CHARACTERIZATION OF AMBIENT METHYL MERCAPTAN IN SIPCOT INDUSTRIAL COMPLEX, CUDDALORE

S.Sankaran[1], A. Murugappan[2], V. Kanakasabai[3]

[1]Assistant Professor, [2]Professor & Head,[3]Former Professor
Department of Civil Engineering, Annamalai University, AnnamalaiNagar, Tamilnadu (India)

ABSTRACT

In Industrial complex, major air pollutants like SO_2, NOx, SPM, RPM and CO concentrations were standardised. Some site specific air pollutants like fluoride, H2S, methyl mercaptan, hydrogen chloride, vinyl chloride, etc., were also emitted from industries. Methyl mercaptan is a site specific air pollutant in SIPCOT Industrial complex, Cuddalore, TamilNadu. The presence of methyl mercaptan in the ambient air in and around the study area was identified by conducting a one-day monitoring. In this study, it is aimed to characterize the ambient concentration levels of methyl mercaptan in the SIPCOT Industrial complex. The air monitoring study was carried out continuously for 20 consecutive days for 3 seasons (winter, summer and monsoon) in 2011 & 2012. The observed concentrations were characterized for daily pattern and for Day- Night / Sea & Land breeze effects. The results indicate that the concentrations were in the detectable range during all the seasons and also shows, the concentration levels were low after the onset of the sea-breeze.

Keywords: Air Pollutant, APHA, Characterization, Methyl Mercaptan, Monitoring

I. INTRODUCTION

Air pollution, a global problem being faced by both the developed nation as well as the developing ones, has been aggravated by developments that typically occur as countries become industrialised: The environmental degradation through its components such as air, water and soil varies from place to place depending on the density of population, development in Science and Technology, starting up of the industries and consumption of natural resources in a specific region. According to the study conducted during 1975-1995 to compare the rates of economic growth and the rates of growth of industrial pollution projected that the industrial pollution had grown by 3.47 times[7] & [4]. The potential effects of ambient air pollution on health are a major issue in public health, and the subject has received a great deal of attention in the recent years. A number of epidemiological studies have found consistent associations between daily levels of pollution and adverse health effects for both mortality and morbidity [2] & [10]. The nature and importance of air quality problems depend on the size of the area, as well as various physical & chemical processes (Climate, Local meteorological conditions at the moment), graphical process (structure and quality of the surface, vegetation cover, position, relief) and social factors (existing environmental regulations) [3] &[6]. National Ambient Air Quality Standards portrays that SO_2, NO_x, SPM, RPM, CO and leads are the major air pollutants and their permissible levels of concentrations in ambient air are standardized. Many air pollutants, other than these are site specific and depending upon the industrial process being carried out. Industries like pharmaceuticals, Agrochemicals, paints, etc. are discharging the pollutants like fluoride, hydrogen sulfide, ammonia, hydrocarbons, mercaptan and hydrogen chloride. Monitoring of such air pollutant in the ambient air is becoming more important as some are toxic, having both

carcinogenic and non-carcinogenic hazards such as Nero-toxicity. Methyl mercaptan is used in pesticides, in the plastics industry, in petrochemical industry, in making methionine for poultry feed, in pharmaceutical industry and in wood pulp mill. In the atmospheric air the detectable level of methyl mercaptan is 2.1 µg/m^3, according to US-EPA (Region 6 screening level). Methyl mercaptan was detected in ambient air at 4ppb (8.2µg/m^3) and in a primary school in Japan at 2.8ppb (5.7µg/m^3) [1]. According to the study conducted in 2007 in the SIPCOT industrial estate, Cuddalore, Tamilnadu, India presence of methyl mercaptan was identified at detectable range [8]. And it is confirmed, that the presence of ambient methyl mercaptan in the SIPCOT Industrial complex, Cuddalore was reported by the members of SIPCOT Area Community Environmental Motoring (SACEM) during February 2007 and July 2007 at two different sites in the complex. This study aimed to confirm further the presence of methyl mercaptan as per standard procedure in an appropriate manner and to characterize the levels of ambient concentration of methyl mercaptan around the study area.

II. STUDY AREA

An industrial estate is promoted by the State Industries Promotion Council of Tamil Nadu (SIPCOT) in the coastal town, Cuddalore (latitude 11^0 40' N and longitude 79^0 46' E). The estate is located 2Km west of the Bay of Bengal in between the Uppanar River (Back water of the Bay of Bengal) and a National Highway called, the East Coast Road. About 27 chemical and pharmaceutical industries coming under Red/Large industry category are functioning here. After a detailed investigation of these industries, their processes and stack emission characteristics, fluoride, methyl mercaptan and hydrogen sulphide are identified as a major site specific air pollutants in the study area [5]. Workers in sewage treatment plants, pulp mills, chemical plants and other industrial or agricultural settings would have potentially high exposure to this compound where chemical and microbiological formation of methyl mercaptan is significant. People living in the immediate vicinity of these facilities as well as in the hazardous waste sites also have higher exposure potential than the general population. Under these circumstances, the ambient air quality survey was conducted on 23rd march 2007 and found that the presence of methyl mercaptan in and around the SIPCOT [9]. A map of the Cuddalore SIPCOT Industrial Estate is given in Fig-1.

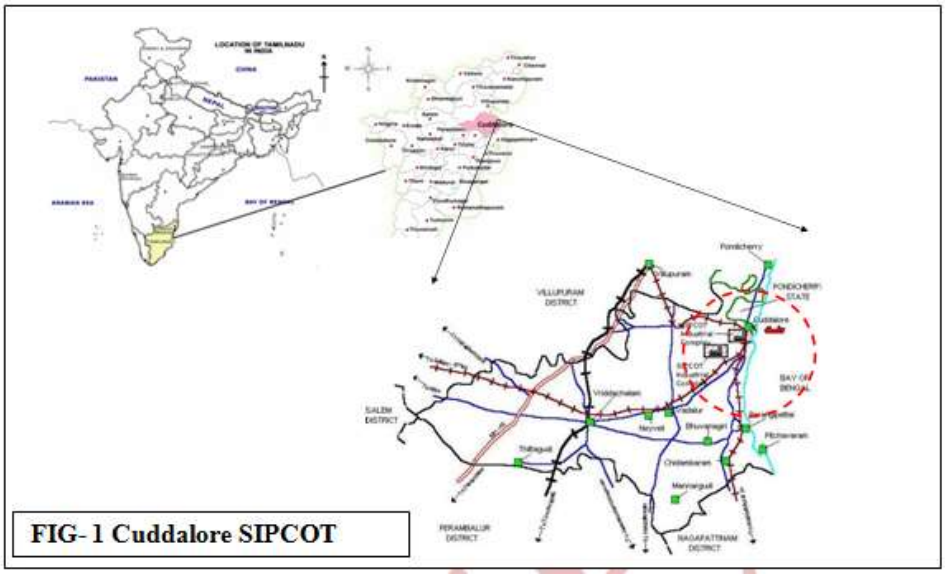


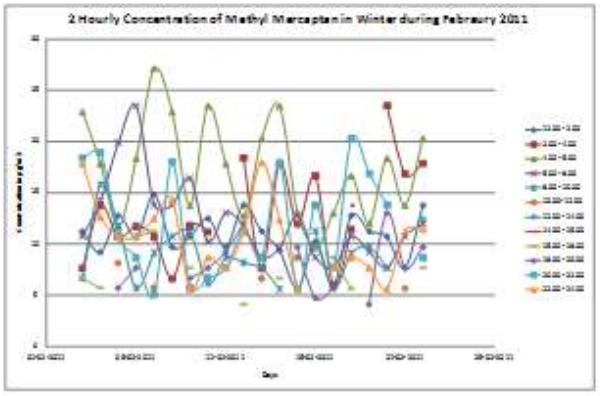
FIG- 1 Cuddalore SIPCOT

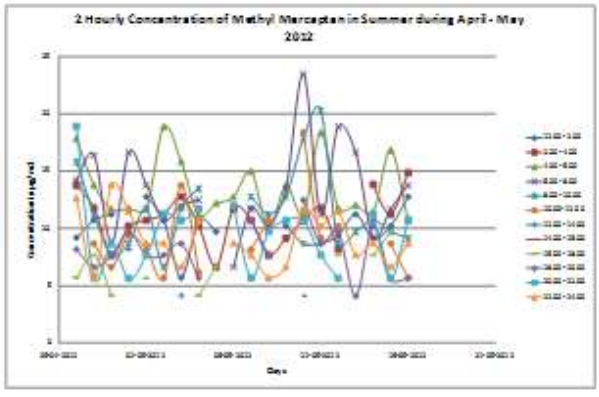
III MATERIALS AND METHODS

At the SIPCOT Industrial estate, Cuddalore for monitoring methyl mercaptan, a Natel make High Volume Sampler was used to take air sampling at the site. Essential chemicals, glass wares, sampling bottle and absorbing reagent were taken in an ice box. Air samples were aspirated through 15ml of the absorbing solution kept in an impinger at 1- 1.5 lit/min for a selected time duration [9]. The method determines the total mercaptans although is most sensitive to lower molecular weight alkinethiols(methyl mercaptan) The collected sample bottles were taken to the laboratory every day and subsequently determined the methyl mercaptan concentration by spectrophotometric analyzer as stated by the APHA procedure. The above mentioned method of measurement was adopted to observe continuously the level of concentrations of methyl mercaptan during the winter, summer and monsoon periods of 2011 & 2012 respectively at a two hour interval observations. Necessary meteorological observations were made and wind roses were plotted for determining the appropriate sampling station location.

IV RESULTS AND DISCUSSIONS

Levels of ambient concentration of methyl mercaptan in SIPCOT Industrial estate, Cuddalore were presented in two different patterns. The pattern of mercaptan distribution on a two hourly concentration plot for every individual season with respect to the days of observations shows that the presence of mercaptan was at the detectable levels during each day; it is evident even from individual observations (FIG 2). The Sea and Land breeze pattern for every day's observation were plotted to study the effect of the onset of the sea breeze on the pollutant dispersion.





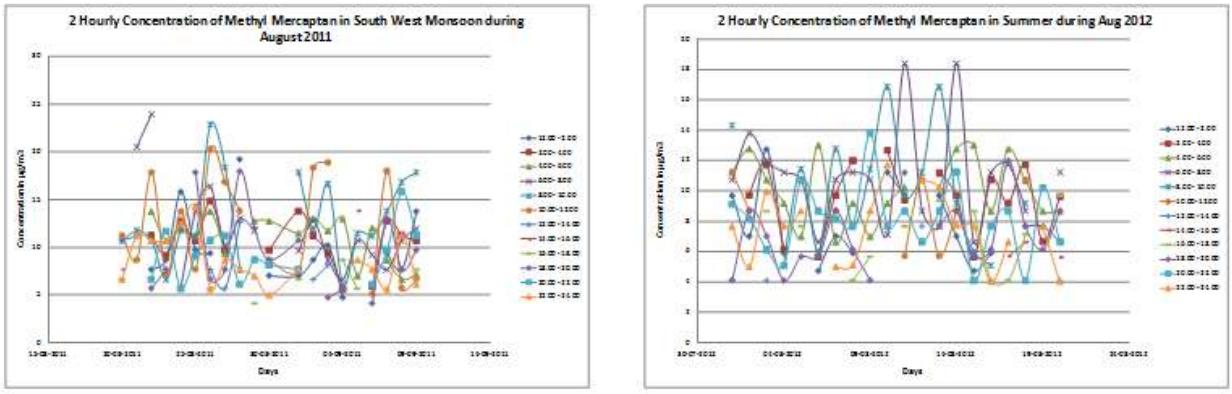
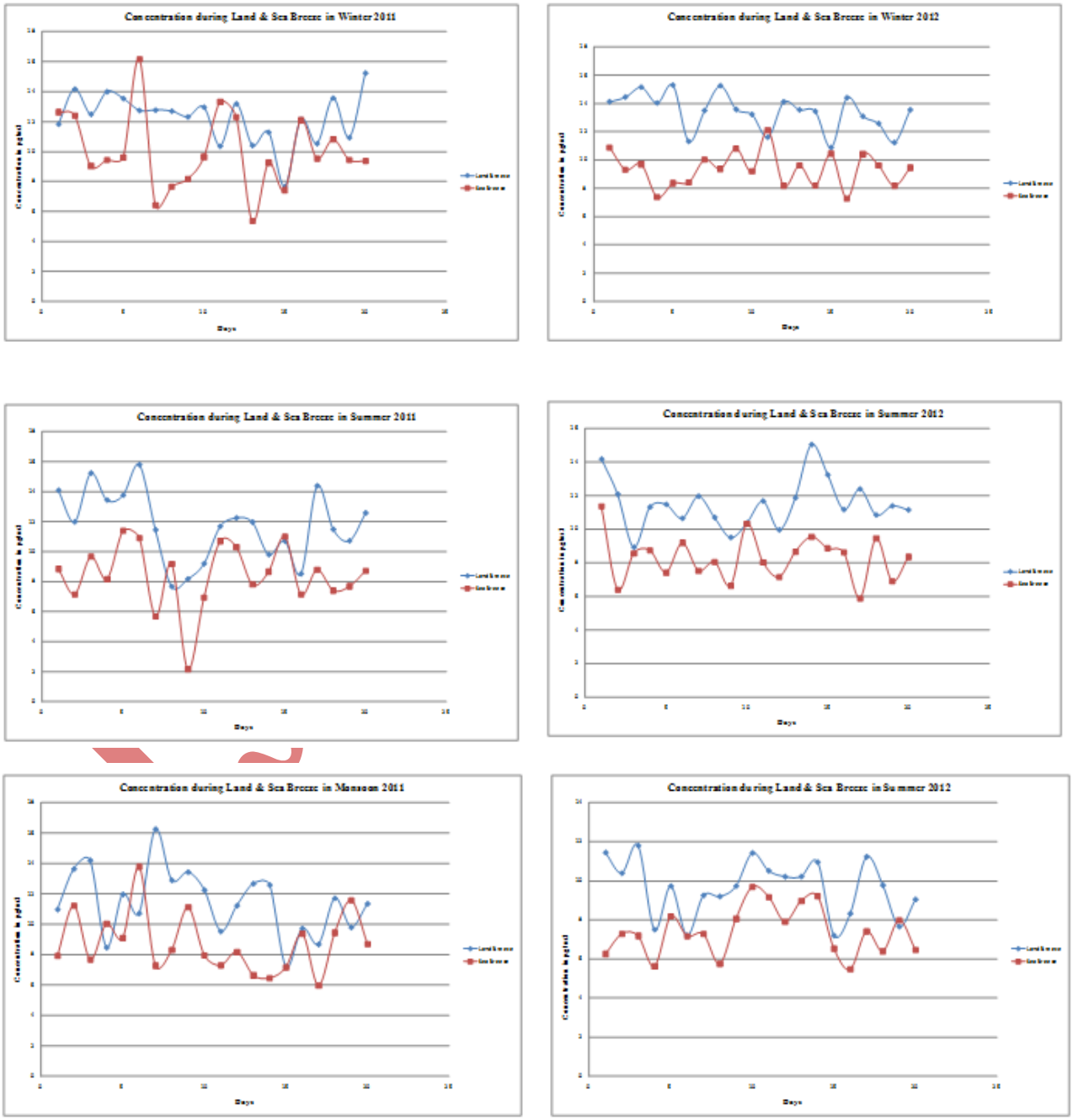


FIG- 2 Two Hourly Concentration Of Methyl Mercaptan During 2011 & 2012



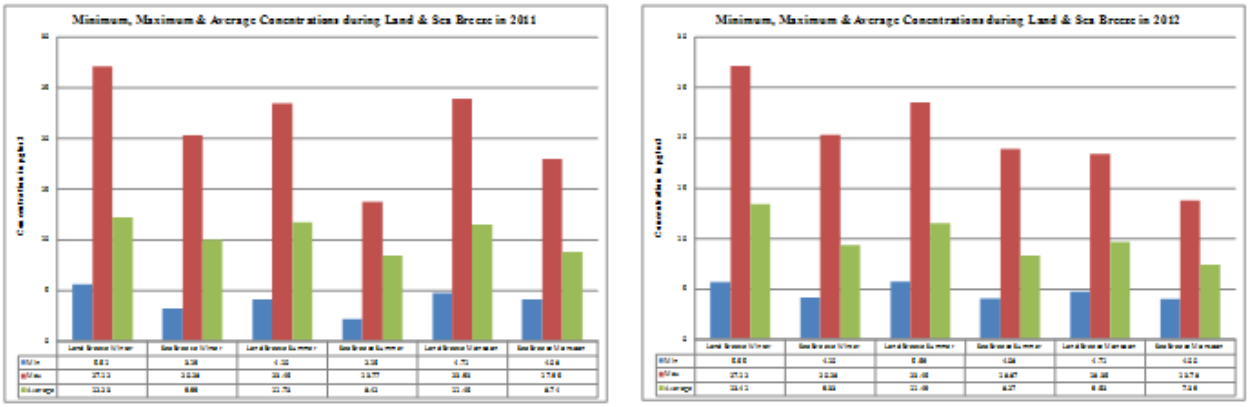


FIG- 3 Averaged Methyl Mercaptan Concentration During Land And Sea Breeze

4.1 Daily Pattern

The industrial emission sources form a major contribution of ambient methyl mercaptan around the study area. From the observed data for the study area, the Two hourly Concentration pattern plots during winter, summer and monsoon of 2011 & 2012 were made. It is generally considered that the effect of the onset of the sea breeze is felt during 12.00 noon to 10.00pm. Therefore, lower levels of concentration of mercaptan were noticed during these hours and in sometimes below detectable levels were also experienced due to the turbulent wind speed during the onset of the sea breeze and also the sampling site is so located at a distance of 500m to 1km from the shore. The hourly concentration of ambient methyl mercaptan is apparently higher during early morning hours (i.e. Between 4.00 am to 8.00 am), which is mainly due to the lower wind speed characteristics.

4.2 Day-Night Effect / Sea & Land Breeze Effect

As mentioned above, sea breeze forms a major effect in the dispersion of pollutants during night hours. In order to bring out the effect of sea breeze on the pollutant dispersion from the data, two hourly ambient methyl mercaptan diurnal pattern for sea and land breeze during 2011 & 2012 were computed and plotted in FIG- 3. It is generally considered that the influence of the sea breeze is high during the second half of the day (i.e. Between 12.00pm to 12.00am) and an adverse effect of turbulent wind speed is experienced. Therefore, a difference in the ambient methyl mercaptan level is expected between sea breeze and land breeze. The averaged ambient methyl mercaptan for sea breeze & land breeze for a winter (Feb), a summer month (May) and Monsoon month (Aug) during 2011 & 2012 were presented. From the plot, the ambient methyl mercaptan concentration during land breeze are more than over the sea breeze and remains the same variation for all the seasons for both the years. The difference between the concentration levels of ambient methyl mercaptan during Land & sea breeze is apparently seen. This could be due to the effect of the onset of the sea breeze in the coastal locations. The maximum averaged level of 12.73 and 13.41 $\mu g/m^3$ were observed during the winter month (Feb) of both the years 2011 & 2012. The results show that the variation in levels of concentration between the years is similar.

V. CONCLUSION

The primary goal of this research was to characterize the harmful emission of methyl mercaptan from the industry located in the industrial estate. The study allowed the investigators to identify and measure the pollutant as per standard procedure. Higher concentrations were observed in all the sampling stations in the

study area. The results of the study indicated the need to do a more comprehensive evaluation of area to determine the sources of methyl mercaptan and apportionment.

VI ACKNOWLEDGEMENT

The authors acknowledge the authorities of Annamalai University for giving necessary permission to carry out the study for academic purpose only.

REFERENCES

[1] Okita, T. 1970, Filter method for the determination of trace quantities of amines, "*Mercaptans and organic sulfides in the atmosphere*", Atmospheric Environment 4:93

[2] Pope, et.al., 1995, "*Review of epidemiological evidence of health effects of air pollution*", InhalationToxicology7, 1-18

[3] Mayer, 1999 "*Air pollution in cities*", Atmospheric Environmental 33, pages 4029-4037

[4] Kumar,P and Battacharya, S. 1999, Down to Earth 7, pages 32-40

[5] Kanakasabai, V, 2002, Project report to AICTE "Study of atmospheric pollution in Cuddalore Industrial Estate". New Delhi

[6] Kiss.G., 2005,"*Temporal characteristics of air pollutant concentrations in Szeged, Hungary*", ACTA climatological ET chorologica Universitatis szegediensis, Tom 33-39, 125-133.

[7] Qayoom Mir. A., 2009, "*Total flavonoids and phenolics in catharanthus roseus L.ocimum sanctum L as biomarkers of urban auto pollution*", Caspian J. Env. SCI. Vol.7, No.1, pages 9-16

[8] Sankaran S et.al., 2012, "*Methyl Mercaptan monitoring in the neighborhood of SIPCOT industrial estate, Cuddalore, TamilNadu*" in Indian journal of Environmental protection, vol-32, April 2012, No-4, pages:313-316., ISSN 0253-7141

[9] APHA , 1972 "*Methods of Air Sampling Analysis*" published by the American Public Health Association, Washington, 1972

[10] "*Toxicological profile for Methyl Mercaptan*" published by the Agency for Toxic substances & Disease Registry, US Public Health Service. Sep., 1992

[11] COMEAP, 1995, Committee on the Medical Effects of Air Pollutions, Asthma and outdoor pollution, London, HMSO

[12] Report on "*Methyl Mercaptan(CAS-74.93-1)*"- High production volume challenge program Test plan, Mercaptans Thiols Council, USA, 2001