Ambient Air Quality at Ahlone Township in Yangon City

[1] Swe Swe Ohn, [2] Daw Hla Ngwe
[1.] Lecturer, Department of Chemistry, University of Yangon, Myanmar
[2.] Professor and Head (Retired), Dr, Department of Chemistry, University of Yangon, Myanmar
Email - [1] swesweohn2011@gmail.com, [2] drhlangwe@gmail.com

Abstract: *The main focus point of the present study is the assessment of atmospheric burden of particulate matter and gas-phase pollutants of Ahlone Township, Yangon. Total suspended particulate matter (TSPM), particulate matter (PM-10) and gas-phase pollutants (SO_2 and NO_2) were collected to investigate from Ahlone Township in Yangon City during November 2017 to July 2018. Weekly, monthly and seasonal variation of these pollutants had been monitored. On the basis of the weekly level of PM-10 (58.40 µg m^{-3} in March and 63.60µg m^{-3} in April) and NO_2 (24 h) (52.10 µg m^{-3} in April) were observed to be higher than permissible level of WHO (2000) standard 50 µg m^{-3} and 40 µg m^{-3} respectively. The concentrations of SO_2 (24 h) were observed to be very lower than the WHO (2000) standard. The concentrations of TSPM were found to be within the permissible level of USEPA (1997) standard respectively. On the basis of the monthly average, it was observed that concentrations of the pollutants in the ambient air of Ahlone Township were found to be within the permissible level of USEPA (1997) and WHO (2000) standard. In general, the level of all pollutants were higher in hot season as compared to cold and rainy season. The results of this study identified the degree of air pollution in Ahlone Township, Yangon City.*

Keywords: *Ambient air, Particulate matter, Gas-phase pollutants, Total suspended particulate matter.*

1. INTRODUCTION:

Air pollution has become a matter of global concern, particularly in some of the world's largest cities. It is made up of many different components that affect the environment and directly or indirectly the health of people. The main components include sulphur dioxide, particulate matter, carbon monoxide, reactive hydrocarbon compounds, nitrogen oxides, ozone and lead. If concentration of any substance or element in air is more than a certain value, it may affect man and property, directly or indirectly and may be termed as air pollution (Chaurasia *et al*., 2013). Airborne particulate matter, which includes dust, dirt, soot, smoke and liquid droplets emitted into the air, is small enough to be suspended in the atmosphere. PM is a major cause of all kinds of respiratory problems (Kumar and Kriti, 2016). The aim of this study is to achieve better understanding of the condition of atmosphere due to the air pollution.

2. MATERIALS AND METHODS :

General Description of Sample Collection Area

Sampling site was selected at the urban area in Yangon Region. Ahlone Township in the western part of Yangon is located between 16° 47.248′ N and 96° 07.793′ E. The township covers an area of 4 km^2 (1.4 sq. miles). The population was found to be 55428 in census 2014. The area which is very much close to Hteen Dan Port Jetty, Asia World Port Jetty, Kyee Myint Dine International Port, Myanmar Industrial Port, palm oil storage tank, white rice mill, CNG and LPG gas filling station, gas turbine plant and public transport station. This area is surrounded by commercial complexes and residential area.

Samples, Study Area and Sampling Periods

The samples studied are airborne particulate matter (APM) samples including total suspended particulate matter (TSPM) and PM-10 and the gaseous air pollutants (GAPs) such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). Sampling site is Occupational Health Department, Lower Kyee Myint Dine Road, Ahlone Township in Yangon . Air sampling was conducted weekly for one year from November 2017 to July 2018. Samples were collected from November to February representing cold season, March to May representing hot season and June to July representing rainy season.

Sample Collection and Data Collection

The air sampling pump (High Volume Sampler (HVS), Envirotech APM 460 NL., New Delhi, India) was used to collect particulate matters (TSPM and PM-10) and the gaseous air pollutants (SO_2 and NO_2). Figure 1 depicts the HVS with gaseous sampling attachment and interior view of gaseous sampling attachment. PM-10 samples were

collected on glass microfiber filter (460 x 570 mm) and pore size is 1.0 µm. Figure 2 shows the unloaded and loaded filters. TSPM was collected from the fiber container which was placed into the HVS. The average TSPM and PM-10 concentration were determined by dividing the net weight gain of the sample by the total volume of air sample. The gas-phase air pollutants (SO_2 and NO_2) were collected from impingers into the gaseous sampling attachment which was connected with HVS. All samples were collected for 24 h from 8.00 am first day to 8.00 am next day on every Thursday of the whole year. Temperature and pressure were also simultaneously measured hourly during the sampling period. Automatic air flow meter was set at a nominal flow rate of 1.5 Lm^{-1}. The HVS was placed about 5 m above the ground. The modified West and Gaeke Method IS 5218 Part II and Jacob and Hochheiser Method IS 5182 Part IV were used for absorbing the SO_2 and NO_2 contents respectively from the air which was analyzed with suitable spectrometer (Kamyotra and Saha, 2011).

Figure 1 Photographs of high volume sampler (a) exterior view of HVS with gaseous sampling attachment (b) interior view of gaseous sampling attachment

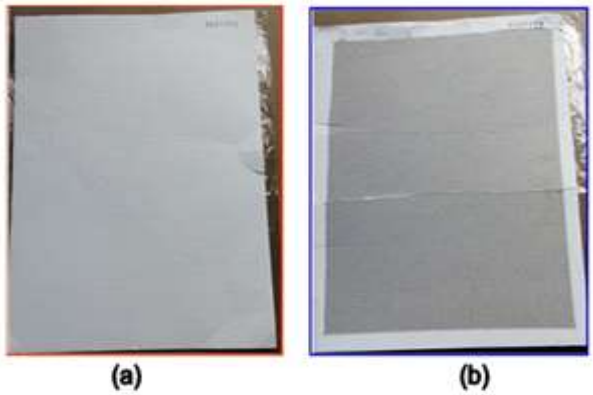

Figure 2 Filter papers (a) Unloaded filter paper and (b) loaded filter paper (460 x 570 mm)

3. RESULTS AND DISCUSSION:

Rapid and unsystematic industrialization has become a major environmental concern for both developed and developing countries. Long-term and short-term effects on human health have been observed due to poor air quality (Kumar and Kriti, 2016). In this study, a number of pollutants (TSPM, PM-10, SO_2 and NO_2) affecting ambient air quality are measured for specified location in Alone Township, Yangon City. During study period from November 2017 to July 2018, weekly, monthly and seasonal variations of the pollutants have been monitored. On the basic of the monthly average, the statistical distribution parameters such as average, standard deviation (SD), minimum (Min) and maximum (Max) values for each of the pollutants were obtained.

The Statistical Distribution Parameters for Particulate Matter and Gaseous Air Pollutants

The standard deviation (SD), minimum (Min) and maximum (Max) values of TSPM (24 h) in Ahlone Township for the period November 2017 to July 2018 are given in Table 1 and Figure 3. The minimum and maximum concentrations of TSPM were found to be 20.80 µg m^{-3} and 119.74 µg m^{-3} respectively. It was found that, the mean concentration of TSPM was lowest in June and highest in March which were representing rainy and hot season respectively. The mean values in the range 41.35 ± 13.71 µg m^{-3} to 82.26 ± 31.82 µg m^{-3} were lower than the value of 150 µg m^{-3} annual average stipulated by the USEPA, 1997.

The statistical distribution parameters of PM-10 (24 h) in Ahlone Township during November 2017 to July 2018 are given in Table 2 and Figure 3. The minimum and maximum concentrations of PM-10 were found to be 6.37 µg m^{-3} and 63.60 µg m^{-3} respectively. It was indicated that the concentration was lowest in July representing rainy season and highest in April representing hot season. The mean values in the range 17.89 ± 12.76 to 36.56 ± 19.98 µg m^{-3} were lower than the WHO (2000) standard (50 µg m^{-3}). Apart from petroleum and diesel vehicle exhaust is also responsible for emitting particulate matter (PM-10) in large amount.

The average, SD, minimum, maximum values of ambient gas-phase pollutants (SO_2 and NO_2) in Ahlone Township during November 2017 to July 2018 are given in Tables 3 to 4 and Figure 4. The mean concentration of SO_2 (24 h) was found to be lowest in December and highest in April which were represented cold and hot season respectively. The mean values in the range 0.0046 ± 0.002 to 0.5533 ± 0.541 were lower than the permissible level of WHO (2000) standard (20 µg m^{-3}). The minimum and maximum concentrations of NO_2 (24 h) were found to be 0.46 to 52.10 µg m^{-3} respectively. The mean concentration of NO_2 (24 h) was found to be lowest in November and highest in April which were represented cold and hot season respectively. The mean values in the 1.61 ± 1.65 to 35.13 ± 14.70 were lower than

the permissible level of WHO (2000) standard (40 µg m^{-3}). NO_2 are emitted primarily by motor vehicles, making it a strong indicator of vehicle emission. NO_2 and other nitrogen oxides are also a precursor for a number of harmful secondary air pollutants, including nitric acid, nitrates part of secondary inorganic aerosols and photo oxidants (including ozone). Health risks from NO_2 itself or its reaction products including O_3 and secondary particles. Diesel engines have substantial emissions of which particulate matter and SO_2 is vital. Most of the salon cars are petrol run vehicles. Therefore NO_2 emission increased.

Table 1. The Average, Standard Deviation (SD), Minimum (Min) and Maximum (Max) Values of TSPM (24 h) in Ambient Air
All units are in µg m^{-3}

Sampling Period	N	Mean	SD	Min	Max
Nov,2017	3	50.99	6.37	44.40	57.12
Dec,2017	4	59.26	14.76	38.05	70.68
Jan,2018	5	55.41	25.97	24.59	82.65
Feb,2018	4	51.56	17.02	39.74	76.76
March,2018	4	82.26	31.82	55.40	119.74
April,2018	3	54.69	31.86	33.53	91.34
May,2018	4	52.16	27.10	24.78	85.49
June,2018	5	41.35	13.71	20.80	58.45
July,2018	4	51.12	25.73	28.27	76.23
Total	36	55.42	22.98	20.80	119.74

Permissible level = 150 µg m^{-3} (USEPA, 1997)

Table 2. The Average, Standard Deviation (SD), Minimum (Min) and Maximum (Max) Values of PM-10 (24 h) in Ambient Air Collected
All units are in µg m^{-3}

Sampling Period	N	Mean	SD	Min	Max
Nov,2017	3	23.51	3.96	19.00	26.42
Dec,2017	4	27.69	8.17	16.23	35.21
Jan,2018	5	26.14	11.73	11.71	37.76
Feb,2018	4	23.59	7.60	16.21	34.20
March,2018	4	36.56	19.98	15.66	58.40
April,2018	3	32.35	21.07	17.89	63.60
May,2018	4	26.19	12.48	15.42	40.29
June,2018	5	21.96	6.25	16.40	28.73
July,2018	4	17.89	12.76	6.37	34.73
Total	36	26.21	12.69	6.37	63.60

Permissible level = 50 µg m^{-3} (WHO, 2000)

Table 3. The Average, Standard Deviation (SD), Minimum (Min) and Maximum (Max) Values of SO_2 (24 h) in Ambient Air
All units are in µg m^{-3}

Sampling Period	N	Mean	SD	Min	Max
Nov,2017	3	0.00466	0.002082	0.003	0.007
Dec,2017	4	0.00875	0.008302	0.002	0.020
Jan,2018	5	0.00900	0.003873	0.005	0.014
Feb,2018	4	0.00775	0.001893	0.005	0.009
March,2018	4	0.07500	0.012910	0.060	0.090
April,2018	3	0.55333	0.541233	0.120	1.160
May,2018	4	0.25175	0.478866	0.007	0.970
June,2018	5	0.01340	0.006148	0.007	0.020
July,2018	4	0.01950	0.027148	0.004	0.060
Total	36	0.10479	0.249793	0.002	1.160

Permissible level = 20 µg m^{-3} (WHO, 2000)

Table 4. The Average, Standard Deviation (SD), Minimum (Min) and Maximum (Max) Values of NO_2 (24 h) in Ambient Air
All units are in µg m^{-3}

Sampling Period	N	Mean	SD	Min	Max
Nov,2017	3	1.61	1.65	0.46	3.50
Dec,2017	4	13.35	5.19	10.38	21.10
Jan,2018	5	13.46	3.49	8.29	17.80
Feb,2018	4	14.35	1.97	12.90	16.41
March,2018	4	3.99	5.42	0.50	12.06
April,2018	3	35.13	14.70	26.31	52.10
May,2018	4	8.57	8.33	3.70	20.98
June,2018	5	7.17	4.94	3.32	13.12
July,2018	4	4.57	2.99	2.20	8.90
Total	36	11.36	10.11	0.46	52.10

Permissible level = 40 µg m^{-3} (WHO, 2000)

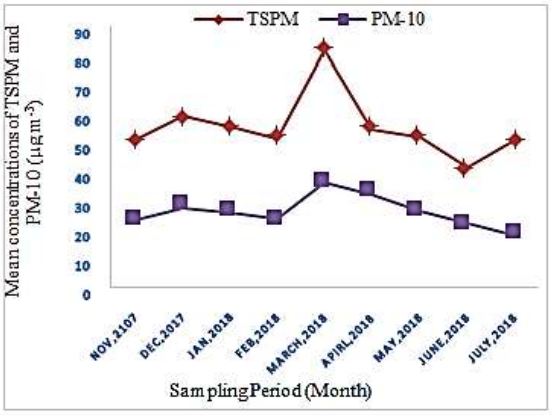

Figure 3. The comparison of mean concentrations of TSPM and PM-10 in ambient air collected from Ahlone Township for the period November 2017 to July 2018

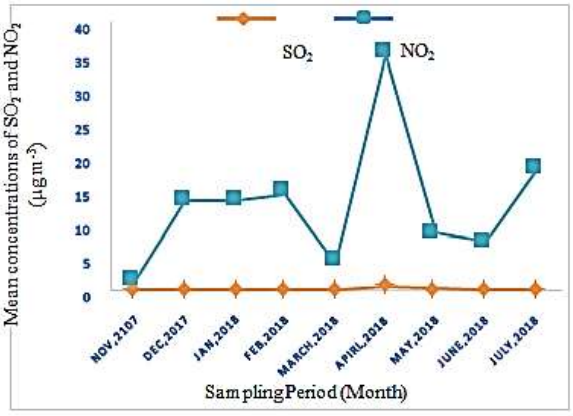

Figure 4. The comparison of mean concentrations of SO_2 and NO_2 in ambient air collected from Ahlone Township for the period November 2017 to July 2018

The Mean Seasonally Levels of PM and Some GAPs in Ambient Air Collected from Ahlone Township

Table 5 and Figure 5. show the mean seasonally levels of PM (TSPM, PM-10) and GAPs (SO_2 and NO_2) which collected from Ahlone Township seasonally from November 2017 to July 2018. The mean levels of TSPM were found to be highest in hot season (63.04 µg m^{-3}) and lowest in rainy season (46.24 µg m^{-3}). The mean levels of PM-10 were found to be highest in cold season (34.37 µg m^{-3}) and lowest in rainy season (19.95 µg m^{-3}). Concentration of particulate matter tended to be higher when conditions were warm and sunny. Conversely, the lowest concentrations of particulate matter were primarily observed during rainy conditions. This was expected due to the removal of the particulates from the atmosphere through wet deposition.

Therefore, the quality of ambient air is good in this season. The concentration of PM was remarkably decreased in this season as compared to other seasons as shown in Table 5 and Figure 5.. This is significant as it establishes the correlation between the meteorological factors and pollutant concentrations. The high relative humidity, moderate temperature and heavy rains result in the decrease of concentration of PM. Low value of TSPM contents during cold season may be attributed to light wind and prevails in cold season. These factors lead to dispersion of pollutants near the sources resulting into less concentration of pollutants during the cold season. Low value of pollutants during the cold season is also in line with the findings of Tripathy and Panigrahi (2000) and Sehra (2007).

In addition, dry season is convenient for travelling, therefore traffic density is increased. So, the large amount of exhaust emission and the PM-10 emission from vehicular sources (wear and tear of automobile tyres, clutch and brake ware, wiring of vehicles) were increased. Construction works which were (building and road construction) higher in dry season than rainy season. So more gaseous air pollutants and particulates emission occurred in dry season than rainy season.

Table 5. The Mean Seasonally Levels of Particulate Matter and Some Gaseous Air Pollutants in Ambient Air

Sr No.	Season	Levels of PM and some GAPs (µg m^{-3})			
	(2017-18)	TSPM	PM-10	SO_2	NO_2
1	Cold	54.31	34.37	0.01	10.69
2	Hot	63.04	31.70	0.29	15.89
3	Rainy	46.24	19.95	0.02	5.88
Permissible level		150**	50*	20*	40*
All were measured within 24 hours *WHO, (2000) **USEPA, (1997)					

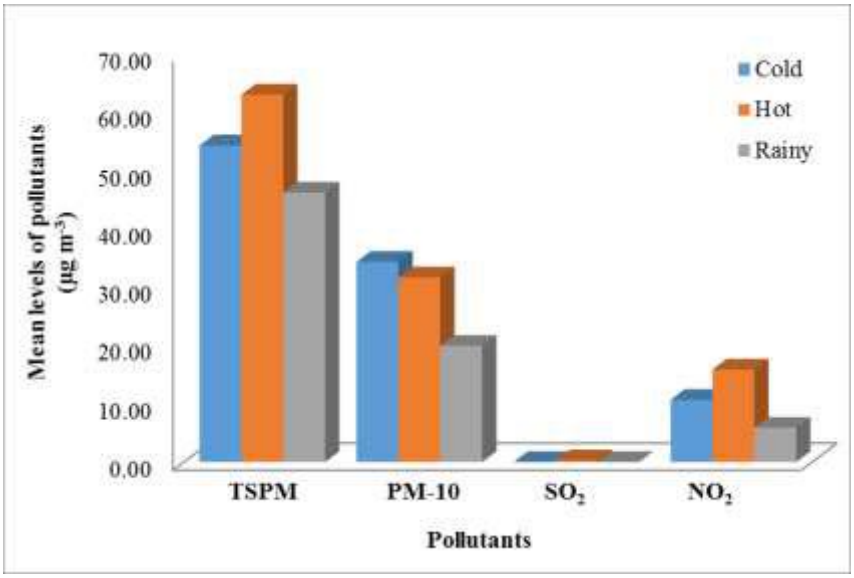

Figure 5. Histogram of mean seasonally levels of particulate matter and some gaseous air pollutants in ambient air collected from Ahlone Township in November 2017 to July 2018.

The mean seasonally levels of SO_2 within 24 hours were found to be highest in hot season (0.29 µg m^{-3}) and lowest in cold season (0.01 µg m^{-3}). The mean seasonally levels of NO_2 within 24 hours were found to be highest in hot

season (15.89 µg m^{-3}) and lowest in rainy season (5.88 µg m^{-3}). These data were found to be within permissible level of WHO air quality guideline (2000) and USEPA standard (1997).

Power plants, industries, motor vehicles and commercial use petrol, diesel as fuel and emissions from traffic are a major contributors of harmful pollutants such as carbon dioxide, oxides of nitrogen and sulphur dioxide along with particulate matter in the form of smoke. All of these have harmful effects on plants and humans (Lima *et al.*, 2005).

4. CONCLUSION:

The study revealed that both particulate matter and gaseous air pollutants were mostly below permissible limits at study site. Results of the study for concentrations of PM-10 were highest in March and April and the concentration of NO_2 (24 h) was highest in April representing hot season. In April, the concentration of PM-10 (63.60 µg m^{-3}) was found to be higher than the permissible level of WHO (2000) standard (50 µg m^{-3}). During summer and winter, there occurs slow dispersion of pollutants which results in more stable atmospheric conditions. Conversely, the lowest concentrations of pollutants were primarily observed during rainy conditions. This was expected due to the removal of the particulates from the atmosphere through wet depositions. Therefore, the quality of ambient air is good in rainy season. The level of pollutants obtained in the study have provided baseline information about the regional pollution pattern and atmospheric cycle of the pollutants of the Ahlone Township, Yangon region. The result shows good air quality with references to pollutants in Ahlone Township, Yangon region.

REFERENCES:

1. Angelika, S and A. K. Raina. (2013). "Assessment of the Status of SPM in Tammu City and its Control Strategies." *Journal of Environmental Science, Toxicology and Food Technology*, **7** (1), 8-12
2. Chaurasia, S., A. Karwaria and A. D. Gupta. (2013). "Air Pollution and Air Quality Index of Kadinar Gujarat, India". *International Research Journal of Environmental Sciences*, **2**, 62-67
3. Kamyotra, S. J. S. and Saha, D. (2011). *Guidelines for the Measurement of Ambient Air Pollutants.* India: Central Pollution Control Board, Ministry of Environmental and Forests, Govt. of India, vol.1, p. 1-7
4. Kumar, S. S and S. Kriti. (2016). "Ambient Air Quality Status of Jaipur City, Rajasthan, India". *International Research Journal of Environment Sciences*, **5** (1), 43-48
5. Lima, L. L., S. J. Hughesb and E. E. Hellawellb. (2005). *Integrated Decision Support System for Urban Air Quality Assessment, Environmental Modelling & Software*, **20**, 947-954
6. Raina, A. K and A. Sharma. (2006). "Assessment of Air Pollution and its Impact on the Leaves of Some Plant Species", *Pollution research*, **25** (3), 543-547
7. Sehra, P. S. (2007). "Atmospheric Pollution: A Case Study of Degrading Urban Air Quality over Punjab". *Indian Journal of Environmental Protection*, **27** (1), 32-38
8. Tripatty, A. K and G. P. Panigrahi. (2000). "Assessment of Air Pollution due to SPM, SO_2, NOx at IRE Ltd., Oscom Environment". *Indian Journal of Environmental Protection*, **20** (12), 901-905
9. USEPA. (1997). *EPA Compendium of Methods of the Determination of Inorganic Compounds in Ambient Air*, USA
10. WHO. (2000). *Air Quality Guidelines for Europe*. Copenhagen: 2nd Ed., WHO Regional Publications, European Series 91