glass micro fibre filters of 8"x10" having low resistance to air flow, low affinity to moisture and 98% collection efficiency. HVS were operated on 8hr basis around 24 hr at each site at an average flow rate of 1.1 and 1.3 m^3/min, respectively. High volume sampler having impingers in series with sodium tetrachloromercurate as absorbing solution, were operated at an average flow rate of 0.5 L/min for 24 hr. In case of collection of NOx, Sodium hydroxide was used as absorbing solution and collected at an average flow rate of 0.5 L/min for 24 hr. The impinger samples were put in ice boxes immediately after sampling and transferred to a refrigerator prior to analysis (Ghosh and Banerjee, 1995). SO_2 µg/m^3 in the ambient air was measured by the tetrachloromercurate(TCM) solution.

Table 2 : Mean concentration of SPM, RPM, NO_2 and SOx at three locations in micrograms per litre

		Pollutants			
Sr. No.	Locations	SPM	RPM	SO_2	NO_x
1.	Madura coats colony	83.9	36.6	9.8	21.5
2.	Pavali	206.2	105.1	16.8	33.7
3.	Perali	186.2	48.3	8.0	26.3

Analysis of air pollution indices:

There are several methods and equations used for the determination of Air Quality Indices (AQI).The relative scale of AQI is given below:

Table 3 : Relative scale of AQI values

AQI values	Ambient air quality status
<20	Excellent
20-39	Good
40-59	Low
60-79	Moderate
80-99	High
100 and above	Critical

The equation developed for calculation AQI is as follows:

$$AQI = [13.7 \sum_{j=1}^{4} Ci/Si]^{1.15} \quad (1)$$

In this study, Oak Ridge Air Quality Index (ORAQI)has been used for the relative ranking of overall air quality status at different study locations.ORAQI can be calculated using the following formula:

$$ORAQI = [9.61(\sum_{J=1}^{4} Ci/Si)]^{1.37} \quad (2)$$

where,Ci concentration of ith pollutant,and Si standard of ith pollutant (Behara *et al.*, 2005).

The suggested rankings for ORAQI readings in the absence of any meaningful correlation with health effects as follows (Ratan and Kumar, 2005)

The modified ORAQI eqation has been developed for four pollutants as

$$Modified\ ORAQI = [7.21(\sum_{J=1}^{4} Ci/Si)]^{1.37} \quad (3)$$

Table 4 :

ORAQI values	Condition
<20	Excellent
20-39	Good
40-59	Fair
60-79	Poor
80-99	Bad
100 and above	Dangerous

24- hr/8-hr mean concentration of various air pollutants were statistically analysed using ANOVA (Analysis of variance). In ANOVA test the variation between the data collected from the sampling stations showed significant variation (P<0.01).

The pollution status of Virudhunagar classified according to AQI index is given in Table 5.

Table 5 : Ambient air quality status in Virudhunagar town

Location	AQI	Ambient air quality status
Maduracoats colony (station 1)	24	Good
Pavali (station 2)	133	Critical
Perali (station 3)	20	Good

Pollution status may also be classified by ORAQI method. Details of the pollution status according to ORAQI is given in the Table 6.

Table 6 : Pollution status according to ORAQI in Virudhunagar

Location	ORAQI	Condition
Madura coats colony (station 1)	19	Excellent
Pavali (station 2)	141	Dangerous
Perali (station 3)	15	Excellent

AQI values obtained for various locations are tabulated in Table 5 and 6 in which the values obtained by the equation 1is found very close to the values obtained by equation 3. The average of the values of all the locations is reported as the pollution status of Virudhunagar.

Madura coats colony was taken as the residential area in which maximum pollutant concentration of SPM (83.9 µg/m^3), RPM(36.6 µg/m^3), SO_2 (9.7 µg/m^3 and NO_x (21.5 µg/m^3) not exceeded the CPCB standards.And the AQI and ORAQI values indicated that the ambient air quality was good in this area. Pavali area comes under sensitive area which is the area of schools and hospitals.In this area maximum pollutant concentration of SPM(206.2 µg/m^3), RPM(105.1 µg/m^3), SO_2(16.8 µg/m^3) and NO_x (33.7 µg/m^3) exceeded the CPCB standards. The AQI and ORAQI values indicate the ambient air quality was critical. The reason being the growing number of automobiles and narrow and poorly maintained roads. The problem of SPM can be checked by ceasing out of tempos and replacing them with more efficient eco-friendly mass transport device. Perali road was taken as the industrial area. In which maximum pollutant concentration of SPM (186.2 µg/m^3), RPM (48.3 µg/m^3), SO_2(8.0µg/m^3) and NO_x (26.3 µg/m^3) not exceeded the CPCB standards. The AQI and ORAQI values indicated that the ambient air quality was good in this area.

Chemical ratio of SO_2/NO_x:

Air chemistry data can provide useful information on the sourses of pollutants measured at specific environmental conditions.The studies conducted by other researchers are presented in Table 7. It is well established that point source are characterized by high SO_2 and NO_x concentration. The SO_2/NOx ratio was found to be 0.42 indicated that point sources are the major contribution of air pollutants.The SO_2 to NOx ratio was equivalent to Guangzhou and higher with respect to Hong Kong, Tung Chung, Tsuen Wang (EPD, 2000). The lower chemical ratio were observed for persent study with respect to New delhi , Tap Mun, Chandrapur (Aneja *et al.*, 2001, and Salve *et al.*, 2006).

Conclusion:

Based on the above and tables, it has been concluded

Table 7 : Comparision of chemical ratio of SO_2/NO_x

Location	SO_2/NO_x	CO/NO_x	Reference
Raliegh NC	-	16.3	Aneja *et al.*, 1997
Guangzhou	0.4	-	Zhang et al.,1998
Hong Kong	0.1	-	EPD,2000
New Delhi	0.58	50.0	Aneja *et al.*,2001
Tap Mun	0.55	7.85	
Tung Chung	0.18	5.25	So and Wang,2003
Tsuen Wang	0.11	2.38	
Chandrapur,India	0.54	15.8	P.R. Salve *et al.*,2006
Virudhunagar,India	0.42	-	Present study

that there are some locations among the monitored sites where the concentrations of the individual are with in the ambient air quality standards.Although these individual at the observed concentration may not have any adverse effects on human health, but combination of two or more pollutants can produce significant adverse effects or synergistic effects sometimes,it is quite possible to have such effects that are more severe than one would anticipate from their individual separate effects.This air pollution analysis indicates that the town has serious dust pollution problem,that may aggravate all the more if not controlled immediately.It is an eye opener for the municipality of Virudhunagar to combat the menace of air pollution.

Recommendation:

– Environmental pollution level may be monitored regularly.

– Traffic rules should be implemented properly.

– Polluting industries should follow pollution control measures unless it should be closed.

– Proper drainage system is the immediate need of Virudhunagar.

– Coarse roads with ups and downs cause severe dust pollution, roads should be properly maintained by the municipality.

– Heavy traffic in the sensitive area should be reduced or altered.

– Green belt may be provided through out the town.

(Singh *et al.*, 2008). This will help to reduce excess carbon dioxide and dust in the environment.

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