A Report on

SPECIAL MONITORING OF AMBIENT AIR QUALITY & NOISE LEVELS AT BHOPAL DURING DIWALI FESTIVAL 2019

(20th October -3rd November, 2019)

Central Pollution Control Board
Regional Directorate (Central)
Bhopal

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Regional Directorate (Central), Bhopal

Report on special monitoring of Ambient Air Quality & Noise Levels at Bhopal city during Diwali Festival 2019

1. **Introduction:** Deepawali or Diwali traditionally known as the "festival of illuminations" is an essential five-day festival occurring between mid-October to mid-November, celebrated for different reasons in India. Deepawali' means "Rows of Lights" so this festival is also known as "Festival of Lights". Diwali festival starts with Dhanteras, followed by small Diwali and then main Diwali. Deepawali is popularly known as the "festival of lights" bringing joy to the young and old all alike. It is a five days long festival start from Dhanteras followed by Chhoti Diwali and ends on Bhaidooj. There becomes huge rush in the market from few weeks before the main date of festival because people start buying clothes, jewellery, decorative things, electric bulbs, firecrackers, things related to food items, etc.

2. **Bhopal City & Climate:** Bhopal city capital of Madhya Pradesh has population of 17,98,2018 (Census 2011) spread in area of 285.88 KM^2. It is situated in latitude of 23°15'N and longitude of 77°25'E. Bhopal city is one of the fast growing city, where housing, infrastructure, transportation and industrialization in Mandideep industrial area, Govindpura industrial area and Smart city project is in greater swing. This city is well known as 'City of Lakes' because of the number of lakes and ponds.

Bhopal has a humid subtropical climate, with cool, dry winters, a hot summer and a humid monsoon season. Summers start in late March and go on till mid-June, the average temperature being around 35°C, with the peak of summer in May, when the high regularly exceeds 40°C. The monsoon starts in late June and ends in late September. The average temperature is around 28°C and the humidity is moderate. Temperatures rise again up to late October when winter starts, which lasts up to early March. Winters in Bhopal are cool, sunny and comfortable.

3. **Objective of Ambient Air quality & Noise level monitoring:** With reference to CPCB Head Office letter no A-21016/1/08-Mon/6039 dated September 2nd, 2019 Regional Directorate (Central), Central Pollution Control Board, Bhopal has conducted Ambient Air Quality monitoring in Bhopal city from 20.10.2019 to 04.11.2019 during Diwali for the parameters of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and selected heavy metals in PM_{10} (Pb, N i& As) & $PM_{2.5}$(Pb, Ni, As, Al, Ba, Fe & Sr). The Ambient Noise Level monitoring performed pre-Diwali on 21.10.2019 and during Diwali on 27.10. 2019 to record the impact of bursting of fire crackers on environment. Intensive Ambient Air Quality and Ambient Noise level monitoring was conducted at selected two locations in the city. Ambient air quality monitored for 24 hours (6:00AM- 6:00AM) whereas ambient noise levels monitored for 6 hours (6:00 PM-12:00mid night). Noise level monitoring was carried out by using integrating sound level meters with free-field microphone which meets the accuracy of noise measurement as per IES 804 (BS 6698) grade I or ANSI type I or equivalent IES 61672-1(2002-05) class-I to see the overall impact of bursting of fire crackers on Ambient Noise level. PM_{10}, SO_2, NO_2 and selected heavy metals in PM_{10} (Pb, Ni and As) & $PM_{2.5}$ (Pb, Ni, As, Al, Ba and Fe) monitored during 20.10.2019, 6:00 AM to 04.11.2019, 6:00 AM.

4. **<u>Monitoring locations and its co-ordinates</u>**: Ambient Air Quality was carried out before Diwali, on Diwali & post Diwali day and Noise Monitoring was carried out before Diwali and on Diwali as per the protocol received from Head Office at the following 02 locations in Bhopal city.

Name of the monitoring location	Description of location	Latitude &Longitude	Activities around locations
North T.T. Nagar	Commercial	23°14'138"N 77°23'891"E	Vehicle movement, commercial, Civil construction activities and bursting of crackers
Nehru Nagar	Residential	23°12.968"N 77°23.579"E	Road sweeping, traffic movement, Bursting of crackers

5. **<u>Google Map showing the monitoring location</u>**

6. Meteorological data during monitoring:

Date	Temperature (°C)		Prominent Wind direction	wind speed (KM/Hrs)	Humidity (%)
	Min.	Max.			
20.10.2019	22.1	24.1	NE	4.23	87
21.10.2019	21.1	26.8	NE	5.11	83
22.10.2019	21.6	23.8	NE	4.18	87
23.10.2019	19.6	22.8	NE	4.05	69
24.10.2019	19.7	28.1	NE	5.98	62
25.10.2019	20.3	26.9	NE	7.98	60
26.10.2019	20	24.6	NE	6.15	78
27.10.2019	20.4	22.4	NE	4.54	95
28.10.2019	19.9	29.0	E	5.68	80
29.10.2019	21.2	28.6	SE	3.39	84
30.10.2019	22.5	29.4	SW	4.07	70
31.10.2019	22.0	30.1	NE	3.78	66
01.11.2019	22.3	29.8	E	5.58	64
02.11.2019	23.1	28.4	SE	4.18	80
03.11.2019	22.1	27.6	NE	3.6	73

Note: Data generated by CPCB, RD, Bhopal

7. Status of Ambient Air Quality at 2 locations in Bhopal

Name of Location : A. North T.T. Nagar (Commercial)

S. No.	Date of Monitoring	Time of Monitoring	Parameters						
			PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Metals in PM_{10}		
							Pb ($\mu g/m^3$)	Ni (ng/m^3)	As (ng/m^3)
1	20.10.19 to 21.10.19	6:00AM -6:00AM	99	85	29.57	5.96	0.886	0.189	BDL
2	21.10.19 to 22.10.19	6:00AM-6:00AM	114	90	32.68	7.37	0.415	0.21	BDL
3	22.10.19 to 23.10.19	6:00AM-6:00AM	136	69	35.29	8.35	0.83	0.44	BDL
4	23.10.19 to 24.10.19	6:00AM-6:00AM	89	42	31.01	8.01	0.99	0.97	BDL
5	24.10.19 to 25.10.19	6:00AM-6:00AM	130	61	28.41	8.90	0.49	0.292	BDL
6	25.10.19 to 26.10.19	6:00AM-6:00AM	110	71	40.18	10.32	0.96	0.55	BDL
7	26.10.19 to 27.10.19	6:00AM-6:00AM	77	59	21.61	9.48	0.93	1.28	BDL
8	27.10.19 to 28.10.19	6:00AM-6:00AM	144	121	32.77	14.34	1.78	0.74	BDL
9	28.10.19 to 29.10.19	6:00AM-6:00AM	87	44	20.58	11.67	0.51	0.33	BDL
10	29.10.19 to 30.10.19	6:00AM-6:00AM	78	55	24.12	10.85	0.74	0.392	BDL
11	30.10.19 to 31.10.19	6:00AM-6:00AM	72	50	20.76	9.29	0.58	0.30	BDL
12	31.10.19 to 01.11.19	6:00AM-6:00AM	124	91	32.31	13.21	0.79	0.61	BDL
13	01.11.19 to 02.11.19	6:00AM-6:00AM	106	78	27.28	11.28	0.782	0.59	BDL
14	02.11.19 to 03.11.19	6:00AM-6:00AM	89	47	23.11	9.58	0.29	0.18	BDL
15	03.11.19 to 04.11.19	6:00AM-6:00AM	97	65	26.91	10.80	0.389	0.27	BDL
National Ambient Air Quality Standards – Industrial/Residential/Rural or other areas (24 hourly average in $\mu g/m^3$) for PM_{10}, $PM_{2.5}$, SO_2, $NO_2$and Lead. *The standard for Nickel and Arsenic are in annual arithmetic mean in ng/m^3			**PM_{10}**	**$PM_{2.5}$**	**NO_2**	**SO_2**	**Pb**	**Ni***	**As***
			100	60	80	80	1.0	20	06

All values are in 24 hours average

Name of Location : B. Nehru Nagar (Residential)

S. No.	Date of Monitoring	Time of Monitoring	Parameters						
			PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Metals in PM_{10}		
							Pb ($\mu g/m^3$)	Ni (ng/m^3)	As (ng/m^3)
1	20.10.19 to 21.10.19	6:00AM -6:00AM	77	52	16.39	5.27	0.52	0.10	BDL
2	21.10.19 to 22.10.19	6:00AM-6:00AM	92	82	18.74	6.96	0.93	0.33	0.06
3	22.10.19 to 23.10.19	6:00AM-6:00AM	79	77	25.83	6.50	0.82	0.29	BDL
4	23.10.19 to 24.10.19	6:00AM-6:00AM	62	57	22.78	6.32	0.81	0.22	BDL
5	24.10.19 to 25.10.19	6:00AM-6:00AM	94	59	24.03	7.73	0.59	0.32	BDL
6	25.10.19 to 26.10.19	6:00AM-6:00AM	82	68	17.93	6.86	0.68	0.11	BDL
7	26.10.19 to 27.10.19	6:00AM-6:00AM	79	65	16.72	5.93	1.13	0.62	BDL
8	27.10.19 to 28.10.19	6:00AM-6:00AM	156	89	24.20	12.83	1.34	0.70	BDL
9	28.10.19 to 29.10.19	6:00AM-6:00AM	105	65	21.11	10.94	0.76	0.23	BDL
10	29.10.19 to 30.10.19	6:00AM-6:00AM	80	61	19.19	5.86	0.99	0.61	BDL
11	30.10.19 to 31.10.19	6:00AM-6:00AM	77	52	17.88	5.88	0.52	0.11	BDL
12	31.10.19 to 01.11.19	6:00AM-6:00AM	114	74	32.26	7.11	0.81	0.38	BDL
13	01.11.19 to 02.11.19	6:00AM-6:00AM	96	67	23.71	6.21	0.80	0.46	BDL
14	02.11.19 to 03.11.19	6:00AM-6:00AM	76	40	20.65	6.67	0.39	0.20	BDL
15	03.11.19 to 04.11.19	6:00AM-6:00AM	92	47	22.25	7.29	0.46	0.31	BDL
National Ambient Air Quality Standards – Industrial/Residential/Rural or other areas (24 hourly average in $\mu g/m^3$) for PM_{10}, $PM_{2.5}$, SO_2, $NO_2$and Lead. *The standard for Nickel and Arsenic are in annual arithmetic mean in ng/m^3			**PM_{10}**	**$PM_{2.5}$**	**NO_2**	**SO_2**	**Pb**	**Ni***	**As***
			100	60	80	80	1.0	20	06

All values are in 24 hours average

8. Ambient air quality monitoring Results and discussions:

A. Particulate Matter (PM_{10}):

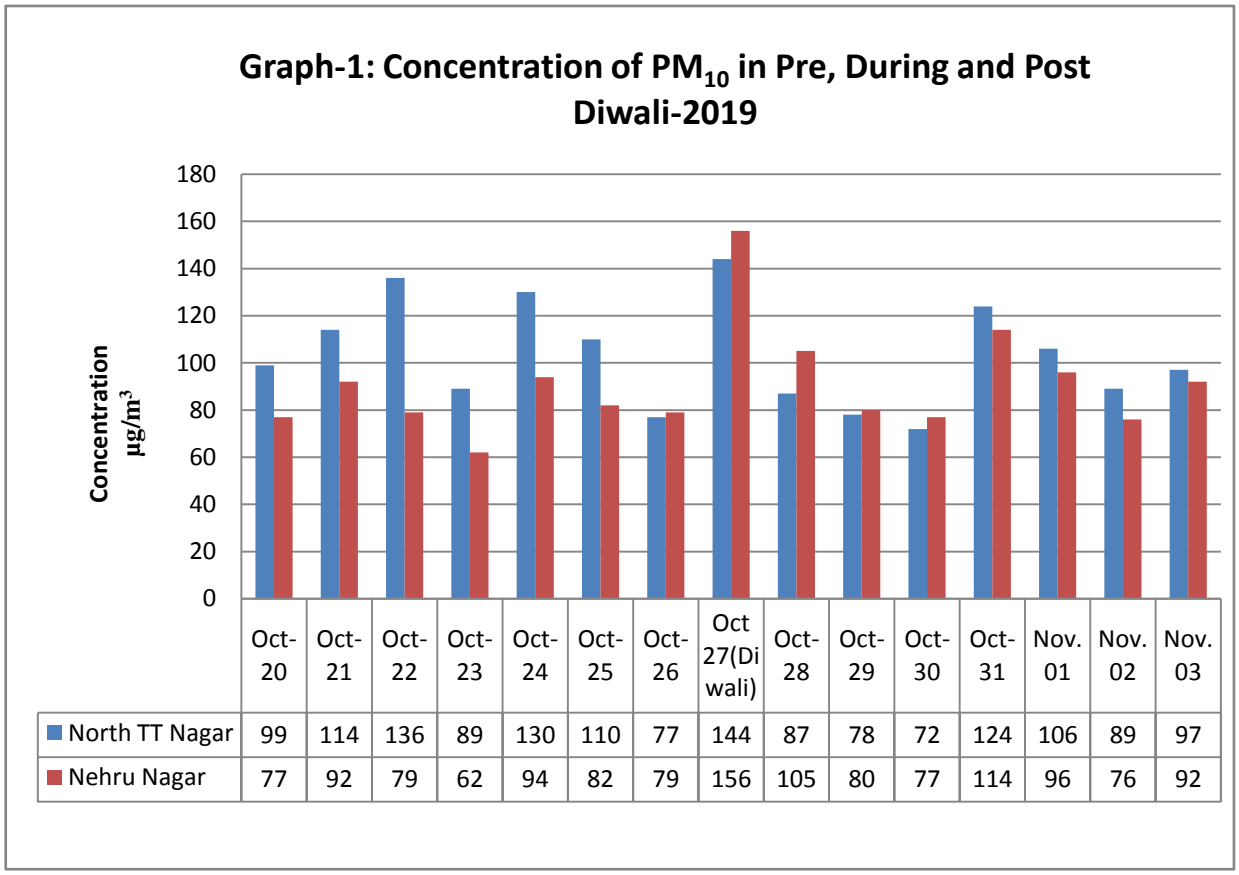
- During pre-Diwali the ambient air quality monitoring carried out from October 20th to October 26th, 2019. The minimum and maximum of PM_{10} values were detected in the range of 89 µg/m^3 to 136 µg/m^3 at North T.T. Nagar and 62 µg/m^3 to 94 µg/m^3 at Nehru Nagar respectively.

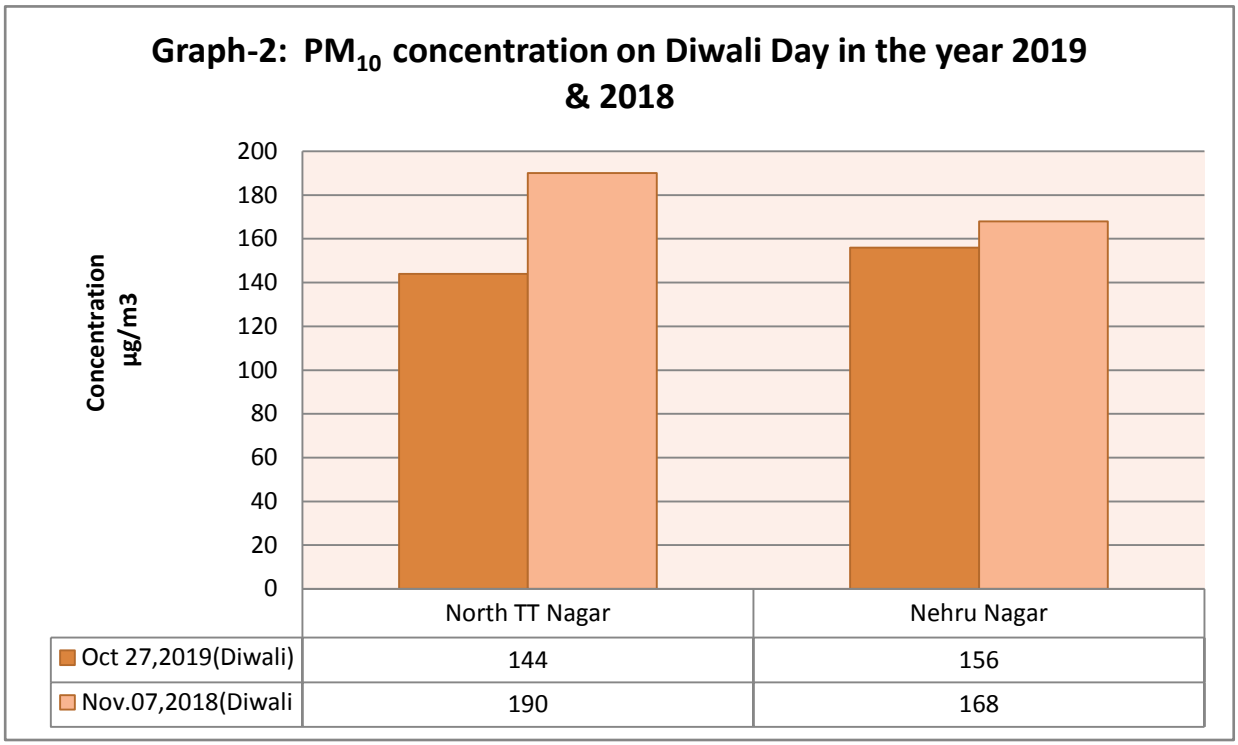
- During the Diwali Day (27.10.2019) less fire crackers bursting was observed and the PM_{10} was detected 144 µg/m^3 at North T.T Nagar and 156 µg/m^3 at Nehru Nagar.

- During post-Diwali the ambient air quality monitoring carried out from October 28th to November 4th, 2019. The PM_{10} level are decreasing from the festival day and the minimum and maximum PM_{10} values were detected in the range of 72 µg/m^3 & 124 µg/m^3 at North T.T. Nagar and 76 µg/m^3 & 114 µg/m^3 at Nehru Nagar respectively.

- The concentrations of PM_{10} is exceeding total 7 days out of 15 monitoring days at North T.T. Nagar and total 3 days exceeding out of 15 days monitoring at Nehru Nagar. The average PM_{10} concentrations are shown below in the graph no.1.

- The average concentration of PM_{10} was observed low on Diwali Day (2019) as compare to Diwali Day (2018) on both the locations. The concentration was detected at North T.T. Nagar on Diwali Day (2019) i.e. 144 µg/m^3 and at Nehru Nagar i.e. 156 µg/m3 which is low concentration from the Diwali Day (2018) i.e. 190 µg/m^3 and 168 µg/m^3 respectively. The level of PM_{10} found in 2019 & 2018 are shown in graph no. 2.


Graph-1: Concentration of PM10 in Pre, During and Post Diwali-2019
Concentration µg/m3
180
160
140
120
100
80
60
40
20
0
Oct-20 Oct-21 Oct-22 Oct-23 Oct-24 Oct-25 Oct-26 Oct 27(Diwali) Oct-28 Oct-29 Oct-30 Oct-31 Nov. 01 Nov. 02 Nov. 03
North TT Nagar 99 114 136 89 130 110 77 144 87 78 72 124 106 89 97
Nehru Nagar 77 92 79 62 94 82 79 156 105 80 77 114 96 76 92

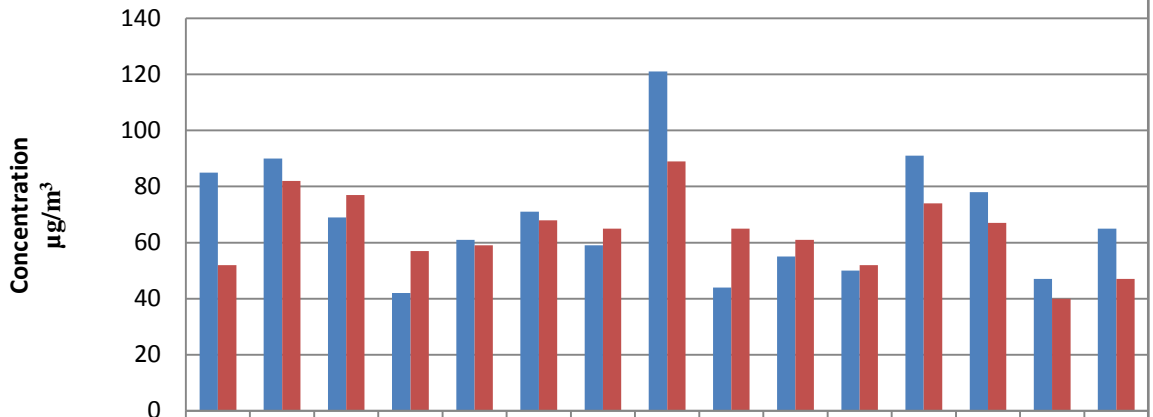

Graph-2: PM10 concentration on Diwali Day in the year 2019 & 2018
Concentration µg/m3
200
180
160
140
120
100
80
60
40
20
0
North TT Nagar Nehru Nagar
Oct 27,2019(Diwali) 144 156
Nov.07,2018(Diwali 190 168

B. Particulate Matter ($PM_{2.5}$):

- During pre-Diwali the ambient air quality monitoring carried out from October 20th to October 26th, 2019. The minimum and maximum $PM_{2.5}$ values were detected at North T.T. Nagar i.e. 42 µg/m^3 and 90 µg/m^3. The minimum and maximum $PM_{2.5}$ values observed at Nehru Nagar i.e 52 µg/m^3 and 82 µg/m^3 respectively.

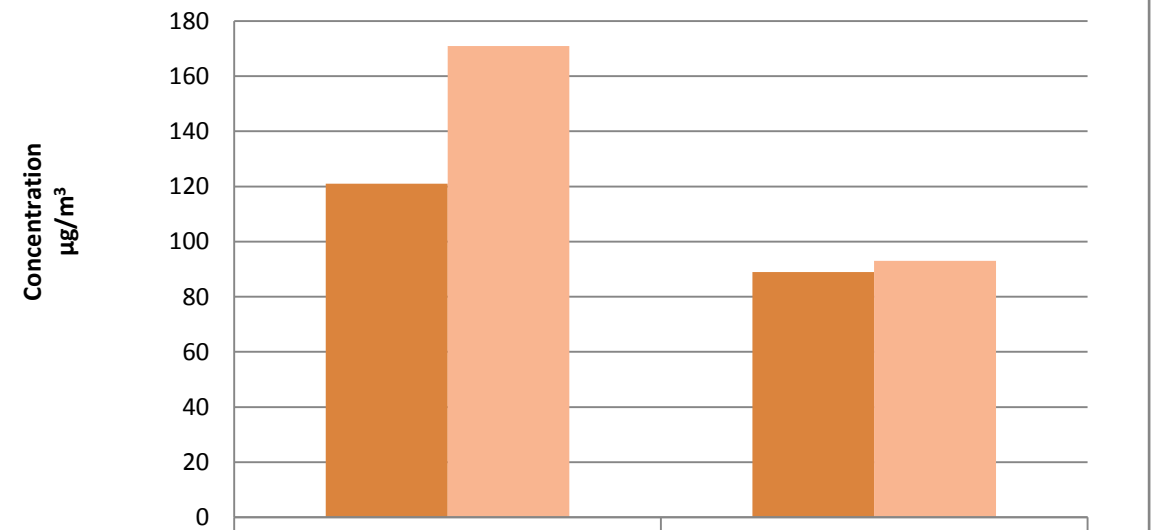
- During the Diwali Day (27.10.2019) less fire crackers bursting was observed. The $PM_{2.5}$ was detected at North T.T Nagar- 121 µg/m^3 and at Nehru Nagar 89 µg/m^3.
- During the post-Diwali ambient air quality monitoring was carried out from October 28th to November 4th, 2019. The $PM_{2.5}$ levels are decreasing from the festival day and the minimum and maximum $PM_{2.5}$ values detected at North T.T. Nagar- 44 µg/m^3 and 91 µg/m^3. The minimum and maximum $PM_{2.5}$ values detected at Nehru Nagar - 40 µg/m^3 and 74 µg/m^3 respectively.
- The concentrations of $PM_{2.5}$ is exceeding total 9 days out of 15 monitoring days at North T.T. Nagar and total 9 days exceeding out of 15 days monitoring at Nehru Nagar. The average $PM_{2.5}$ concentrations are shown below in the Graph no.3.
- The average concentration of $PM_{2.5}$ was detected low on Diwali Day (2019) as compare to Diwali Day (2018) on both the locations. The concentration was detected at North T.T. Nagar on Diwali Day (2019) i.e. 121 µg/m^3 and at Nehru Nagar i.e. 89 µg/m^3 and the concentration was observed on Diwali Day (2018) i.e. 171 µg/m^3 and 93 µg/m^3 at North T.T. Nagar and Nehru Nagar respectively. The level of $PM_{2.5}$ found in 2019 & 2018 are shown in Graph no. 4.

Graph-3: Concentration of $PM_{2.5}$ in Pre, During and Post Diwali-2019



	Oct-20	Oct-21	Oct-22	Oct-23	Oct-24	Oct-25	Oct-26	Oct 27(Diwali)	Oct-28	Oct-29	Oct-30	Oct-31	Nov .01	Nov .02	Nov .03
North TT Nagar	85	90	69	42	61	71	59	121	44	55	50	91	78	47	65
Nehru Nagar	52	82	77	57	59	68	65	89	65	61	52	74	67	40	47

Graph-4: $PM_{2.5}$ concentration on Diwali Day in the year 2019 & 2018



	North TT Nagar	Nehru Nagar
Oct 27,2019(Diwali)	121	89
Nov.07,2018(Diwali	171	93

C. Nitrogen Dioxide (NO_2):

- During pre-Diwali monitoring (October 20th to October26th, 2019) analysis result of NO_2 concentration was detected in the range of 21.61 µg/m^3 - 40.18 µg/m^3 at North T.T. Nagar and at Nehru Nagar the concentration was detected in the range of 16.39 µg/m^3 - 25.83 µg/m^3.

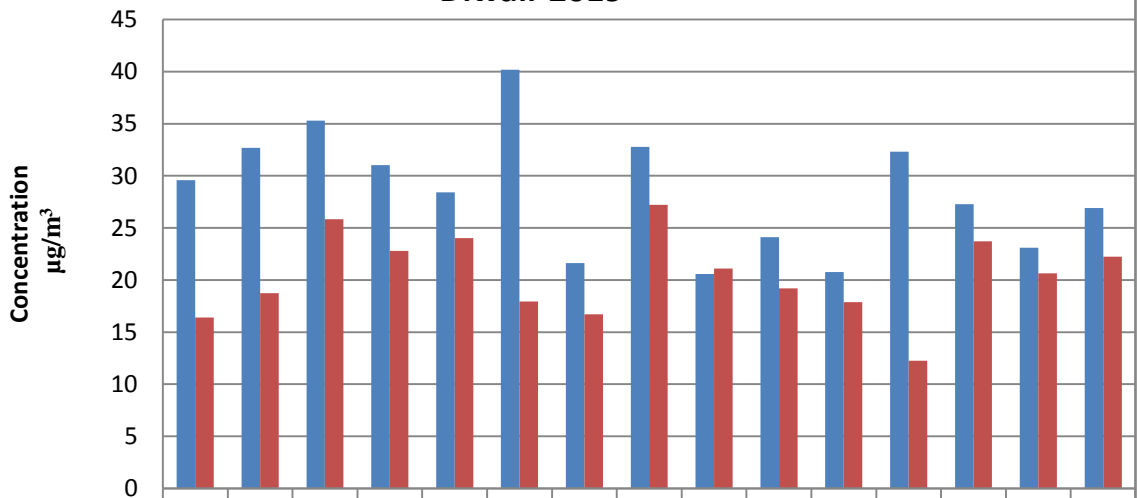
- During the Diwali Day (27.10.2019) the average concentration of NO_2 was detected on Diwali Day i.e. 32.77 µg/m^3 and 27.20 µg/m^3 at North T.T. Nagar and Nehru Nagar respectively.

- During the post-Diwali monitoring (October 28th to November 4th, 2019) the concentration of NO_2 levels are decreased from the festival day. The concentration of NO_2 was detected in the range of 20.58 µg/m^3 - 32.31 µg/m^3 at North T.T. Nagar and at Nehru Nagar concentration was observed in the range of 17.88 µg/m^3 - 32.26 µg/m^3.

- All the NO_2 values during pre, on & post Diwali are within the national ambient air quality standards (24 hours average).The NO_2 concentrations during pre- Diwali, on Diwali and post Diwali of both the locations are shown below in the Graph no.5.

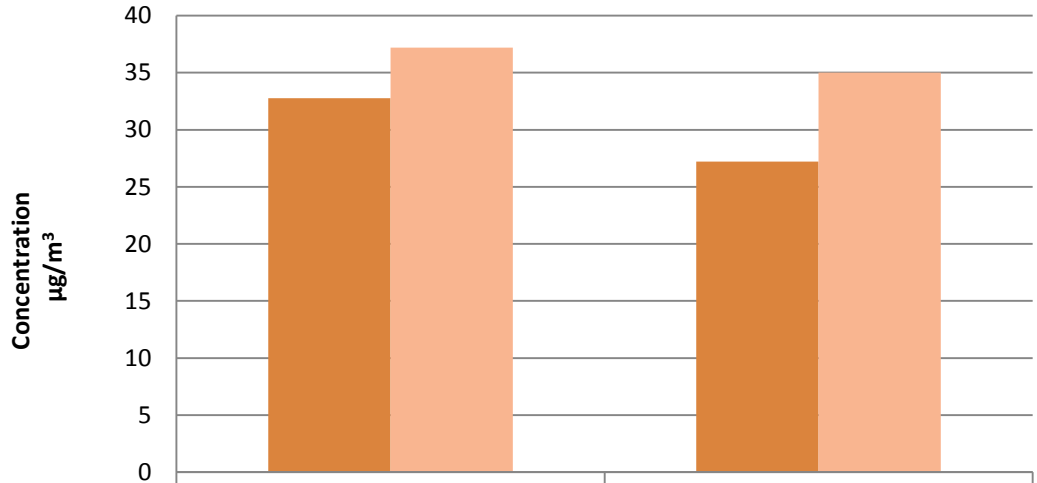
- The average concentration of NO_2 was detected low on Diwali Day (2019) as compare to Diwali Day (2018) on both the locations. The concentration was detected at North T.T. Nagar on Diwali Day (2019) i.e. 32.77 µg/m^3 and at Nehru Nagar i.e. 27.20 µg/m^3 which is low concentration from the Diwali Day (2018)) i.e. 37.2 µg/m^3 and 35.0 µg/m^3 respectively. The level of NO_2 detected in 2019 & 2018 are shown in Graph no. 6.

Graph-5: Concentration of NO_2 in Pre, During and Post Diwali-2019



	Oct-20	Oct-21	Oct-22	Oct-23	Oct-24	Oct-25	Oct-26	Oct 27(Diwali)	Oct-28	Oct-29	Oct-30	Oct-31	Nov. 01	Nov. 02	Nov. 03
North TT Nagar	29.5	32.6	35.2	31.0	28.4	40.1	21.6	32.7	20.5	24.1	20.7	32.3	27.2	23.1	26.9
Nehru Nagar	16.3	18.7	25.8	22.7	24.0	17.9	16.7	27.2	21.1	19.1	17.8	12.2	23.7	20.6	22.2

Graph-6: NO_2 concentration on Diwali Day in the year 2019 & 2018



	North TT Nagar	Nehru Nagar
Oct 27,2019(Diwali)	32.77	27.2
Nov.07,2018(Diwali	37.2	35

D. Sulphur Dioxide (SO_2):

- The monitoring is carried out from pre-Diwali (October 20th to October 26th, 2019) During Diwali (October 27th) and post Diwali (October 28th to November 4th, 2019). During pre-Diwali the concentration of SO_2 was detected in the range of 5.96 µg/m^3 – 10.32 µg/m^3 at North T.T. Nagar and at Nehru Nagar the concentration of SO_2 was detected in the range of 5.27 µg/m^3 – 7.73 µg/m^3.

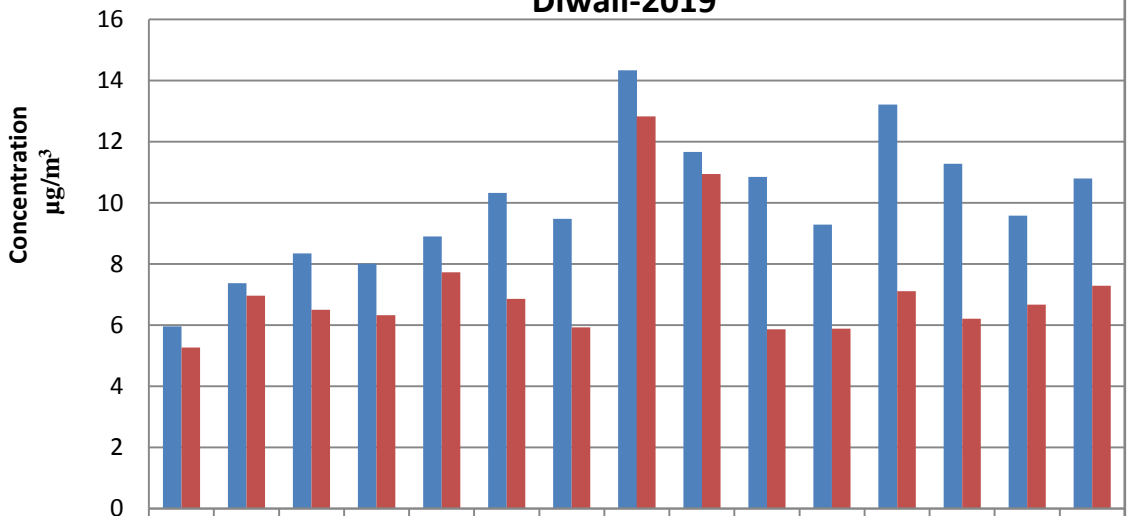
- The maximum concentration of SO_2 was detected on Diwali day during evening time (10:00 PM – 02:00AM) at North T.T. Nagar i.e. 25.17 µg/m^3 and at Nehru Nagar the concentration was detected as 27.80 µg/m^3 due to bursting of fire crackers.

- During the post-Diwali day the level of SO_2 was decreased and reached almost pre-Diwali concentrations. The concentration detected at North T.T. Nagar in between 9.29 µg/m^3-13.21 µg/m^3 and at Nehru Nagar the concentration of SO_2 was detected in the range of 5.86 µg/m^3 - 10.94 µg/m^3.

- All the SO_2 concentration pre Diwali, on Diwali & post Diwali are within the National Ambient Air Quality Standards. The SO_2 concentrations are shown below in the Graph no.7.

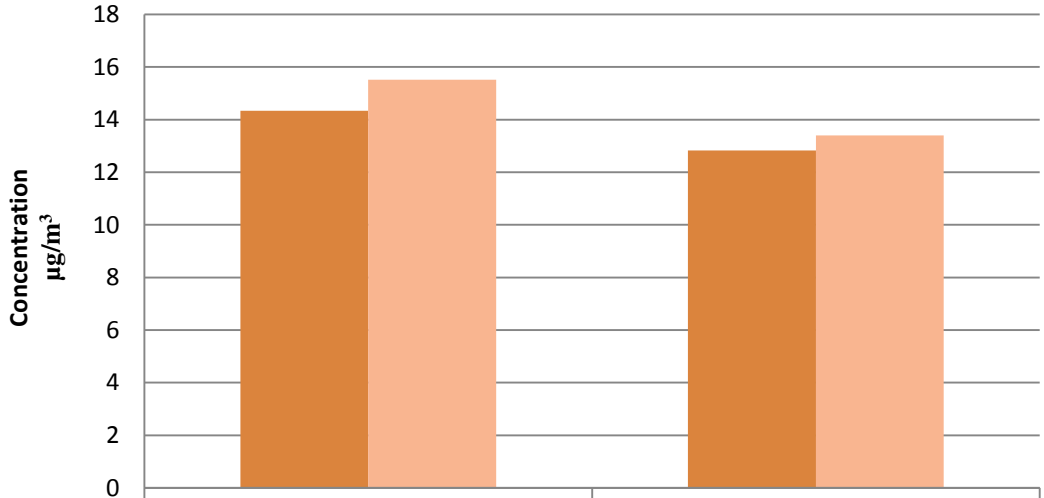
- The average concentration of SO_2 was detected low on Diwali Day (2019) as compared to Diwali Day (2018) on both the locations. The concentration was detected at North T.T. Nagar on Diwali Day (2019) i.e. 14.34 µg/m^3 and at Nehru Nagar 12.83 µg/m^3 which was low as compare to Diwali Day (2018). The level of SO_2 detected in 2019 & 2018 are shown in Graph no. 8.

Graph-7: Concentration of SO_2 in Pre, During and Post Diwali-2019



	Oct-20	Oct-21	Oct-22	Oct-23	Oct-24	Oct-25	Oct-26	Oct 27(Diwali)	Oct-28	Oct-29	Oct-30	Oct-31	Nov. 01	Nov. 02	Nov. 03
North TT Nagar	5.96	7.37	8.35	8.01	8.9	10.3	9.48	14.3	11.6	10.8	9.29	13.2	11.2	9.58	10.8
Nehru Nagar	5.27	6.96	6.5	6.32	7.73	6.86	5.93	12.8	10.9	5.86	5.88	7.11	6.21	6.67	7.29

Graph-8: SO_2 concentration on Diwali Day in the year 2019 & 2018



	North TT Nagar	Nehru Nagar
Oct 27,2019(Diwali)	14.34	12.83
Nov.07,2018(Diwali	15.52	13.4

E. Heavy Metals:

- During pre-Diwali monitoring (October 20th to October 26th, 2019) the selected heavy metals in PM_{10} filters i.e. Pb, Ni and As analyzed. The lead was detected in the range of 0.99 µg/m^3 – 0.415 µg/m^3, Nickel was detected in the range of 0.189 ng/m^3-1.28 ng/m^3 and Arsenic was found below detectable limit at North T.T. Nagar. The concentration of lead was detected in the range of 0.52 µg/m^3 - 1.13 µg/m^3, Nickel was detected in the range of 0.1 ng/m^3- 0.62 ng/m^3 and Arsenic was found BDL - 0.06 ng/m^3 at Nehru Nagar.

- During the Diwali Day the concentration of heavy metals were detected at North T.T. Nagar Pb - 1.78 µg/m^3, Ni - 0.74 ng/m^3 and As – BDL. The concentrations of heavy metals were detected at Nehru Nagar Pb - 1.34 µg/m^3, Ni - 0.70 ng/m^3 and Arsenic found below detectable limit. During the Diwali day the less fire crackers bursting and drizzling rain was observed.

- During the post Diwali the lead was detected in the range of 0.29 µg/m^3 – 0.79 µg/m^3, Nickel was detected in the range of 0.18 ng/m^3-0.61 ng/m^3 and Arsenic was found below detectable limit at North T.T. Nagar. The concentration of lead was detected in the range of 0.39 µg/m^3 - 0.99 µg/m^3, Nickel was detected in the range of 0.11 ng/m^3-0.61 ng/m^3 and Arsenic was found below detectable limit at Nehru Nagar.

- All the heavy metals values during pre, on & post Diwali are found within the National Ambient Air Quality Standards (24 hours average) except lead. The values of lead found above the prescribed standard on Diwali day at both locations.

- The metals derived from roadside dust and soil is another potential source of heavy metals. Prior to ban of lead in gasoline, vehicles were the major source of lead so lead may be legacy pollutant in environment. Strontium, Barium etc. are elements that are create coloring effects red, green respectively. Heavy metal analysis in $PM_{2.5}$ is being done by the HO laboratory.

9. Air Quality Index:

Air Quality Index is a tool for effective communication of air quality status to people which is easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and color. There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of these categories is based on ambient concentration values of air pollutants and their likely health impacts. The AQI of the normal day, Diwali day and post Diwali day are given below:

Air Quality Index	Pollution Category	Related Health Impact
0-50	Good	Minimal Impact.
51-100	Satisfactory	May cause minor breathing discomfort to sensitive people.
101-200	Moderate	May cause breathing discomfort to people with lung diseases such as Asthma and discomfort to people with heart disease Children and older adults.
201-300	Poor	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart diseases.
301-400	Very Poor	May cause respiratory illness to the people on prolonged exposure. Effect may be more prolonged exposure in people with lung and heart disease.
>401	Severe	May cause respiratory effects even on healthy people and serious health effect on people with lung/heart diseases.

9.1 Air Quality Index of pre Diwali day, during Diwali day and post Diwali day are as given below:

Date	Location					
	North T.T. Nagar			Nehru Nagar		
	AQI	Category	Prominent Parameter	AQI	Category	Prominent Parameter
20.10.2019	182.84	MODERATE	PM $_{10}$, $PM_{2.5}$	86.47	SATISFACTORY	PM $_{10}$,$PM_{2.5}$
21.10.2019	199.89	MODERATE	PM $_{10}$, $PM_{2.5}$	172.61	MODERATE	PM $_{10}$, $PM_{2.5}$
22.10.2019	128.28	MODERATE	PM $_{10}$, $PM_{2.5}$	155.56	MODERATE	PM $_{10}$, $PM_{2.5}$
23.10.2019	89.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	94.91	SATISFACTORY	PM $_{10}$, $PM_{2.5}$
24.10.2019	120.14	MODERATE	PM $_{10}$, $PM_{2.5}$	98.29	SATISFACTORY	PM $_{10}$, $PM_{2.5}$
25.10.2019	135.10	MODERATE	PM $_{10}$, $PM_{2.5}$	124.87	MODERATE	PM $_{10}$, $PM_{2.5}$
26.10.2019	98.29	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	114.64	MODERATE	PM $_{10}$, $PM_{2.5}$
27.10.2019 Diwali	301.00	POOR	PM $_{10}$, $PM_{2.5}$	196.48	MODERATE	PM $_{10}$, $PM_{2.5}$
28.10.2019	87.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	114.64	MODERATE	PM $_{10}$, $PM_{2.5}$
29.10.2019	91.54	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	101.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$
30.10.2019	83.09	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	86.47	SATISFACTORY	PM $_{10}$, $PM_{2.5}$
31.10.2019	201.00	MODERATE	PM $_{10}$, $PM_{2.5}$	145.33	MODERATE	PM $_{10}$, $PM_{2.5}$
01.11.2019	158.97	MODERATE	PM $_{10}$, $PM_{2.5}$	121.46	MODERATE	PM $_{10}$, $PM_{2.5}$
02.11.2019	89.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$	76.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$
03.11.2019	114.64	MODERATE	PM $_{10}$, $PM_{2.5}$	92.00	SATISFACTORY	PM $_{10}$, $PM_{2.5}$

- $PM_{10}$and $PM_{2.5}$ was found prominent parameter out of monitored 4 parameters i.e. PM_{10}, $PM_{2.5}$, SO_2 & NO_2.
- The AQI values were found during the pre Diwali in the range of 89.00 – 199.89 at North T.T. Nagar and 86.7 - 172.61 at Nehru Nagar.
- The air quality index on Diwali Day was found poor i.e. 301 at North T.T. Nagar and at Nehru Nagar was found moderate i.e. 196.48.
- The AQI values found during post Diwali in the range of 83.09 – 201.0 at North T.T. Nagar and 76 – 145.33 at Nehru Nagar.
- The AQI is found less than the last year due to less use of fire crackers by the people on Diwali day because continuous awareness programs conducted by the CPCB , SPCB and state government agencies.
- It was also observed that few types of green crackers were found in the market which may also contributed some extent for reduction of pollution on Diwali day. The drizzling rain was also observed during festival night.

10. Monitoring of Ambient Noise levels:

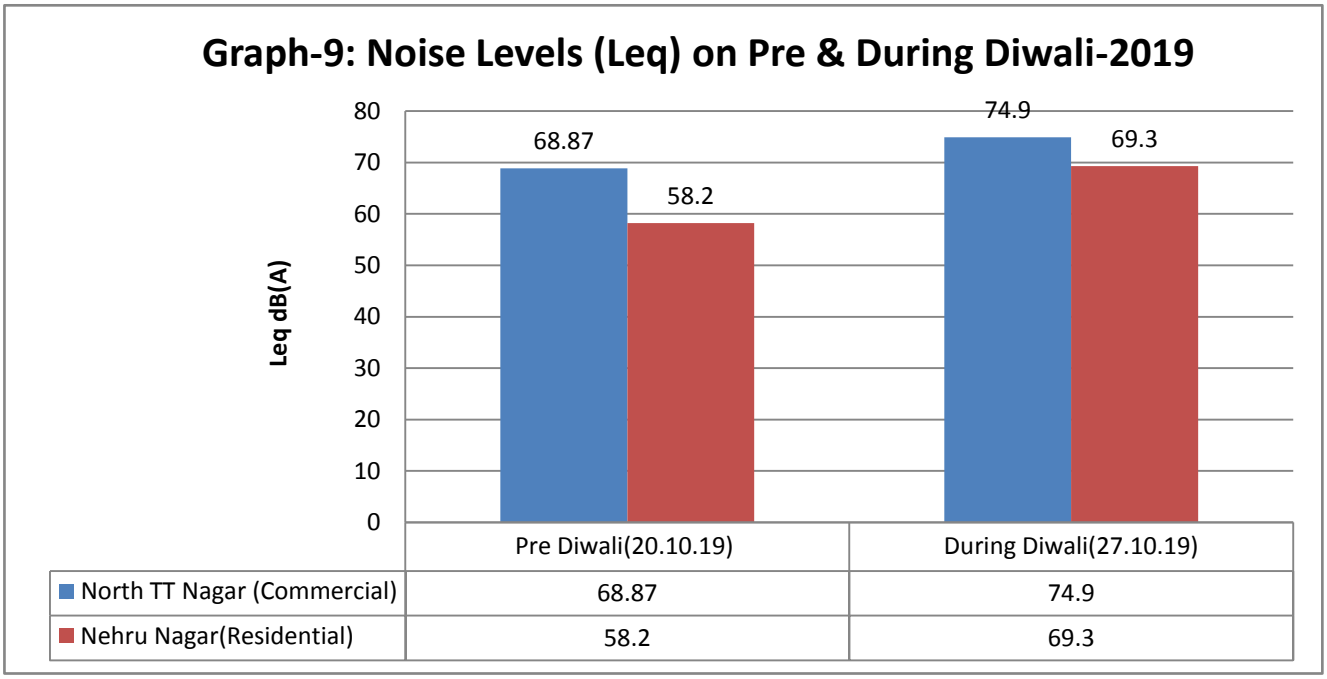
The sound which pleases the listeners is music whereas which causes pain and annoyance is termed as noise. Noise is generally defined as the undesirable sound. We can measure individual sounds that may damage human hearing, but it is difficult to monitor cumulative exposure to noise. The effect of noise pollution is multifaceted and inter related can lead to decrease in work efficiency, lack of concentration, fatigue, increase in blood pressure, temporary deafness, even could lead to abortion etc. Noise is measured in decibels dB (A). 'A' symbol indicates a measurement of a logarithmic scale.

The objective of this monitoring is to assess the problem being faced by the residents when the noise level in their surroundings exceeds the permissible limit especially at Diwali due to bursting of fire crackers.

The noise level measurement during before and on Diwali day was carried out using Delta OHM HD2110Linstrument. Monitoring was carried out from 18.00hrs to 24.00hrs as per the prescribed protocol for L_{eq}, L_{min}, L_{max}, L_{50}& L_{90} parameters.

Location	Time Duration	Pre Diwali (21.10.2019)					During Diwali (27.10.2019)				
		L50	L90	Lmin	Lmax	Leq	L50	L90	Lmin	Lmax	Leq
North T.T. Nagar (Commercial)	18:00hrs-19:00hrs	69.2	66.0	62.4	88.9	71.8	67.2	64.1	61.7	101.7	72.4
	19:00hrs-20:00hrs	67.9	63.3	53.3	81.9	68.5	66.9	63.5	60.6	91.4	71.5
	20:00hrs-21:00hrs	65.4	63.7	58.5	85.9	69.5	66.4	63.1	60.7	94.3	71.8
	21:00hrs-22:00hrs	65.0	63.0	60.0	85.7	68.2	66.8	63.1	60.7	104.6	79.6
	22:00hrs-23:00hrs	64.3	61.6	58.4	90.9	66.6	65.7	61.8	59.0	97.7	74.7
	23:00hrs-24:00hrs	58.4	56.6	49.8	85.7	66.0	64.2	59.6	54.8	102.0	72.6
	Average(18:00hrs-24:00hrs)					**68.87**	**Average (18:00hrs-24:00hrs)**				**74.90**
Nehru Nagar (Residential)	18:00hrs-19:00hrs	63.8	60.1	50.3	80.2	60.8	64.0	63.1	45.9	87.9	64.3
	19:00hrs-20:00hrs	51.9	47.7	44.2	79.3	59.3	52.0	51.2	44.5	92.3	64.6
	20:00hrs-21:00hrs	59.6	54.5	47.4	84.7	59.6	52.0	50.2	46.6	95.1	68.4
	21:00hrs-22:00hrs	54.5	50.2	48.6	80.6	58.0	69.5	67.2	45.8	100.1	72.4
	22:00hrs-23:00hrs	63.9	60.7	40.6	76.8	54.9	66.0	59.2	55.5	98.4	72.1
	23:00hrs-24:00hrs	45.8	39.0	38.3	77.9	49.8	54.1	54.6	48.7	88.9	66.7
	Average (18:00hrs-24:00hrs)					**58.20**	**Average (18:00hrs-24:00hrs)**				**69.3**

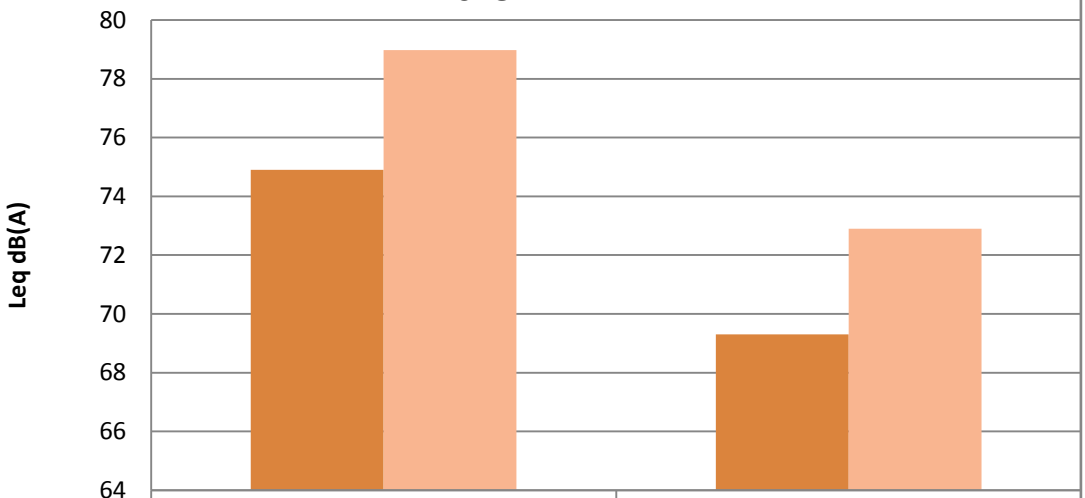
Graph-9: Noise Levels (Leq) on Pre & During Diwali-2019



Note:

1. All the above noise values are in dB (A).
2. Noise limits in Residential area in Leq dB(A)—day:55, Night:45
3. Noise limits in commercial area in Leq dB(A)—day:65, Night:55

Graph-10: Noise Lavel (Leq) on Diwali Day in the year 2019 & 2018



	North TT Nagar	Nehru Nagar
Oct 27,2019(Diwali)	74.9	69.3
Nov.07,2018(Diwali	78.98	72.9

10.1 Noise monitoring Results and discussions:

- During pre-Diwali and during Diwali the noise level monitoring was carried out from (18:00 hrs to 24.00) hrs at North T.T. Nagar and Nehru Nagar locations. During pre-Diwali (21.10.2019) the maximum sound level was found during 22:00 hrs to 23:00 hrs at North T.T. Nagar i.e. 90.9 dB (A) and in the Nehru Nagar the maximum sound level was found during 20:00 hrs to 21:00 hrs i.e. 84.7 dB (A).

- The average Leq values on pre-Diwali day was observed at North T.T. Nagar i.e. 68.87 dB (A) and at Nehru Nagar 58.18 dB (A).

- On the Diwali day (27.10.2019) due to bursting of fire crackers the maximum sound level was observed during 21:00 hrs to 22:00 hrs on both the locations North T.T. Nagar and Nehru Nagar i.e. 104.6 dB(A) and 100.1 dB(A) respectively.

- Due to bursting of fire crackers the average Leq value was found on Diwali day at North T.T. Nagar (Commercial) i.e. 74.90 dB (A) and at Nehru Nagar (Residential) i.e. . 69.3 dB (A) that is above the prescribed limit.

- The average noise level was detected low on Diwali Day (2019) as compare to Diwali Day (2018) on both the locations due to less bursting fire crackers. The average Leq was detected at North T.T. Nagar on Diwali Day (2019) and Diwali Day (2018) are shown in Graph no. 10.

10.2 Noise Level Meter Calibration Result

Location	Calibration Result	Date				Instrument Make & Model
		21.10.2019		27.10.2019		
		94 dB at 1000 Hz	114 dB at 1000Hz	94 dB at 1000 Hz	114 dB at 1000Hz	
North T.T. Nagar	Initial	94.0	114.0	94.0	114.0	Delta QHM & HD2110L (3)
	Final	93.9	113.9	93.9	113.8	
Nehru Nagar	Initial	93.9	113.9	93.9	114.0	Delta QHM & HD2110L (4)
	Final	93.9	113.8	93.9	113.9	

11. Observations:

1. During Diwali monitoring i.e. October 20th – November 3rd , 2019 the temperature varies from 19.6^{o}C to 30.1^{o}C, wind velocity recorded in the range of 3.39 KM/hrs – 7.98 KM/hrs. The prominent wind direction was observed North East (NE) and relative humidity recorded in the range of 60% – 95 % during monitoring period.

2. Due to humid weather and poor wind velocity the mixing height was dropped. As on the day of Diwali fire crackers bursting was observed minimal level in comparison of 2018. Due to increase public awareness, rain and meteorological conditions create the atmosphere stable, that resulted in decrease concentration of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and heavy metals in comparison to 2018 monitoring results and Particulate Matter 10

& 2.5 level are found above the limit from the standard during the festival day.

3. Civil construction, vehicular movement, traffic jam, azan, crackers and playing dhol-nagada during festival are the main attributes responsible for the high noise level. The attraction of customers towards the crackers has played a significant nuisance in noise level and ambient air quality deterioration

12. Mass Awareness Activities during Diwali 2019

Generally it is observed that during the fire crackers bursting the ambient noise and air quality levels were found above the prescribed limits during Diwali festival. As per the direction of the Hon'ble Supreme Court the state and central Governments have to give wide publicity to stop the bursting of fire crackers upto 10:00 PM and ill effects of fireworks. To encourage teachers for convincing their students, local people about the bad effects of fire crackers, schools where given priority for mass awareness.

In compliance of the above, CPCB Regional Directorate Bhopal has conducted various programs during October 11 -15, 2019 to create awareness among public and to give wide publicity on ill-effects of fire crackers. Efforts were made by the office to educate and sensitize the children, parents; public that sound and air pollution harm their health.

Under the mass awareness programme various activities i.e. demonstration of PM_{10} sampler, $PM_{2.5}$ sampler, handy sampler & noise level meter and environmental quiz among the school children have been organized to deliver the message of Eco-friendly Diwali. Mass awareness programme were organised in school namely Govt Chandrashekhar Azad High School, Govt Kashturba Girls Higher Secondary School, Govt. Sardar Patel Naveen High School, Punchsheel Nagar and Govt Sanjay Gandhi Middle School, Shivaji Nagar at Bhopal. The photographs are shown below.

PHOTOGRAPHS OF MASS AWARENESS ACTIVITY

Govt. Sardar Patel Naveen High School, Punchsheel Nagar Bhopa

PHOTOGRAPHS OF MASS AWARENESS ACTIVITY

Govt. Sanjay Gandhi High School, Shivaji Nagar, Bhopal

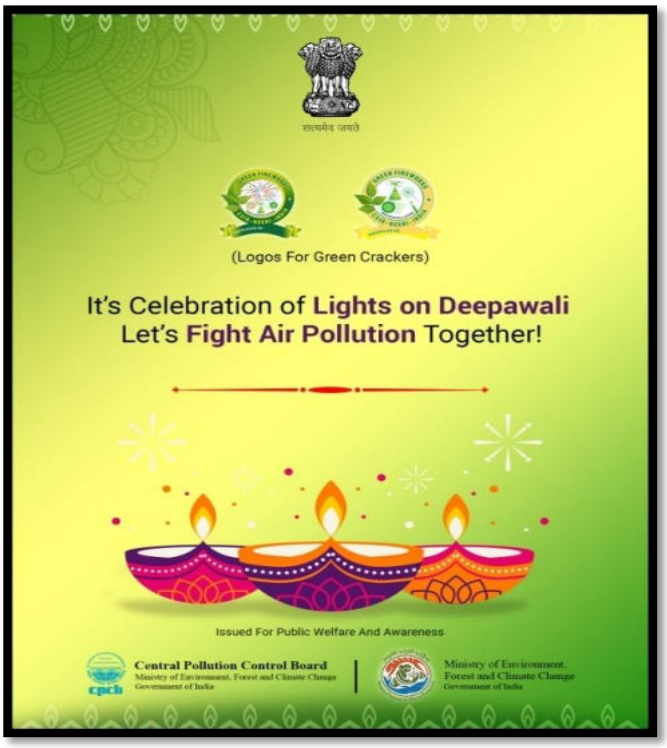
PHOTOGRAPHS OF MASS AWARENESS ACTIVITY

Govt. Kashturba Girls Higher Secondary School, North TT Nagar, Bhopal

PHOTOGRAPHS OF MASS AWARENESS ACTIVITY

Govt. Chandra Shekhar Azad Middle School, North TT Nagar, Bhopal

13. **Newspaper advertisement** : In addition to local awareness programme print media was observed for advertisement was also released on behalf of CPCB & MoEF&CC to make Eco-friendly Diwali in color format in leading Hindi Newspaper "Dainik Bhaskar" and English Newspaper "The Times of India" edition in Bhopal (MP), Jaipur (Rajasthan) & Raipur (Chhattisgarh) on 27.10.2019 (Diwali Day). The Regional Directorate, Bhopal is continuously making efforts to ensure that people enjoy a safe Diwali through awareness programme and inspiring and motivated the students not to burn firecrackers for safety of environment & health.



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