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Measurement of vehicle emission in Chidambaram

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Abstract

The air we breathe is a mixture of gases and small solid and liquid particles. Some substances come from natural sources while others are caused by human activities such as our use of motor vehicles, domestic activities, industry and business. During the summer of concentrations of oxides of nitrogen (No_x), oxides of sulphur (so_x) and suspended particulate matter (SPM) were collected over successive periods of about 8 hour at five sites. High volume air sampler was used to measure the concentration of oxides of nitrogen (No_x), oxides of sulphur (so_x), suspended particulate matter (SPM). The results reported pertain to an eight hour successive continuous air sampling exercise carried out at each of the five select locations in Chidambaram in Tamilnadu. While transport related emissions are the major sources of air contamination, increasing civil construction activities also contribute to particulates.

Key words: Air pollution, vehicle emission, high volume sampler.

1. INTRODUCTION

The air pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. The sources of air pollutants include vehicles, industries, domestic sources and natural sources. The responsibility has been further emphasized under environmental (Protection) act, 1986. It is necessary to assess the present and anticipated air pollution through continuous air quality surveying/monitoring programs. Therefore, central pollution control board had started national ambient air quality monitoring (NAAQM) network during 1984-1985 at national (NAMP). It involves measurement of a number of air pollutants at number of locations in the country so as to meet objectives of the monitoring. The network design also depends upon the type of pollutants in the atmosphere through various common sources, called common urban air pollutants, such as suspended particulate matter (SPM), respirable suspended particulate matter, sulphur dioxide (SO_x), oxides of nitrogen (NO_x), and carbon monoxide (CO) etc. The areas to be chosen primarily are such areas which represent high traffic density, industrial growth, human population and its distribution, emission source, public complaints if any and the land use pattern etc.,

2. EXPERIMENTAL METHODOLOGY

2.1 Study area

Chidambaram is a semi urban settlement. It is an ancient southern town in the state of tamilnadu, India. Popularly known as temple the head quarters for salivates (a major seat of worship for Hindus) is believed to be the heart for the world. The shrine depicts the space, one of the five forms of shiva, others being land, air, water and fire. Space means that material life is nothing compared to spiritual. The presiding deity is lord nataraja (King of dance) and his cosmic dance of bliss is believed to spin all worldly actions. Annamalai university, a residential variety of faculties. Population of Chidambaram town is around a lakhs excluding that of tens of existing and emerging mini satellite townships. Chidambaram town is mostly affected by the air pollution, because the emission from the vehicle is high.

2.2 Description of sampling site

2.2.1 Pachayappan street (CDM01)

This site has four way traffic system, vehicle queuing, stop-go practice, open-loop signal control, and high vehicle mobility percentage traffic shares of two wheelers/ three wheelers/ light vehicles/ heavy vehicles were 3, 2, 3 and 92 respectively.

2.2.2 West car street (CDM02)

This site possesses one way traffic system, less frequent queuing, less stop-go practice, and commercial bazaar activity. Percentage traffic shares of two wheelers/ three wheelers/ light vehicles/ heavy vehicles were 70, 11, 13 and 6 respectively.

2.2.3 Bus stand (CDM03)

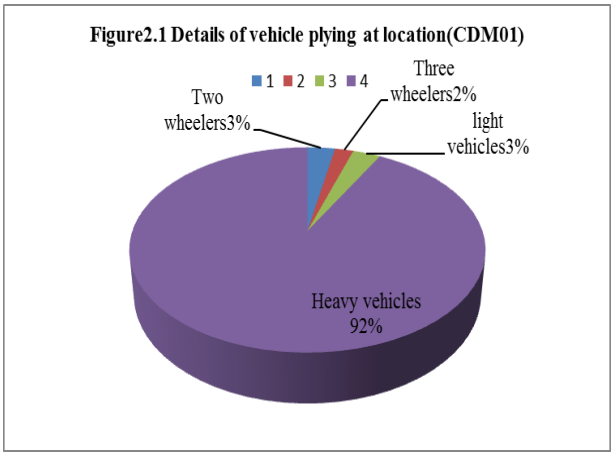
This site faces large number of bus operations, vehicles queuing, frequent stop-go operation, idling, acceleration, cruising, deceleration and non-smooth vehicle flow. Percentage traffic shares of two wheelers/ three wheelers/ light vehicles/ heavy vehicles were 3,1,1 and 95 respectively.

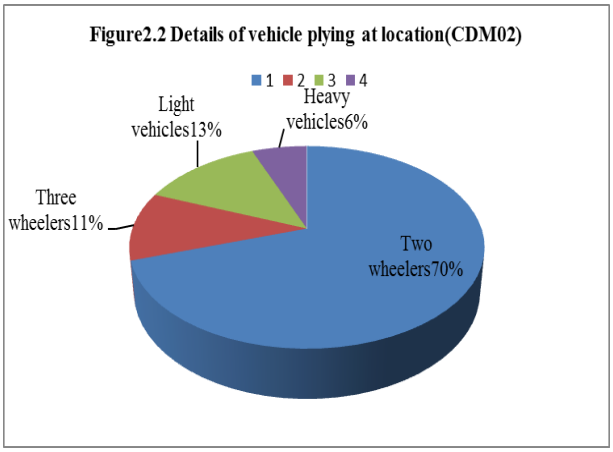
2.2.4 Saliyantoppu (CDM04)

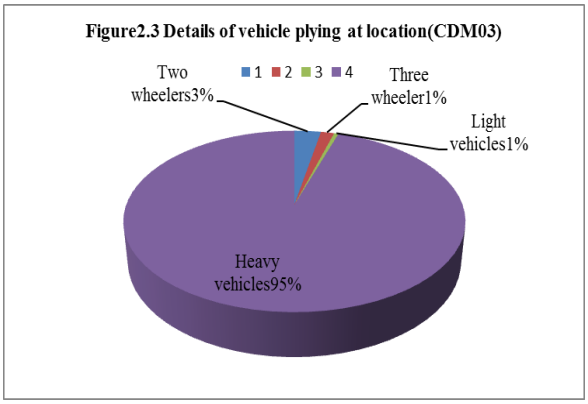
This site has two way traffic, heavy traffic flow, non-smooth due to narrowing and abrupt turning of roads. Percentage traffic shares of two wheelers/ three wheelers/ light vehicles/ heavy vehicles were 1, 1, 2 and 97 respectively.

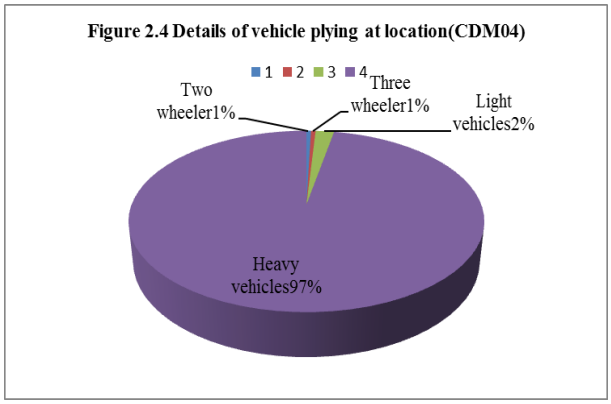
2.2.5 Vandigate (CDM05)

This site has two way traffic signal, vehicle queuing and heavy traffic flow. Percentage traffic shares of two wheelers/ three wheelers/ light vehicles/ heavy vehicles were 4, 3, 4 and 89 respectively.









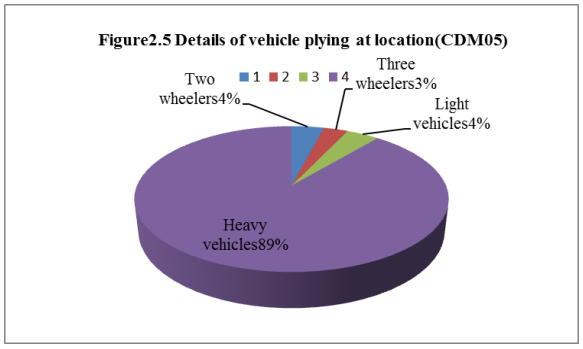


Figure1-Details of vehicle plying at locations

3. MATERIALS AND METHODS

SPM (suspended particulate matter) concentrations were measured by finding the sample air volume(m^3) through on orifice meter and the mass (µg) particulate matter collected in a Watt man grade1 fiberglass filter paper. Concentrations of so_2 and NO_2 (µg/m^3 or ppm) were colorimetrically determined using a spectrophotometer. 5 to 20ml of reagent (sodium tetrachloromercurate for west and Geake method to find so_2 and sodium hydroxide and NO_2) filled in a train of impingers of the high volume sampler trap specific contaminant in air.

3.1 Suspended particulate matter

High volume air sampler was used for the monitoring of particulates. Before sampling, the watt man filter GFA (20.3 cm x 25.4 cm) of the high volume sampler was kept at 15-34ºc, 50% relative humidity for 8-hour and then weighed. The filter was placed into the filter holder of the high volume sampler and air was drawn through a 410cm^2 portion of the filter at the flow rate of 1.40m^3/min. The filter was removed after sampling. The mass concentration of suspended 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.

3.2 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 nitrate. The nitrite ion produced during sampling was determined colorimeterically by reacting the exposed observing reagent with phosphoric acid, sulphanilamide and N- (1- napthyl ethylene-diamine dihydrochloride) producing an azo dye. The absorbance of the color was read at 540nm. The range of the analysis was between 0.01 and 1.0 µg/ml.

3.3 Sulphur oxides

Ambient air was continuously drawn into 35ml of sodium tetracholormercurate solution at a flow rate of 1.5LPM 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 560nm.

4. RESULT AND DISCUSSION

Figures2 and table1 illustrate the eight hour contaminant levels at the sampled sites along with standard limits for comparison. SPM levels have exceeded limits at all the five sample sites. SO_2 level has crossed the limit at one of the five sample sites. No_x level has crossed the limit at three of the five sample sites. It is likely that the alarming levels of all the pollutants will be revealed if a continuous monitoring is carried out, in the place of random sampling.

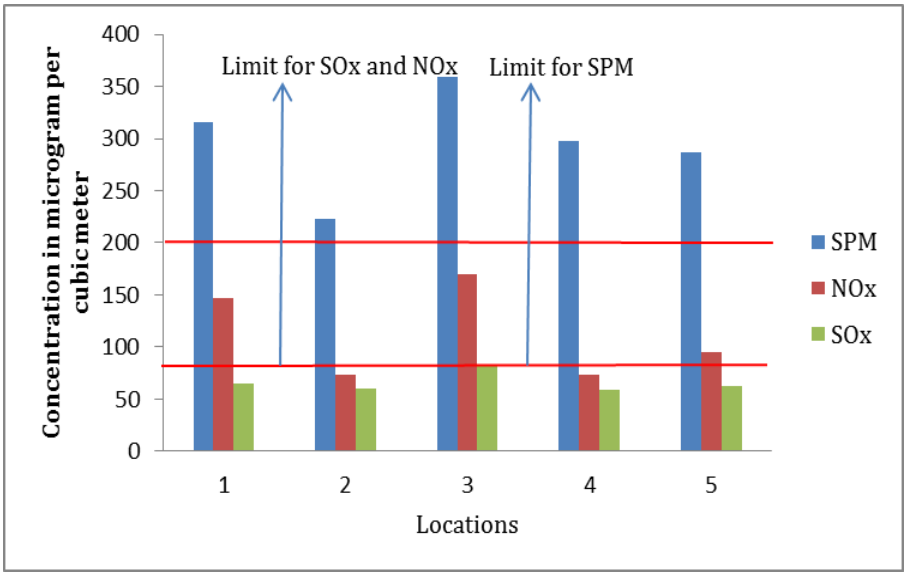


Figure2- Measurement Of Vehicle Emissions

Table1- Result tabulation for vehicle emissions

Location	SPM (200µg/m³)	NO_X (80µg/m³)	SO_X (80µg/m³)
Pachayappan (CDM01)	315.21	146.57	64.64
West car street (CDM02)	223.21	73.28	59.49
Bus stand (CDM03)	358.63	169.71	82.95
Saliyanthoppu(GRGR) (CDM04)	297.62	73.28	56.06
Vandigate (CDM05)	287.20	95.23	62.35

Figure 2.1 to 2.5 depict the eight hour traffic shares of the two wheelers, three wheelers, light vehicles and heavy vehicles at the sampling sites during the sampling period. Except at the bus terminus, at all the other five sites two wheelers predominantly account for nearly fifty percent and more. At the bus terminus heavy vehicles with a major share of 98 percent dominate. There is considerable correlation between pollutant levels and activities at the sites. At bus terminus with intensive transport activities two pollutants are found to cross the limits. NO_X at the bus stand is the highest (169.71 µg/m^3 more than the limit) due to heavy automobile mobility. NO_X level is the second largest at the pachayappan street. The only source for NO_2 is the auto emission, in the absence of any other industrial or commercial activities in the region. At places with one way traffic system and location specific restricted automobile mobility, the pollutant levels are observed to be relatively lower.

At Pachayappan Street, this site has four way traffic system, vehicle queuing, stop – go practice, open-loop signal control and high vehicle mobility, the pollutant levels are: SPM (315.47 µg/m^3, 325.89 µg/m^3 of the limit) crossed the standard limit. SO_2 (64.64 µg/m^3, 59.89 µg/m^{3}of the limit) crossed the standard limit. NO_2 (146.57 µg/m^3, 135.0 µg/m^3 of the limit) crossed the standard limit.

At west Car Street, one way traffic system, less frequent queuing, less stop-go practice and commercial bazzar activity, the pollutant levels are: SPM (223.21 µg/m^3 , 205.52 µg/m^3 of the limit) crossed the standard limit. SO_2 (59.49 µg/m^3, 57.78 µg/m^{3}of the limit) have not crossed the standard limit. NO_2 (73.28 µg/m^3, 61.71 µg/m^3 of the limit) have not crossed the standard limit.

At with bus stand, this site faces large number of bus operations, vehicle queuing, frequent stop-go operation, idling, acceleration, crushing and non-smooth vehicle flow, the pollutant levels are: SPM (358.63 µg/m^3 , 400.29 µg/m^3 of the limit) crossed the standard limit. SO_2 (82.95 µg/m^3, 87.80 µg/m^{3}of the limit) crossed the standard limit. NO_2 (169.71 µg/m^3, 177.428 µg/m^3 of the limit) crossed the standard limit.

At saliyantoppu, this site has two way traffic, heavy traffic flow, non-smooth due to narrowing and abrupt turning of roads, the pollutant levels are: SPM (297.62 µg/m^3, 294.64 µg/m^3 of the limit) crossed the standard limit. SO_2 (56.06 µg/m^3, 58.35 µg/m^{3}of the limit) crossed the standard limit. NO_2 (73.28 µg/m^3, 65.57 µg/m^3 of the limit) have not crossed the standard limit.

At vandigate having restricted automobile mobility and two-way traffic signal, the pollutant levels are: SPM (287.20 µg/m^3, 308.03 µg/m^3 of the limit) crossed the standard limit. SO_2 (62.35 µg/m^3, 60.64 µg/m^{3}of the limit) have not crossed the standard limit. NO_2 (95.23µg/m^3, 87.14µg/m^3 of the limit) crossed the standard limit.

5. CONCLUSIONS

Criteria pollutant levels of SPM, NO_X, SO_X in the ambient air of Chidambaram town are found to cross the limits in the single day per site random sampling, while SO_X level is also considerable at about (82.95 µg/m^3) (maximum). It is likely that

right now the levels of all the pollutants have crossed the limits at all the sites, but not revealed due to random nature of sampling. The alarming situation will worsen further is future due to further addition of two, three and four wheelers on the road. Preliminary random studies in all pollution prone towns/cities irrespective of the grade to quantify the pollutant levels will throw light on the range of pollutant level, cause-effect correlations, trend evaluation, remedial strategies and priorities for the installation of continuous monitoring and control mechanism.

Chidambaram town is a stronger case for continuous monitoring of ambient air quality. Traffic diversions, better traffic regulation, restricting vehicles with emission features, staggering office/school timings, provision of alternate routes, by-pass infrastructures and encouraging other modes of transport are worthy considerations. Phasing out of older vehicle versions, arranging for periodic vehicle maintenance, encouraging multimode transport system and strengthening of related researches are some of the remedies, safety measures against poor ambient air quality are to be evolved and implemented. Priority locations (like bus stand, road junction, and level crossing) and priority occupants like the drivers, traffic control personnel, and theatre employees are to be paid due to consideration and attention. Continuous monitoring shall include all the six criteria pollutants ground level ozone (O_3), carbon monoxide (CO_2), sulphur dioxide (SO_X), small particulates (PM10), nitrogen dioxide (NO_2) and the lead (pb). Additrally CO_2 and volatile organic compounds like benzene the class “A” human carcinogen also need to be quantified. Global attempts to combat air pollution need to attract the support of institutions like World Health Organization, World Bank and United Nations Organizations.

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