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ASSESSSMENT OF PARTICULATE MATTER ($PM_{2.5,10}$) LEVEL IN SOME SELECTED AREAS IN SOUTH-WEST NIGERIA

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Abstract

The severe side effect of Particulate Matter (PM) inhalation in our environment has necessitated the need to monitor the PM and take appropriate measure. Dust is present everywhere, but most times, it is not visible to the eyes even when it is above the permissible limit set by United State Environmental Protection Agency (USEPA) – 150 μgm^{-3}. This study was carried out to determine different PM levels at different locations at selected areas in Southwest Nigeria using a developed dust density measurement system. It was observed that PM level in a residential area at Oye-Ekiti, Akure, and Ibadan was below 120 μgm^{-3} in most cases and above in few cases. PM level in Federal University Oye-Ekiti environment was at some time above 150μgm^{-3}. The PM level in public transport also showed that commuters are exposed to dust hazard as the dust density level rose between 133% to 400% compared to the permissible limit. Government must ensure the roads are in good conditions.

Keywords: Particulate Matter, severe, environment, permissible, effect, measurement

Introduction

Environmental pollution issue has been a big challenge to deal with in Africa. Advanced countries of the world are not left out as this issue had occupied an important part of them. This is due to underdevelopment in this part of the world especially in terms of bad road network, poor and deteriorating conditions of vehicles on the highway, and breaking of traffic regulations by going beyond speed limit. This has affected the environment and the life of people generally. (Lamri *et. al.,* 2017). Many commuters are unaware of the quantity of exposure to the Particulate Matter (PM) on the highways which often come with life threatening ailment like silicosis, cancer and it is thought to contribute to a condition known as chronic obstructive pulmonary disease (Aeroqual 2015). Also, university lecture halls, office corridors, offices, and houses are areas where less attention is given to considering the dust density level. There could be a high rise of PM during harmattan and it is in this season some levels of caution should be observed (Ifeanyi *et. al.*, 2012).

It is obvious that dust is noticed when it is far beyond the permissible limit when the eyes and the nose can detect streams of particles in the atmosphere. However, a lot of particles travel in the atmosphere unnoticed. Many of this unnoticed dust particles are harmful to human causing serious health challenges.

Many of the roads selected for this research are in bad state. Many are left unrepaired over a long period of time. Drivers also contribute by recklessly driving through this bad road. Researches had been done to determine heavy metals deposit on Nigerian roads. Pollution level has increased considerably in recent years as result of increasing human activities such as burning of fossil fuels, industrial and vehicular emission on the road (Babatunde and Oladewa 2012, Ubwa *et. al.,* 2013). It is also common that Industrial-populated areas have more tendency of air pollution to areas with less industry. Study carried out in Warri, Nigeria showed the extent of air pollution in the area. The analysis of the PM collected has 922 - 2333 μgm^{-3}. These are derived from combustion and industrial activities. (Okuo *et. al.,* 2006).

Materials and methods

Data Collection

A developed dust measurement system (Ewetumo *et al.*, 2018) that uses Sharp Dust Sensor GP2Y1010AU0F was used to take measurement of dust density in residential areas of Oye-Ekiti, Akure, Ibadan and Federal University Oye-Ekiti examination hall. The response of device was tested by blowing dust particles towards the sensing point of the sensor and the value displayed on the LCD screen increases as the blowing speed increase and vice versa. The dust measuring instrument was calibrated using the sensitivity of Sharp Dust Sensor GP2Y1010AU0F (0.5 V/0.1 mg/m^3). The output voltage ranges from 0.9 V without dust (0 mg/m^3) to 3.2 V at maximum of 0.541 mg/m^3 which was used to generate a calibration equation (Ewetumo *et al* 2018). The device was placed at a location in the rooms over several hours. It has capacity to measure PM_{10} and $PM_{2.5}$. It is usually programmed to take measurement every minute and store the data collected on a serial data (SD) card. The study areas were extended to some selected roads in the South Western states of Nigeria. Data were collected in a public transport travelling from Oye-Ekiti to Akure, Oye-Ekiti to Ibadan, Ibadan to Ile-Ife and Akure to Ibadan respectively. The high correlation coefficient (r = 0.99998) between the values obtained from the dust measuring system and Dust Particle Measuring Device PCE-MPC10 together with high sensitivity of the equipment ascertained the degree of precision and accuracy of the results presented in this study.

Results and discussion

The results of the data collected in all the chosen locations are presented in Figures 1-9. The data collected especially on the selected roads have similarities of high dust densities beyond the safe limit as set by United State EPA – 150 μgm^{-3}. Many of the considered roads are Federal road with high traffic. These Federal roads link one state to the other. A sample data collected in a public transport on Ibadan road to Ife road is shown in Table 1. The data was collected in about 72 minutes at every one-minute interval. The plot of dust density against time in Figure 1 revealed the variation in different amount of dust exposure. There were about eleven peaks where the dust densities were above the permissible limit. The percentage increase of these peaks as compared to the permissible limit ranges from 101% to 210%. These are routines commuters encounter on daily basis as they travel on these roads. Dust densities taken on the road Oye-Ekiti to Akure and Akure to Ibadan have similar data in terms of the high dust density experienced on the roads. In Figure 2, it is obvious that the dust density of the room is normal. The data was collected within the period of 67 minutes. The highest peak in Figure 2 was 90 μgm^{-3}. This level fell within the permissible or safe limit.

The same trend was observed in Figures 3-9 which depicts some periods of abnormality in the dust densities especially for the data collected travelling on the road. Taken into consideration the site of data collection and the period over which the data is collected. The pattern of data collected from Figure 3-9 differs from Figure 1 and 2 because these data were collected at longer time duration of 2 hours or above. Sudden rise or high peaks (higher than the permissible limit) in the dust density levels were observed in Figure 4 with the measurement taken for a period of 140 minutes. The first high peak was noticed between 18 to 20 minutes. This was the time movement was high as booklets and examination questions were being distributed to students in the hall by the examiners. The second-high peak occured between 114 to 118 minutes. This also was another rush period when students were submitting booklets after the stoppage of the exam. PM at rest experiences displacement by the movement. Hence, this explained the possibility of increase in the level at depicts periods.

Table 1: A typical dust density in a public transport Ibadan to Ile-Ife, 5th November 2018.

Time (mins)	Dust density µg/m^{-3}	Time (mins)	Dust density µg/m^{-3}	Time (mins)	Dust density µg/m^{-3}
1	88.4277	25	134.9121	49	149.8535
2	158.1543	26	150.6836	50	129.1016
3	208.7891	27	151.5137	51	263.5743
4	145.7031	28	315.8692	52	160.6445
5	138.2324	29	137.4024	53	224.5606
6	147.3633	30	145.7031	54	134.082
7	137.4024	31	154.834	55	125.7812
8	156.4941	32	144.043	56	120.8008
9	145.7031	33	138.2324	57	155.6641
10	141.5527	34	129.9316	58	139.0625
11	151.5137	35	136.5723	59	141.5527
12	199.6582	36	139.0625	60	121.6309
13	147.3633	37	163.1348	61	132.4219
14	143.2129	38	134.082	62	131.5918
15	212.9395	39	193.0176	63	136.5723
16	154.0039	40	147.3633	64	129.1016
17	141.5527	41	144.873	65	129.1016
18	135.7422	42	192.1875	66	133.252
19	151.5137	43	131.5918	67	193.8477
20	196.3379	44	127.4414	68	131.5918
21	160.6445	45	132.4219	69	143.2129
22	266.0645	46	129.1016	70	147.3633
23	163.9648	47	136.5723	71	150.6836
24	160.6445	48	133.252	72	136.5723

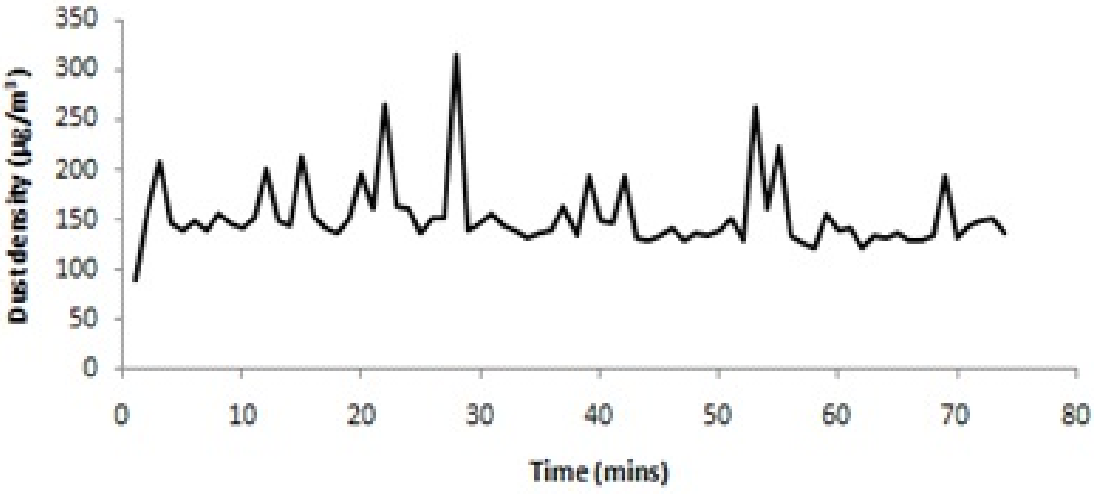

Figure 1: Dust Density in a public transport (Ibadan to Ile-Ife)- 5th November, 2018

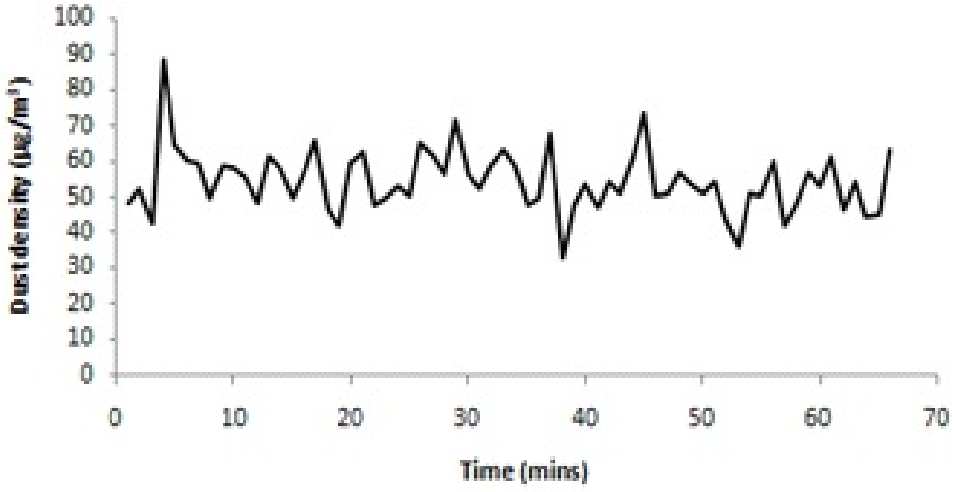

Figure 2: Dust Density of a Room at Oye-Ekiti-13th October, 2018

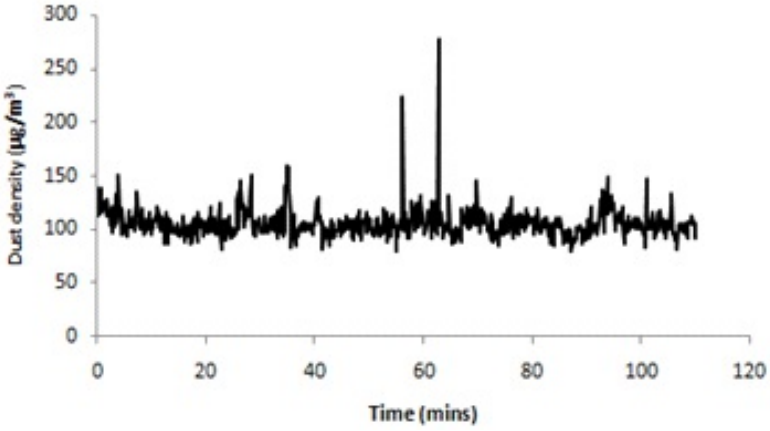

Figure 3: Dust Density of an Office at Federal University Oye-Ekiti-13th October, 2018

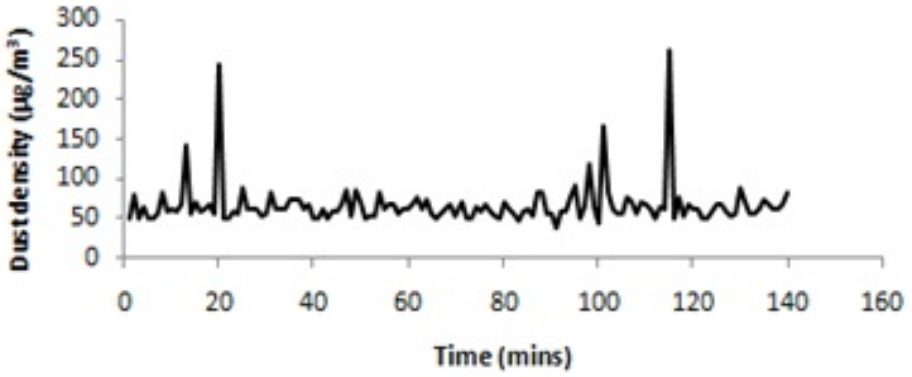

Figure 4: Dust Density in a public transport (Ibadan to Ile-Ife)- 5th November, 2018

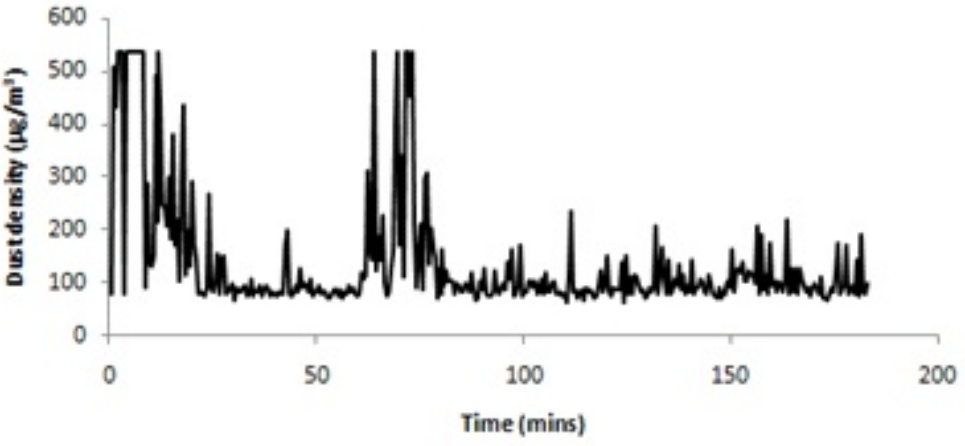

Figure 5: Dust Density of Faculty Passage at Federal University Oye-Ekiti-16th October, 2018

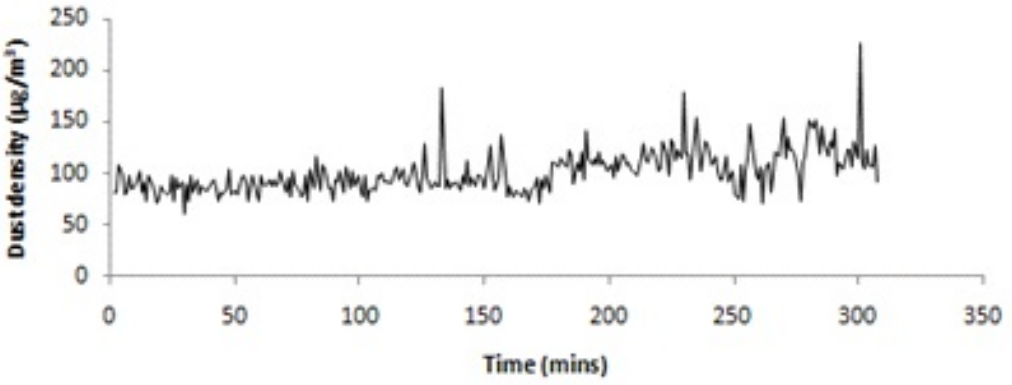

Figure 6: Dust Density in a car from Oye-Ekiti to Akure -16th October 2018

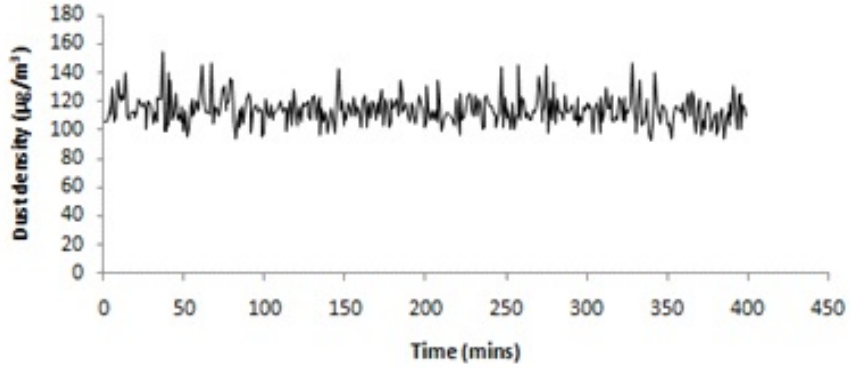

Figure 7: Dust Density of a House in Akure -30th October 2018

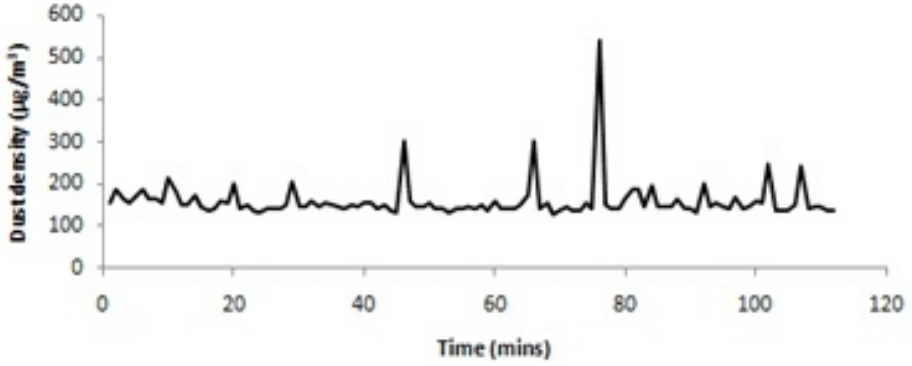

Figure 8: Dust Density in a Bus (Akure to Ibadan)- 4th November 2018

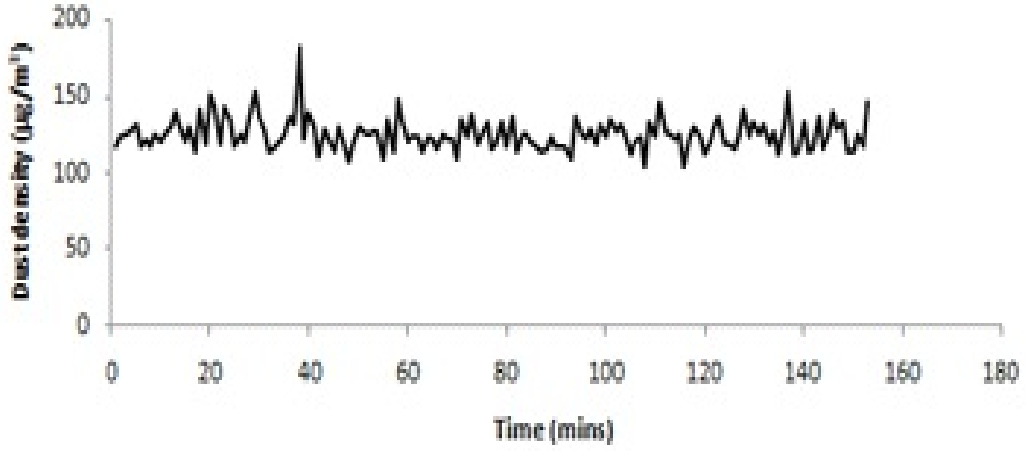

Figure 9: Dust Density in a House at Ibadan- 4th November 2018

Conclusion

This research revealed the levels of PM in the selected areas. Bad roads coupled with reckless driving on the road expose commuters to uneasily noticed menace. Dust density levels in all the roads selected in this research were beyond the permissible limit set by United State Environmental Protection Agency (EPA) – 150μgm^{-3} but within the permissible limit in selected residential areas. The environment and activities in the selected area at Federal University Oye-Ekiti was responsible for the high dust densities in some particular times. Government should ensure that the bad roads are repaired in these areas covered in the research and drivers should be educated more on the driving limit of the road. Cleaning of the university environment should be done early enough before the resumption of people for work.

Acknowledgement

The effort of Dr. T. Ewetumo is appreciated in the construction stage of the Dust Density Measuring System.

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