ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012

A Study of Surface Ozone Measurement at Vadasery, Kanyakumari District

M.Nageshwari *, Dr.A.Mukunthan ,C.Rathika Thaya Kumari

Department of Physics, Bharath Institute of Higher Education and Research, Chennai

ABSTRACT : Ozone in the troposphere is a pollutant, a constituent of smog. Ground level ozone is regarded as a pollutant by the World Health Organisation. A high concentration of tropospheric ozone can contribute to a potentially important climate forcing, which needs to be properly assessed. In this study Surface ozone measurement was estimated at vadasery, which is one of the heavy traffic prone area in Kanyakumari district has been analysed for a period of 12 months .Ozone measurements was carried out by using a hand held ozone monitor from Aeroqual. In Diurnal variation cycle shows maximum value of ozone around 14.30 hrs and minimum around 5.30 hrs. The highest ozone concentrations was recorded in April (0.0583ppm) and minimum in June (0.010ppm) .Seasonal Variation of surface ozone showed maximum values during winter (0.05065ppm) and minimum values at Southwest monsoon(0.01411ppm).

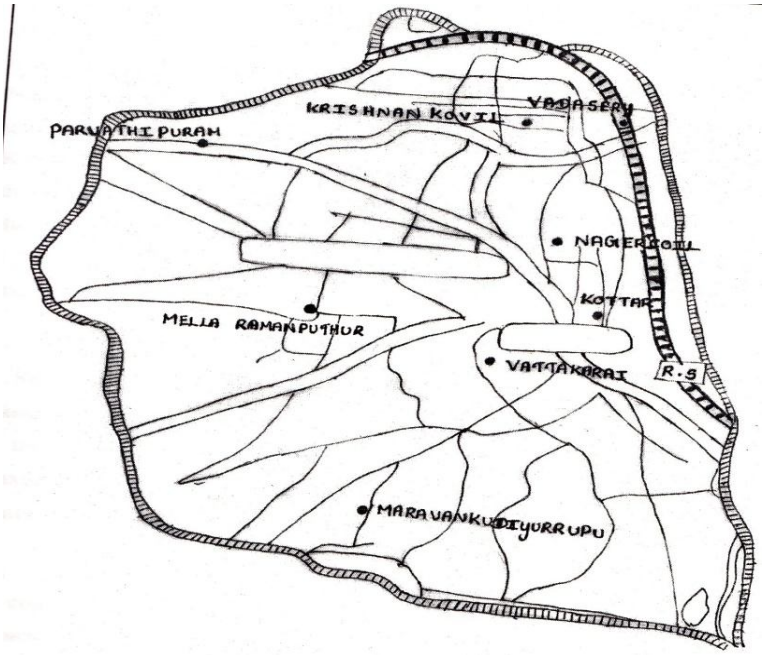
KEYWORDS: Surface ozone, Diurnal variation, Seasonal variation, Air Pollution, Troposphere.

1. INTRODUCTION

Ozone is present in trace amounts in our atmosphere, averaging about three molecules of ozone for every 10 million air molecules. Ozone was discovered by C.F.Schonbein when observing electrical charges in 1839, but it was not determined as a natural constituent till 1850 . Ozone was identified as O_3 by Olding in 1861(Detlev Meyer). The dual role of ozone leads to two environmental issues. Ozone (O_3) is a gas that occurs in two layers of the atmosphere, the stratosphere and troposphere. It has positive and negative influence on human health. The stratospheric or "Good ozone" which extends upward from about 15 to 50 km above the earth surface, protects life on earth from the sun's harmful ultraviolet rays (UV-B).Hence ozone is called as "sun screen". However, ozone in the troposphere , extends from the earth surface to about 0-15km up is deemed ground level or " bad ozone". Surface ozone is not directly emitted into the atmosphere. It results from photochemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds(VOCs) in the presence of sunlight(Lin Tang et al.). At the ground level, ozone is highly reactive and toxic to the living system. Elevated tropospheric ozone concentration will damage the tissues of plants and animals and will cause the temperature of the atmosphere to rise. It also damages both natural and artificial materials such as stone and rubber. It is evident that the amount of stratospheric ozone is decreasing while the amount of tropospheric ozone is increasing .Atmospheric CO_2 concentrations are currently rising at approximately 0.5% per year and surface ozone values are increasing at a rate of 0.32% per year. Thus there is a great need to monitor the atmospheric ozone concentration in the troposphere. There are number of major campaigns like INDOEX, which provides insight of seasonal changes in ozone. Mandal,Beig,Mithra(2004) have studied ozone scenario over India and have found over the past three decades, there has been considerable reduction in stratospheric ozone and substantial increase in tropospheric ozone. The tropospheric ozone and its precursor gases are increasing in Asia with the rapid increase in industrial and other anthropogenic activities. Most of the devolped countries including India have already defined the ambient air quality standard (AAQS) for surface ozone.Two standards has been set , a one hour (120ppb) and an eight hour (80 ppb)standard. However a large number of countries in Asia has not yet set the ambient air quality standard for ozone and also do not have enough regular monitoring stations ("Tropospheric ozone over Asia Oceania Geosciences Society 5-9 July 2004, Singapore).Ground level ozone is significantly exceeding the permissible concentrations in several regions of India. Its background concentrations have been reported to increase during the last decades and it is expected that its concentration will continue to rise further during the coming years (Chand.D and Lal.S,2004). Hence the study aims to assess the level of surface ozone concentration in Vadasery for the period of one year.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012



2. STUDY AREA

Surface ozone measurements were carried out in Vadasery (8°19´N,77°43´E) , 3 km from Nagercoil , Kanyakumari district.This place has a pleasant climate for most part of the year. The maximum temperature during summer hovers around 30 degree Celsius. Kanyakumari district has four seasons a) Southwest monsoon (June – September) b) North east monsoon (October – December) c) Winter (January-February) and d) the hot weather summer seasons(March-May). In the hill region, the rainfall is uniformly distributed in both seasons and maximum rainfall during October and November.The annual average rainfall of kanyakumari district is 1329.5mm.

3. MATERIALS USED AND METHODS FOLLOWED

Ground level ozone concentration were carried out in vadasery using a portable sensitive gaseous monitor Aeroqual S200. An aeroqual series 200 ozone monitor is constructed to measure low and high ozone levels Ultralow concentration ozone head measures the ozone concentration from 0.000 to 0.500 ppm and a high concentration ozone head measures ozone concentration from 0.50 to 20.00 ppm. Accuracy of a low concentration ozone head is +/-0.010 ppm (from 0 to 0.100ppm) ; +/-10% ppm (from 0.100 to 0.500ppm) , while that of high concentration ozone head is +/-10%(from 0.20 to 2.00 ppm) ; +/-15% (from 2.00 to 20.00 ppm). The operating temperature range is from 5°C to 50°C, relative humidity limits are 5% and 95%.The measurements units being either ppm or $\mu g/m^3$.The ozone sensor was caliberated against certified UV Photometer.

Fig .2.Aeroqual S200 Ozone monitor

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012

4. RESULTS AND DISCUSSION

Diurnal and Seasonal variation of surface ozone concentration was observed for the period of 12 months from September 2007 to August 2008 at vadasery, kanyakumari district. For each day 8 readings were taken from 5.30 AM to next day 5.30 AM in the interval of 3 hours.

4.1. Diurnal variation in surface ozone:

The average Diurnal variation of surface ozone concentration (ppm) over the period from September 2007 to August 2008 is given in Table1. As expected, it is seen that concentration of ozone in the early morning is minimum and then it increases gradually and reaches maximum in the afternoon and then it gradually decreases. Diurnal variation cycle shows maximum value of ozone around 14.30 hrs and minimum around 5.30 hrs. Thus the diurnal variation is characterized by maximum O_3 concentration in the afternoon and minimum in the early morning. The increase in O_3 concentration during day time is due to the increase of photochemical reaction. In the night time O_3 concentration decreases due to the decrease of photochemical reaction. This is the pattern observed globally, since the photochemical reaction increases with the solar flux. The same pattern observed for all the 12 months, but with different peak values because of

1. Meteorological parameters such as temperature, Relative Humidity and prevailing wind speeds
2. The photochemical reaction happen fastly between 5.30 to 14.30 hrs.
3. The availability of NO_2 because of the variability in traffic.
4. And other Anthropogenic activities

Among the study period the maximum ozone concentration varies from 0.0583 ppm to 0.0387 ppm and the highest maximum (0.0583) is observed in April 2008, whereas the lowest maximum (0.0387) is observed in August 2008.The minimum ozone concentration (0.010 ppm) is observed in June 2008. Diurnal pattern for surface ozone measurement during the month April and June is represented in Figure 3 and Figure 4, Similar diurnal patterns is observed for the remaining months during the study period.

According to the overall ozone observations at 14.30 hrs, it is higher than other hours, this is because maximum solar flux density at this time. The diurnal variation in the concentration of surface ozone clearly follows the diurnal variation of surface temperature.

4.2. Seasonal variation in surface ozone:

The diurnal variation of surface ozone concentration includes four seasons. Figure 5 shows the seasonal variation of surface ozone for the period of one year. Average Seasonal variation of Surface ozone concentration (ppm) in Vadasery, Kanyakumari District is given in Table 2. Among the study period the ozone concentration is maximum(0.05065) during the winter and it is minimum(0.01411ppm) during the Southwest monsoon during the study period. Total surface ozone variation during the study period is represented in Figure 6. Average ozone concentration during the study period is represented in Figure 7.

The ozone concentration (58.3 ppb) at vadasery during April is higher than that of Tranquebar (30 ppb) (Debaje, S.B., Johnson Jeyakumar,S.,2003) and less than that of Chennai(69 ppb) (Pullikesi,M.) in Tamilnadu.Compared to other urban sites in India such that Ahmedabad (80 ppb) (Lal et al,2000), Delhi(126 ppb) (A. Singh et al,1997) the level of the ozone concentration in this semi urban area is well below these sites.

Table 1: Average Diurnal variation of Surface ozone concentration (ppm) in Vadasery, Kanyakumari District

Date	Time								
	5.30	**8.30**	**11.30**	**14.30**	**17.30**	**20.30**	**23.30**	**2.30**	**5.30**
Sep-07	0.0193	0.0260	0.0350	0.0400	0.0353	0.0290	0.0270	0.0257	0.0207
Oct-07	0.0160	0.0240	0.0307	0.0403	0.0337	0.0267	0.0260	0.0243	0.0183
Nov-07	0.0190	0.0300	0.0360	0.0447	0.0387	0.0323	0.0303	0.0340	0.0247
Dec-07	0.0197	0.0320	0.0460	0.0563	0.0383	0.0373	0.0323	0.0370	0.0297
Jan-08	0.0193	0.0340	0.0393	0.0520	0.0437	0.0350	0.0383	0.0417	0.0293

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012

Feb-08	0.0183	0.0303	0.0390	0.0493	0.0410	0.0353	0.0290	0.0330	0.0260
Mar-08	0.0223	0.0260	0.0363	0.0420	0.0340	0.0283	0.0270	0.0303	0.0263
Apr-08	0.0287	0.0357	0.0423	0.0583	0.0497	0.0417	0.0407	0.0393	0.0360
May-08	0.0257	0.0323	0.0363	0.0417	0.0373	0.0323	0.0317	0.0297	0.0287
Jun-08	0.0100	0.0233	0.0347	0.0403	0.0320	0.0330	0.0330	0.0307	0.0237
Jul-08	0.0137	0.0243	0.0313	0.0427	0.0387	0.0333	0.0340	0.0283	0.0227
Aug-08	0.0187	0.0257	0.0317	0.0387	0,0333	0.0287	0.0267	0.0287	0.0240

Table 2:Average Seasonal variation of Surface ozone concentration (ppm) in Vadasery,Kanyakumari District

Season	**Time**								
	5.30	**8.30**	**11.30**	**14.30**	**17.30**	**20.30**	**23.30**	**2.30**	**5.30**
Winter	0.01880	0.03215	0.03915	0.05065	0.04235	0.03515	0.03365	0.03735	0.02765
Summer	0.02557	0.03133	0.03830	0.04733	0.04033	0.03410	0.03313	0.03310	0.03033
South West Monsoon	0.01411	0.02444	0.03256	0.04056	0.03467	0.03167	0.3122	0.02922	0.02344
North East Monsoon	0.01823	0.02867	0.03757	0.04710	0.03690	0.03210	0.02953	0.03177	0.02423

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012

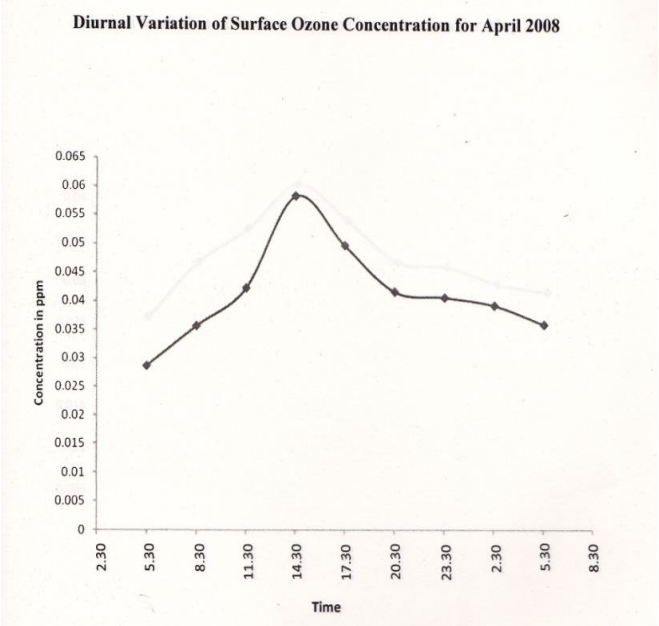


Fig.3

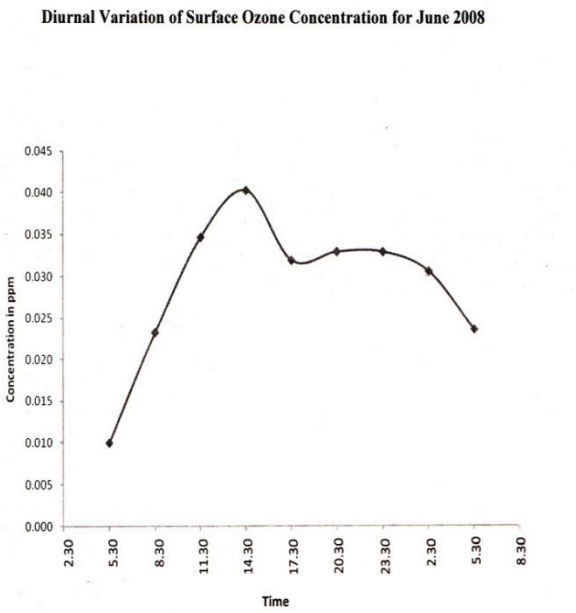


Fig.4

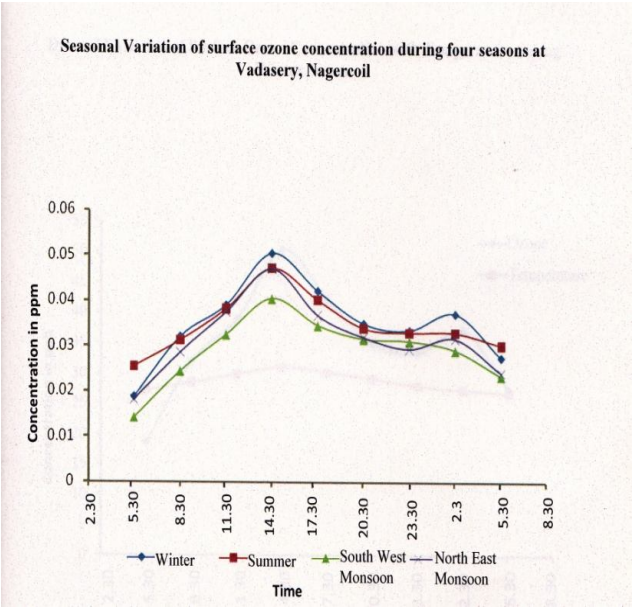


Fig.5

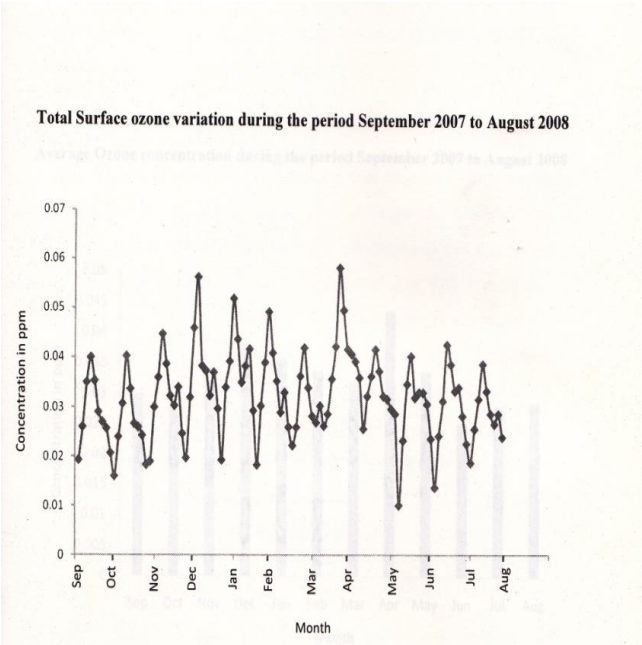


Fig.6

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 1, Issue 2, December 2012

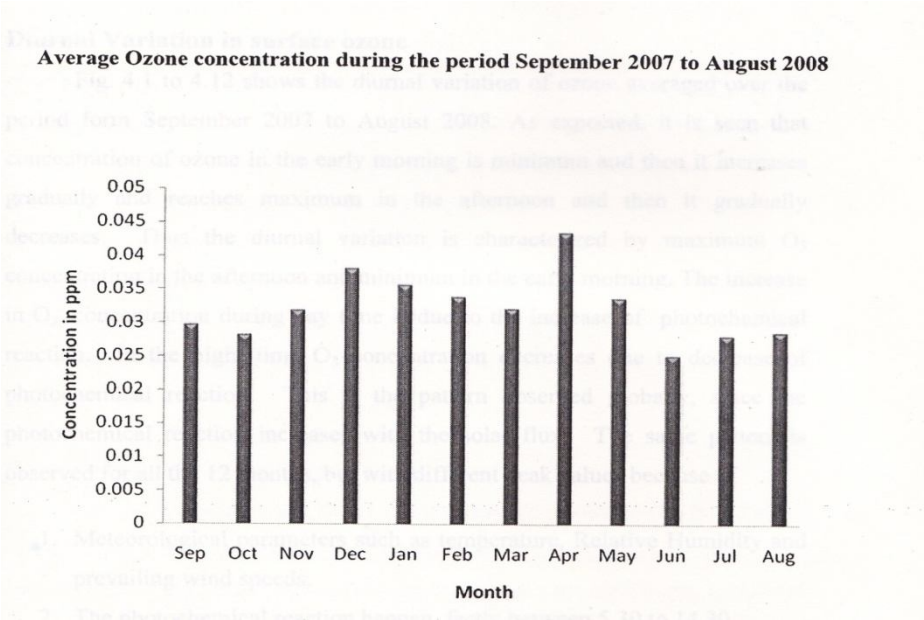


Fig.7

5.CONCLUSION

It is now widely believed that earth's atmosphere originally was very different from its present state that the changes were brought by anthropogenic activity and accompanying chemical changes. Ozone is an important trace species present in the atmosphere. The physical and chemical processes of the ozone directly depands on the local precursor emission levels and meteorological factors. Among all the secondary pollutant, ozone has undoubtedly received the most important attention. This is mainly because, in the ambient air, even a microlevel variation in the concentrations of ozone brings lethal effects on the biological system. This study gives information about the surface ozone concentrations in Vadasery. The values obtained in the present work are compared with the past work. There is slight variation in the results depanding upon the area of study lies in the urban and rural area, where the pollution is more in urban area due to heavy traffic. Eventhough surface ozone concentration are below the national standard at present, it is expected to cross the limit in the forth coming years due to increase in vehicular traffic and other anthropogenic activities.

ACKNOWLEDGEMENT

We are very thankful to honourable chairman Pro-chancellor, Vice Chancellor, Registrar, Dean R&D and Dean Engineering of Bharath University for their continuous support and encouragement given to carry out this research work

REFERENCES

1. Chand,D. and S.Lal, Physical Research Laboratory, Navrangpura,Ahmedabad, India. High Ozone at rural sites in India. Atmospheric Chemistry and Physics Discussions, Volume 4, Issue 3, 2004, pp.3359-3380
2. Debaje,S.B.,Johnson Jebakumar,S.,Ganesan,K.,Jadhav,D.B.,Seetaramayya, P.-Surface ozone measurement of tropic rural coastal station Tranquebar, India. Atmospheric Environment 37 (2003) 4911-4916
3. Detlev Moler Brandenburg technical University, Cottbus, Germany 2004. Tropospheric ozone problem.
4. Lal,S., Naja, Manish, Subbaraya, B.H.2000, Seasonal variations in surface ozone and its precursors over an urban site in India,34:2713-2724
5. Lin Tang Deliang Chen Per-Erik Karlsson Yangfeng Gu and Tinghai Ou, Synoptic circulation and its influence on spring and summer surface ozone concentrations in southern Sweden, Boreal Environment research 14, 889-902, 2009.
6. Pullikesi, M., Baskaralimgam, P., Rayudu, V.n., Elango D.Ramamurthhi, V. and Sivanesan. Surface ozone measurement at urban coastal site Chennai in India(2006).,Journal of Hazardous Materials.B137, 1554-1559.
7. Singh.A.,Sarin,S.M.,Shanmugam,P., Sharma,N.,Attri, A.K.,Jain V.K.1997. Ozone distribution in the urban environment of delhi during atmospheric environment,31:3421-3427