

# Seasonally Comparison of Concentrations of some Heavy Metals in PM-10 at Urban Areas in Yangon City

<sup>1</sup>Swe Swe Ohn, <sup>2</sup>Ni Ni Sein

<sup>1</sup> Lecturer, Department of Chemistry, University of Yangon, Myanmar

<sup>2</sup> Professor (Retired), Dr, Department of Chemistry, University of Yangon, Myanmar

Email - <sup>1</sup>swesweohn2011@gmail.com, <sup>2</sup>ninisein1955@gmail.com

**Abstract:** In this study, an innovative and inexpensive approach, based on fabricated high volume air sampler, was used to collect particulate matter (PM-10) from 16 different sites in Yangon City. A total of 48 (PM-10) samples were collected for 3 seasons (16 samples on each season) from July 2017 to May 2018. Some heavy metals (Cd, Cu, Pb and Mn) in PM-10 samples were quantitatively determined by AAS technique. The PM-10 concentrations varied from 0.21 to 13.75 mg m<sup>-3</sup> and the mean value was 4.88 ± 3.47 mg m<sup>-3</sup> in the period of July 2017 to May 2018. The mean values of Cd, Cu, Pb and Mn were 0.0140 ± 0.0041 mg m<sup>-3</sup>, 0.1220 ± 0.7184 mg m<sup>-3</sup>, 0.0360 ± 0.0167 mg m<sup>-3</sup> and 0.0120 ± 0.0046 mg m<sup>-3</sup> respectively. The present study provides the base line information and the results are useful for effective environmental pollution monitoring in the Yangon City.

**Key Words:** Fabricated high volume air sampler, particulate matter, AAS.

## 1. INTRODUCTION:

Atmospheric pollution is a serious public health problem in the developing countries. Yangon City is a large commercial city, high urbanization, industrialization, motorization and faced with a heavy traffic density. Air pollution quality is increased in Yangon City as increased the rate of urbanization, motorization, industrialization and economic activities. Due to the fact that need to assess particulate matter with respect to toxic heavy metals in Yangon City, Myanmar.

## 2. MATERIALS AND METHODS :

PM -10 samples were collected from 16 different sites (restaurant kitchen, in front of restaurant, tea shop kitchen, in front of tea shop, two constructions sites, Hale Dan Junction, Sule Junction, car workshop, glass and aluminium fitting shop, in front of glass and aluminium fitting shop, interior decoration site, ground and 5<sup>th</sup> floor of Yuzana Plaza, car painting and body repair shop and residence) in Yangon City, Myanmar.

The air sampling pump (Fabricated High Volume Air sampler) was used to collect PM-10 samples. PM- 10 sample were collected on glass microfiber filter with a diameter of 37 mm and 1.0 µm pore size. Automatic air flow meter was set at a nominal flow rate of 2 Lm<sup>-1</sup>. Temperature and pressure were also simulations measured hourly during the sampling period. The PM-10 samples were collected for 8 hours from 8:00 am to 4:00 pm during the period of July 2017 to May 2018. Four toxic heavy metals (Cd, Cu, Pb and Mn) in all PM-10 samples were quantitatively determined by Atomic Absorption Spectrophotometer (AAS) at Universities Research Centre (URC), University of Yangon.

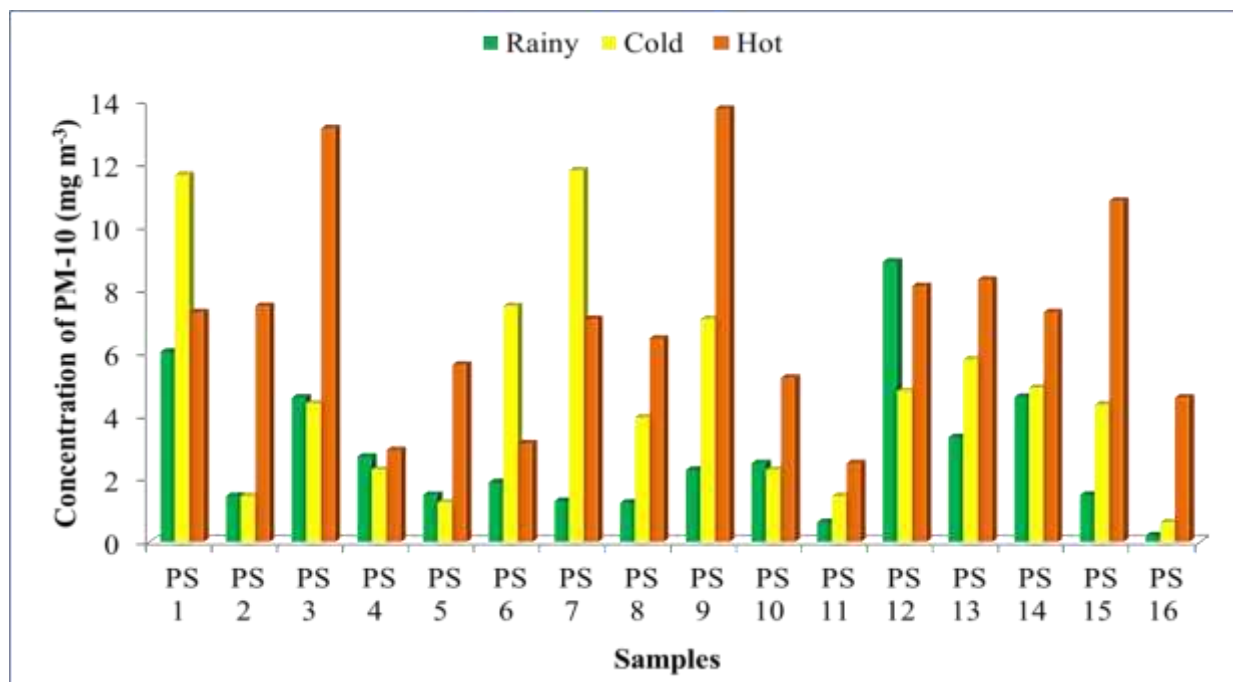
## 3. RESULTS AND DISCUSSION:

The results of PM-10 concentrations are shown in Table 1 and Figure 1.

**Table 1 Concentrations of PM-10 (mg m<sup>-3</sup>) Seasonally Collected from 16 Different Locations in Yangon City from July 2017 to May 2018**

Sr No.	PM-10 Samples	Concentrations of PM-10 (mg m <sup>-3</sup> )						
		Rainy	Cold	Hot	Mean	SD	Min	Max
1	PS-1	<b>6.04</b>	<b>11.66</b>	<b>7.29</b>	8.33	2.95	6.04	11.66
2	PS-2	1.46	1.46	<b>7.50</b>	3.47	3.49	1.46	7.50
3	PS-3	4.58	4.40	<b>13.13</b>	7.37	4.99	4.40	13.13
4	PS-4	2.71	2.30	2.92	2.64	3.46	2.30	2.92
5	PS-5	1.50	1.25	<b>5.63</b>	2.79	2.50	1.25	5.63
6	PS-6	1.90	<b>7.50</b>	3.13	4.18	3.72	1.90	7.50
7	PS-7	1.30	<b>11.8</b>	<b>7.08</b>	6.73	5.26	1.30	11.8
8	PS-8	1.25	3.96	<b>6.46</b>	3.89	3.67	1.25	6.46
9	PS-9	2.29	7.08	<b>13.75</b>	7.78	4.05	2.29	13.75

10	PS-10	2.50	2.29	5.21	3.33	3.64	2.29	5.21
11	PS-11	0.63	1.46	2.50	1.53	3.51	0.63	2.50
12	PS-12	<b>8.90</b>	4.79	<b>8.13</b>	7.27	2.18	4.79	8.90
13	PS-13	3.33	5.80	<b>8.33</b>	5.82	2.63	3.33	8.33
14	PS-14	4.60	4.90	<b>7.29</b>	5.56	2.35	4.60	7.29
15	PS-15	1.50	4.36	<b>10.83</b>	5.56	2.81	1.50	10.83
16	PS-16	0.21	0.63	4.58	1.80	2.95	0.21	4.58
					4.88	3.47	0.21	13.75
<b>OSHA Standard Value (Zixus, 2017) - 5.00 mg m<sup>-3</sup></b>								



**Figure. 1** Histogram of comparison of concentrations of PM-10 samples seasonally collected from 16 different locations in Yangon city

In general concentration of PM-10 in hot season were found to be higher than the cold season and rainy season. The concentrations of PM-10 were found to be nearly and higher than the permissible level of OSHA (2017) standard 5 mg m<sup>-3</sup> at restaurant kitchens, Interior or decoration site and plaza for all seasons. High concentration may be caused by heating and cooking activities (use charcoal and gas stove) and interior decoration activities (partition, painting, wiring, aluminium, glass and wood cutting). Car parking, food court, tailoring and so many shops are situated in Yuzana Plaza and inadequate ventilation system. Moreover its area is traffic area. Therefore, the concentrations of PM-10 were found to be high in Yuzana Plaza. In hot season, mostly, concentrations of PM-10 were higher than the permissible level of OSHA (2017) standard 5 mg m<sup>-3</sup>.

**Table 2** Comparison of Concentrations of Cd (mg m<sup>-3</sup>) in PM-10 Samples Seasonally Collected from 16 Different Locations in Yangon City from July 2017 to May 2018

Sr No.	PM-10 Samples	Concentrations of Cd (mg m <sup>-3</sup> ) in PM-10 Samples						
		Rainy	Cold	Hot	Mean	SD	Min	Max
1	PS-1	0.015	0.016	0.017	0.016	0.0010	0.015	0.017
2	PS-2	0.014	0.013	0.011	0.013	0.0054	0.011	0.014
3	PS-3	0.015	0.016	0.013	0.015	0.0049	0.013	0.016
4	PS-4	0.014	0.014	0.016	0.015	0.0047	0.014	0.016
5	PS-5	0.015	0.016	0.014	0.015	0.0047	0.014	0.016
6	PS-6	0.014	0.016	0.016	0.015	0.0047	0.014	0.016
7	PS-7	0.015	0.016	0.018	0.016	0.0047	0.015	0.018
8	PS-8	0.013	0.015	0.017	0.015	0.0047	0.013	0.017
9	PS-9	0.015	0.014	0.017	0.015	0.0047	0.014	0.017
10	PS-10	0.005	0.01	0.015	0.01	0.0048	0.005	0.015
11	PS-11	0.021	0.018	0.016	0.018	0.0050	0.016	0.021

12	PS-12	0.015	0.016	0.018	0.016	0.0050	0.015	0.018
13	PS-13	0.015	0.016	0.016	0.016	0.0050	0.015	0.016
14	PS-14	0.016	0.016	0.016	0.016	0.0049	0.016	0.016
15	PS-15	0.015	0.015	0.015	0.015	0.0049	0.015	0.016
16	PS-16	0.001	0.001	0.002	0.001	0.0054	0.001	0.002
					0.014	0.0041	0.001	0.021
<b>OSHA Standard Value (Zixus, 2017) - 0.02 mg m<sup>-3</sup></b>								

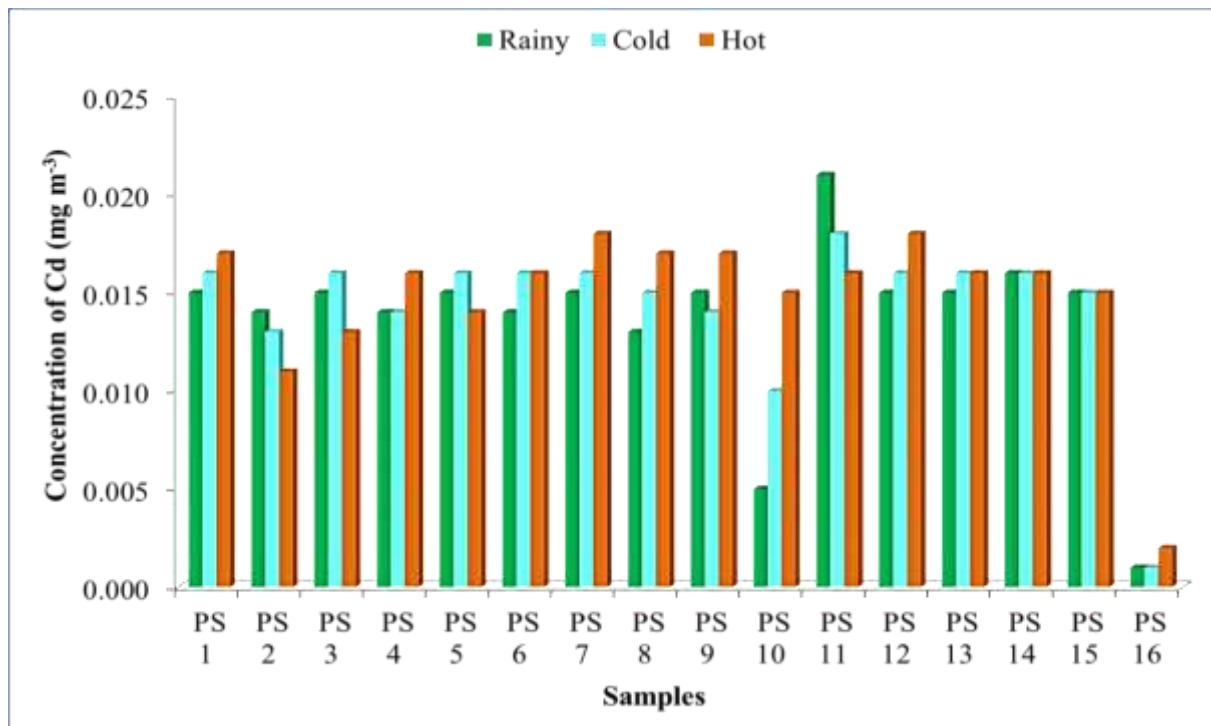
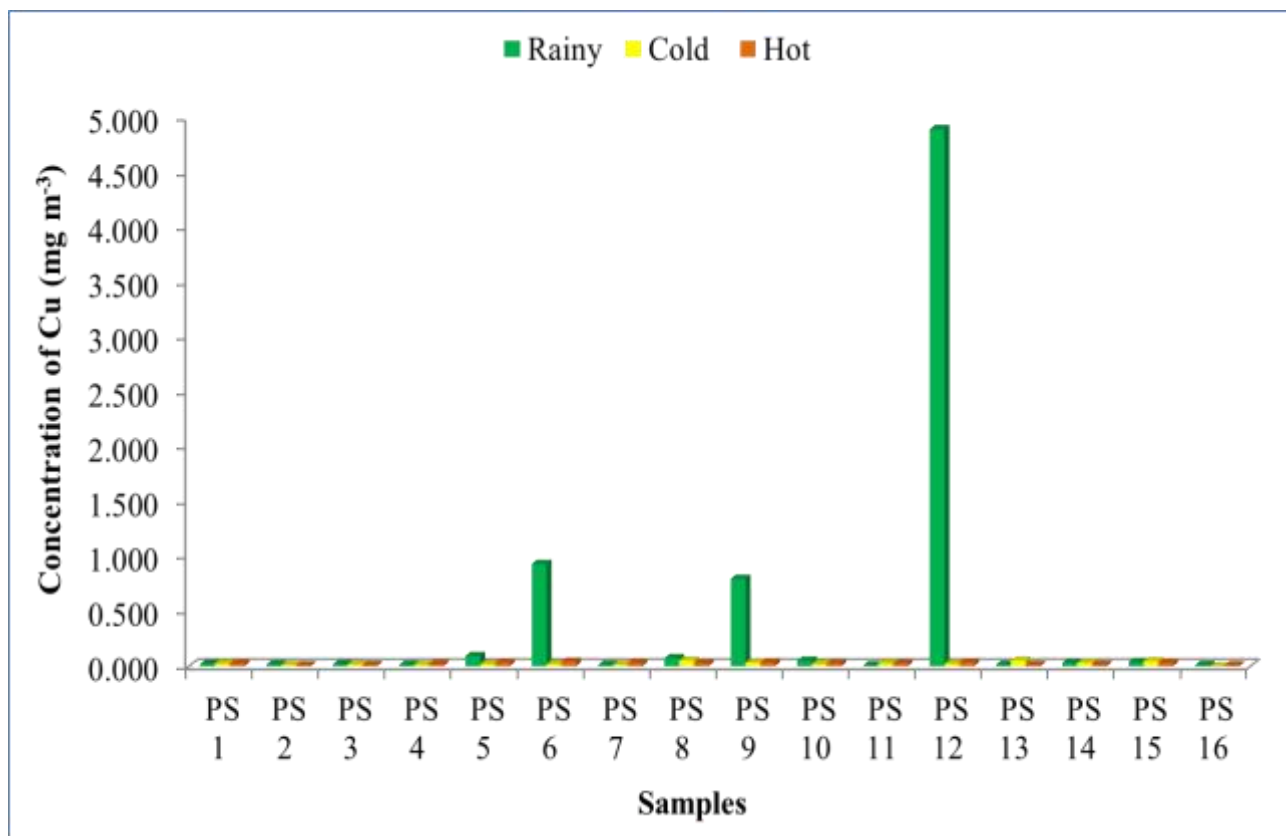


Figure 2 Histogram of comparison of concentrations of Cd (mg m<sup>-3</sup>) in PM-10 samples seasonally collected from 16 different locations in Yangon City from July 2017 to May 2018

Table 3 Comparison of Concentrations of Cu (mg m<sup>-3</sup>) in PM-10 Samples Seasonally Collected from 16 Different Locations in Yangon City from July 2017 to May 2018

Sr No.	PM-10 Samples	Concentrations of Cu (mg m <sup>-3</sup> ) in PM-10 Samples						
		Rainy	Cold	Hot	Mean	SD	Min	Max
1	PS-1	0.021	0.024	0.026	0.023	0.0025	0.021	0.026
2	PS-2	0.016	0.012	0.010	0.013	0.0084	0.01	0.016
3	PS-3	0.018	0.016	0.012	0.015	0.0070	0.012	0.018
4	PS-4	0.013	0.012	0.022	0.016	0.0066	0.02	0.022
5	PS-5	0.094	0.020	0.031	0.048	0.0195	0.012	0.094
6	PS-6	0.933	0.019	0.042	0.331	0.1911	0.019	0.933
7	PS-7	0.013	0.013	0.031	0.019	0.1783	0.013	0.031
8	PS-8	0.074	0.052	0.025	0.053	0.1675	0.025	0.074
9	PS-9	0.798	0.032	0.034	0.288	0.2012	0.032	0.798
10	PS-10	0.051	0.021	0.025	0.032	0.1922	0.021	0.051
11	PS-11	0.010	0.026	0.026	0.021	0.1841	0.010	0.026
12	PS-12	4.896	0.022	0.035	1.651	0.1772	0.022	4.896
13	PS-13	0.015	0.052	0.012	0.029	0.6956	0.012	0.052
14	PS-14	0.031	0.031	0.015	0.026	0.674	0.015	0.031
15	PS-15	0.040	0.046	0.028	0.038	0.6544	0.028	0.046
16	PS-16	0.011	0.001	0.009	0.007	0.6369	0.001	0.011
					0.122	0.7184	0.001	4.896
<b>NIOSH Standard Value (Zixus, 2017) - 1.0 mg m<sup>-3</sup></b>								



**Figure 3** Histogram of comparison of concentrations of Cu ( $\text{mg m}^{-3}$ ) in PM-10 samples seasonally collected from 16 different locations in Yangon City from July 2017 to May 2018

**Table 4** Comparison of Concentrations of Pb ( $\text{mg m}^{-3}$ ) in PM-10 Samples Seasonally Collected from 16 Different Locations in Yangon City from July 2017 to May 2018

Sr No.	PM-10 Samples	Concentrations of Pb ( $\text{mg m}^{-3}$ ) in PM-10 Samples						
		Rainy	Cold	Hot	Mean	SD	Min	Max
1	PS-1	0.015	0.023	0.021	0.06	0.0042	0.015	0.023
2	PS-2	0.013	0.044	0.056	0.039	0.0183	0.018	0.056
3	PS-3	0.019	0.021	0.032	0.024	0.0147	0.019	0.032
4	PS-4	0.018	0.051	0.058	0.042	0.0169	0.018	0.058
5	PS-5	0.018	0.046	0.055	0.04	0.0171	0.018	0.055
6	PS-6	0.018	0.055	0.057	0.043	0.0177	0.018	0.057
7	PS-7	0.015	0.048	0.056	0.04	0.0179	0.015	0.056
8	PS-8	0.019	0.052	0.055	0.042	0.0179	0.019	0.055
9	PS-9	0.017	0.043	0.047	0.036	0.0176	0.017	0.047
10	PS-10	0.012	0.032	0.039	0.028	0.0171	0.012	0.039
11	PS-11	0.022	0.022	0.037	0.027	0.0164	0.022	0.037
12	PS-12	0.022	0.035	0.031	0.029	0.0159	0.022	0.035
13	PS-13	0.027	0.047	0.046	0.04	0.0157	0.027	0.047
14	PS-14	0.022	0.045	0.043	0.033	0.0155	0.022	0.045
15	PS-15	0.004	0.051	0.052	0.036	0.016	0.004	0.052
16	PS-16	0.007	0.011	0.009	0.009	0.0618	0.007	0.011
					0.036	0.0167	0.004	0.058
<b>NIOSH Standard Value (Zixus, 2017) - <math>&lt; 0.1 \text{ mg m}^{-3}</math></b>								

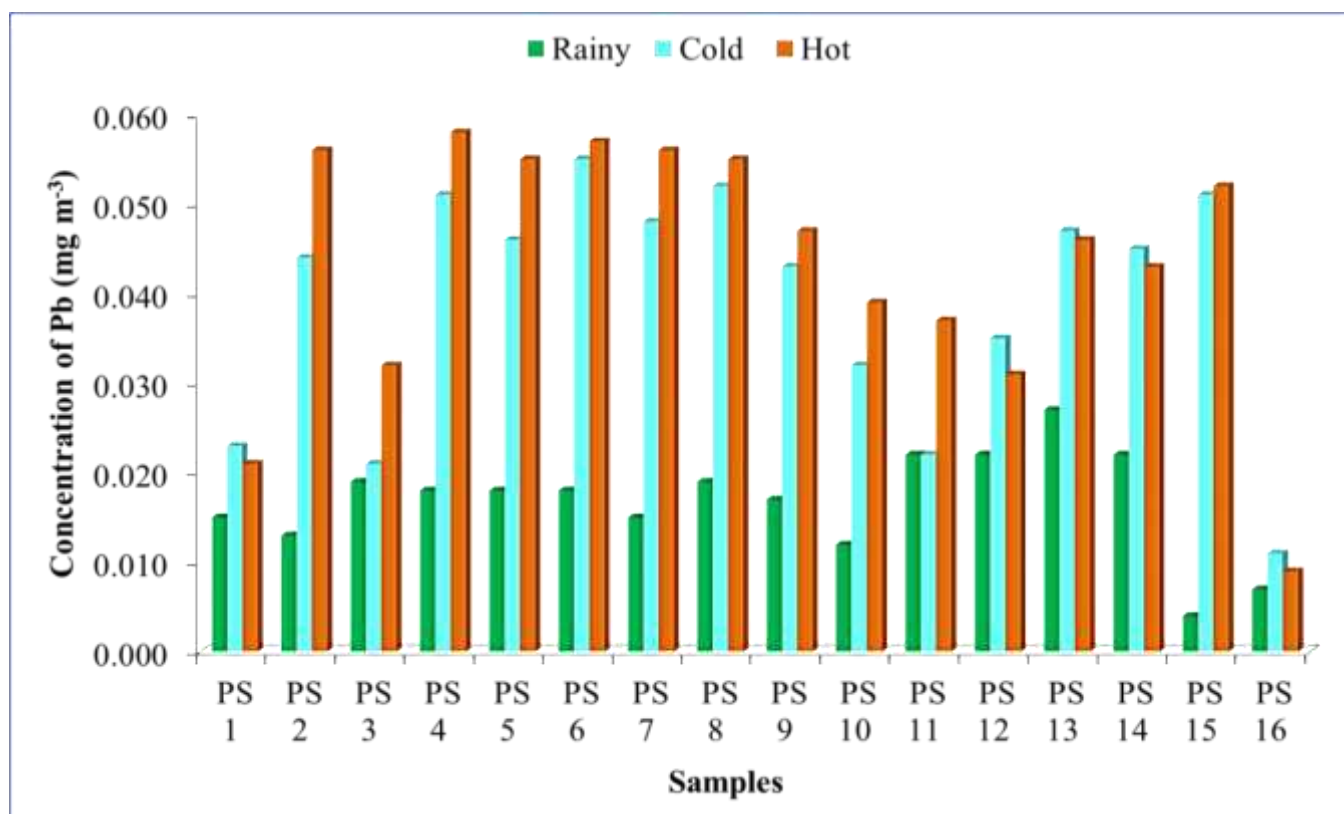
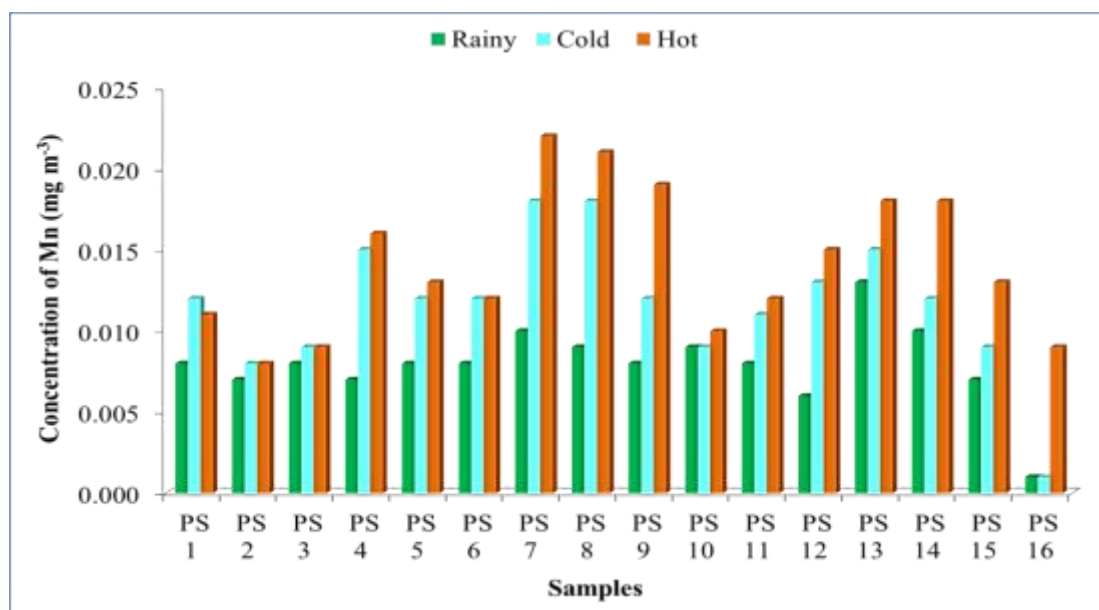


Figure 4 Histogram of comparison of concentrations of Pb (mg m<sup>-3</sup>) in PM-10 samples seasonally collected from 16 different locations in Yangon City from July 2017 to May 2018

Table 5 Comparison of Concentrations of Mn (mg m<sup>-3</sup>) in PM-10 Samples Seasonally Collected from 16 Different Locations in Yangon City from July 2017 to May 2018

Sr No.	PM-10 Samples	Concentrations of Mn (mg m <sup>-3</sup> ) in PM-10 Samples						
		Rainy	Cold	Hot	Mean	SD	Min	Max
1	PS-1	0.008	0.012	0.011	0.020	0.0021	0.008	0.012
2	PS-2	0.007	0.008	0.008	0.008	0.0032	0.007	0.008
3	PS-3	0.008	0.009	0.009	0.009	0.0029	0.008	0.009
4	PS-4	0.007	0.015	0.016	0.013	0.0039	0.007	0.016
5	PS-5	0.008	0.012	0.013	0.011	0.0039	0.008	0.013
6	PS-6	0.008	0.012	0.012	0.011	0.0038	0.008	0.012
7	PS-7	0.010	0.018	0.022	0.017	0.0048	0.010	0.022
8	PS-8	0.009	0.018	0.021	0.016	0.0052	0.009	0.021
9	PS-9	0.008	0.012	0.019	0.013	0.0052	0.008	0.019
10	PS-10	0.009	0.009	0.010	0.008	0.0051	0.006	0.01
11	PS-11	0.008	0.011	0.012	0.012	0.0049	0.011	0.013
12	PS-12	0.006	0.013	0.015	0.017	0.0048	0.010	0.015
13	PS-13	0.013	0.015	0.018	0.015	0.0049	0.013	0.018
14	PS-14	0.010	0.012	0.018	0.013	0.0049	0.010	0.018
15	PS-15	0.007	0.009	0.013	0.01	0.0049	0.007	0.013
16	PS-16	0.001	0.001	0.009	0.004	0.005	0.001	0.009
					0.012	0.0046	0.001	0.022
		<b>OSHA Standard Value (Zixus, 2017) - 1.0 mg m<sup>-3</sup></b>						



**Figure 5 Histogram of comparison of concentrations of Mn (mg m<sup>-3</sup>) in PM-10 samples seasonally collected from 16 different locations in Yangon City from July 2017 to May 2018**

Concentrations of heavy metals (Cd, Cu, Pb and Mn) results are shown in Tables 2-4 and Figures 2-4. According to the AAS results, the concentrations of Cd, Cu, Pb and Mn were found to be in the range of 0.001 to 0.021 mg m<sup>-3</sup>, 0.001 to 4.896 mg m<sup>-3</sup>, 0.004 to 0.058 mg m<sup>-3</sup> and 0.001 to 0.022 mg m<sup>-3</sup> respectively. The mean values of Cd, Cu, Pb and Mn were 0.0140 ± 0.0040 mg m<sup>-3</sup>, 0.1220 ± 0.7184 mg m<sup>-3</sup>, 0.0360 ± 0.0167 mg m<sup>-3</sup> and 0.0120 ± 0.0046 mg m<sup>-3</sup> respectively.

All the level of heavy metals (Cd, Cu, Pb and Mn) in PM-10 samples collected from PS-16 residence (indoor site) were found to be small amount as compared to other sites for all three seasons. The concentrations of heavy metals in PM-10 samples collected from 15 different sites were found to be not much different for all seasons and these values were within the permissible level of OSHA (2017) and NIOSH (2017) standard.

#### 4. CONCLUSION:

The study revealed that both of the concentrations of PM-10 and heavy metals (Cd, Cu, Pb and Mn) were found to be mostly below permissible Limits at study sites. In general, the levels of PM-10 and heavy metals obtained in this study have provided base line information about the Yangon City air pollution pattern.

#### REFERENCES:

1. Hoal, M.L, P. Surje and P. Rouk, (2008): Traffic as a Source of Pollution. Estorian, **14**, 65-82.
2. Nuenesi, A. K, (2010): An Assessment of Common Atmospheric Particulate Matter Sampling and Toxic Metal Analysis Methods. African Journal of Environmental Science and Technology, **4** (11), 718.725.
3. Wong, C.S.C. and X.D. Li, (2004): Pb Contamination and Isotopic Composition of Urban Soils in Hong Kong. Sci Total Environ., **319**, 185,195.
4. Zixus, (2017): Air Sampling Guide to HSE Methods. UK: SKC Ltd., 144 – 211.