

**REPORT ON MONITORING OF
AMBIENT AIR QUALITY & NOISE LEVELS
AT BHOPAL DURING DIWALI FESTIVAL 2017**



**Central Pollution Control Board
Regional Directorate
Bhopal**



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Regional Directorate, Bhopal

Report on monitoring of Ambient Air Quality & Noise Levels
at Bhopal during Diwali Festival 2017

1. Back Ground: Diwali is one of the most famous and significant festival celebrated in India. The spiritual significance of Diwali indicates the victory of light (God) over darkness (evil power). This festival starts with Dhanteras followed by Chhoti Diwali and then main Diwali. It is also called as festival of lights and people of all age groups celebrate it with great joy and enthusiasm.

2. About Bhopal City & Climate: Bhopal, capital city of state Madhya Pradesh has population of 1,995,648 as per the census 2011 spread in the municipal area of 648.24 KM². 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 (i.e. Mandideep industrial area, Govindpura industrial area) projects are in greater swing. This city is well known as 'City of lakes' because of the number of ponds and lakes.

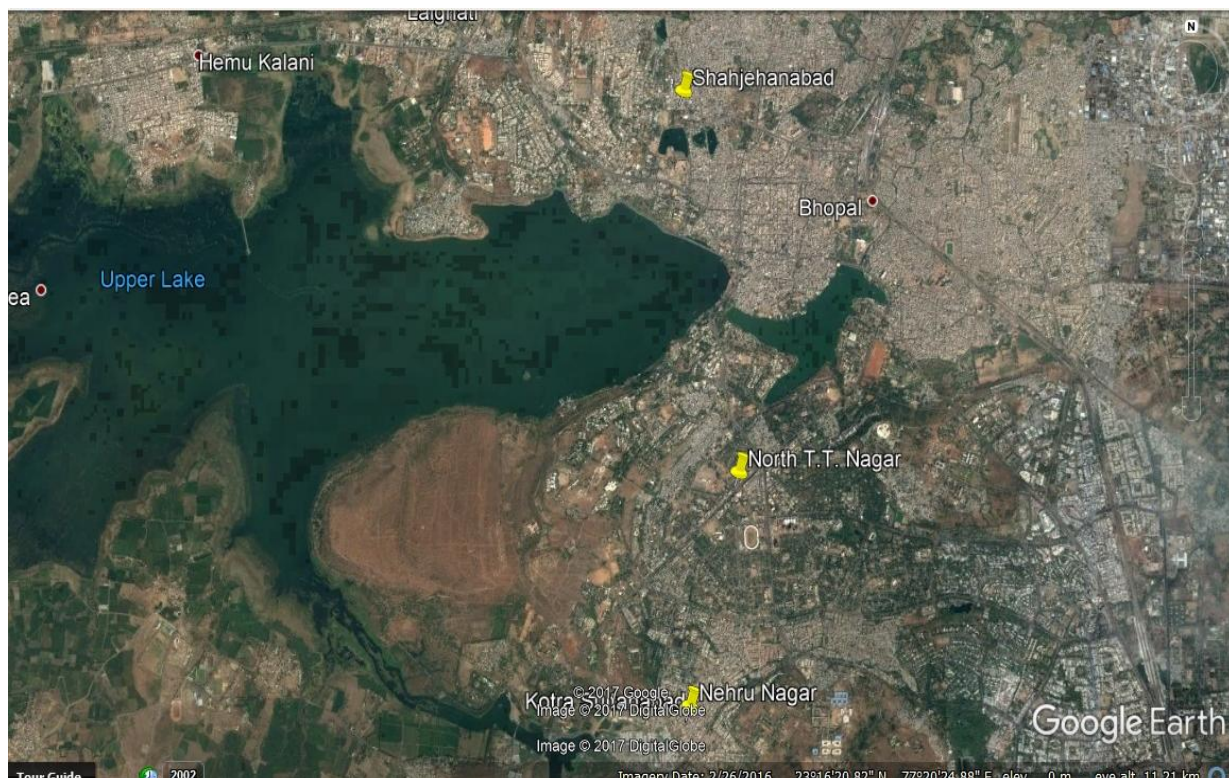
Bhopal has a humid subtropical climate, with cool, dry winters, a hot summer and a humid monsoon. Summer season starts in late March and ends till mid-June, the average temperature being around 33°C in the peak of summer in May and the higher temperature exceeds 40°C. The monsoon starts in June and ends in late September. The average temperature is around 27°C and the humidity is moderate. Temperature rises again in last part of October when winter starts, which lasts up to early March. Winters in Bhopal are cool, sunny and comfortable.

3. Ambient Air quality & Noise level monitoring: With reference to CPCB Head Office letter no A-21016/1/08-Mon/283 dated 21.09.2017, Regional Directorate (Central), Central Pollution Control Board, Bhopal has Conducted Ambient Air & Noise level monitoring in Bhopal city during celebration of Diwali festival in the year 2017 (pre-Diwali on 12.10.2017, on Diwali on 19.10.2017 & post Diwali on 22.10.2017) to record the impact of bursting of crackers on environment. Intensive Ambient Air Quality and Ambient Noise level monitoring was conducted at selected three locations in the city. Ambient air quality monitored for 24 hours (6AM- 6AM) where as ambient noise levels monitored for 6 hours (6 PM-12mid 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 crackers on Ambient Noise level. PM₁₀, SO₂ and NO₂ monitored during pre diwali and on diwali. In addition to PM₁₀, SO₂ and NO₂. PM_{2.5} is also monitored during post diwali day.

3.1 Monitoring locations and its co-ordinates: Ambient air quality & noise level monitoring was carried out before Diwali, on- Diwali and post Diwali day as per the protocol received from Head Office at the following 03 locations in Bhopal city.

Name of the monitoring location	Description of location	Latitude & Longitude	Activities around locations
Nehru Nagar	Residential	23°12.966"N 77°23.578"E	Bursting of crackers & road sweeping
North TT Nagar	Commercial	23°14.136"N 77°23.889"E	Vehicle movement, commercial activities and bursting of crackers
Shahjahanabad	Residential	23°16.093"N 77°23.560"E	Vehicle movement, and bursting of crackers

3.2 Google Map showing the monitoring locations:



3.3 Meteorological data during Diwali monitoring:

Date	Temperature (°C)		Prominent Wind direction & wind speed	Humidity (%)	Rainfall
	Min.	Max.			
12.10.2017 (Pre- Diwali)	21	33	NW, 4.3 KM/h	44.5	Minor Drizzling was observed during 3 PM to 3.10 PM on Oct 12 th & no rainfall on 19 th & 22 nd Oct 2017.
19.10.2017 (On Diwali)	21	30	NW, 3.6 KM/h	45.1	
22.10.2017 (Post Diwali)	23	35	W, 3.2 KM/h	39.0	

3.4 Status of Ambient Air Quality at three locations in Bhopal

Location	Parameters	Pre Diwali		Diwali		Post Diwali	
		24.10.16	12.10.17	30.10.16	19.10.17	2016	22.10.17
Nehru Nagar (Residential)	PM ₁₀	112	65 ↓	697	213 ↓	ND	63
	PM _{2.5}	ND	ND	ND	ND	ND	56
	SO ₂	BDL (3.4)	BDL (2.23) ↓	24	19 ↓	ND	8
	NO ₂	21	14 ↓	49	40 ↓	ND	16
TT Nagar (Commercial)	PM ₁₀	79	89 ↑	217	169 ↓	ND	77
	PM _{2.5}	ND	ND	ND	ND	ND	40
	SO ₂	BDL (2.8)	5.1 ↑	22	16 ↓	ND	7
	NO ₂	24	23 ↓	44	35 ↓	ND	22
Shahjahanaba (Residential)	PM ₁₀	119	92 ↓	215	194 ↓	ND	72
	PM _{2.5}	ND	ND	ND	ND	ND	45
	SO ₂	4.8	5.4 ↑	23	18 ↓	ND	10
	NO ₂	26	27 ↑	45	39 ↓	ND	25
National Ambient Air Quality Standards – Industrial/Residential/Rural or other areas (24 hourly average in µg/m³)				PM₁₀	PM_{2.5}	SO₂	NO₂
				100	60	80	80

Note: All the values are in µg/m³ ND - Monitoring Not Done.

3.5 Ambient air quality monitoring Results and discussions:

A. Particulate Matter (PM₁₀):

- The minimum and maximum PM₁₀ values observed during pre-Diwali at Nehru Nagar- 30 µg/m³ and 90 µg/m³, North T.T Nagar -55 µg/m³ and 113 µg/m³, Shahjahanabad- 72 µg/m³ and 117 µg/m³.
- The minimum and maximum PM₁₀ values observed on Diwali day at Nehru Nagar- 108 µg/m³ and 378 µg/m³, North T.T Nagar – 140 µg/m³ and 185 µg/m³, Shahjahanabad- 158 µg/m³ and 243 µg/m³.
- During the festival day fire crackers bursting was observed and the maximum PM₁₀ value found at Nehru Nagar is 378 µg/m³ which comes

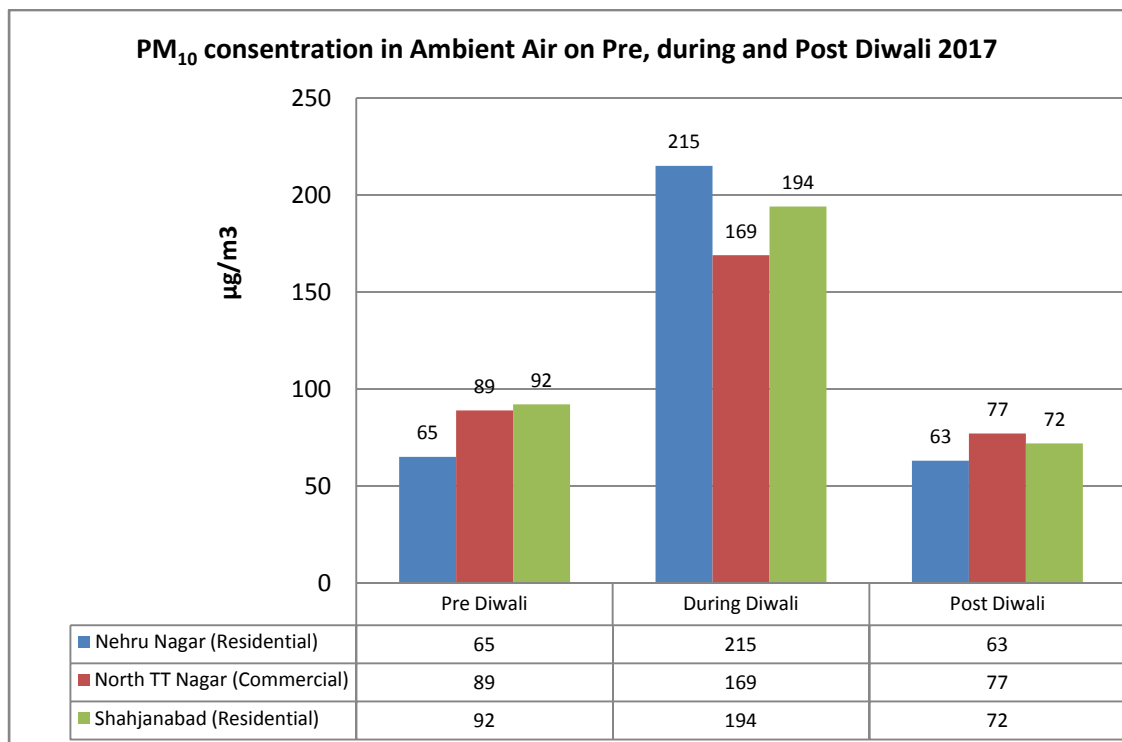


under residential category.

- The minimum and maximum PM₁₀ values observed during post-Diwali at Nehru Nagar- 51 µg/m³ and 73 µg/m³, North T.T Nagar – 52 µg/m³ and 99 µg/m³, Shahjahanabad- 61 µg/m³ and 80 µg/m³ were observed. During the post diwali monitoring the values of PM₁₀ decreased when compared with the Diwali day values.



- The concentrations of PM₁₀ is exceeding the 24 hours average ambient air quality standard at all the 3 locations on diwali day where as the PM₁₀ value are within the limits at all the 3 locations during pre and post diwali. The average PM₁₀ concentrations are shown below in the graph no.1.



Graph 01: PM10 level on Pre, on Diwali & Post Diwali Day 2017

B. Particulate Matter (PM_{2.5}):

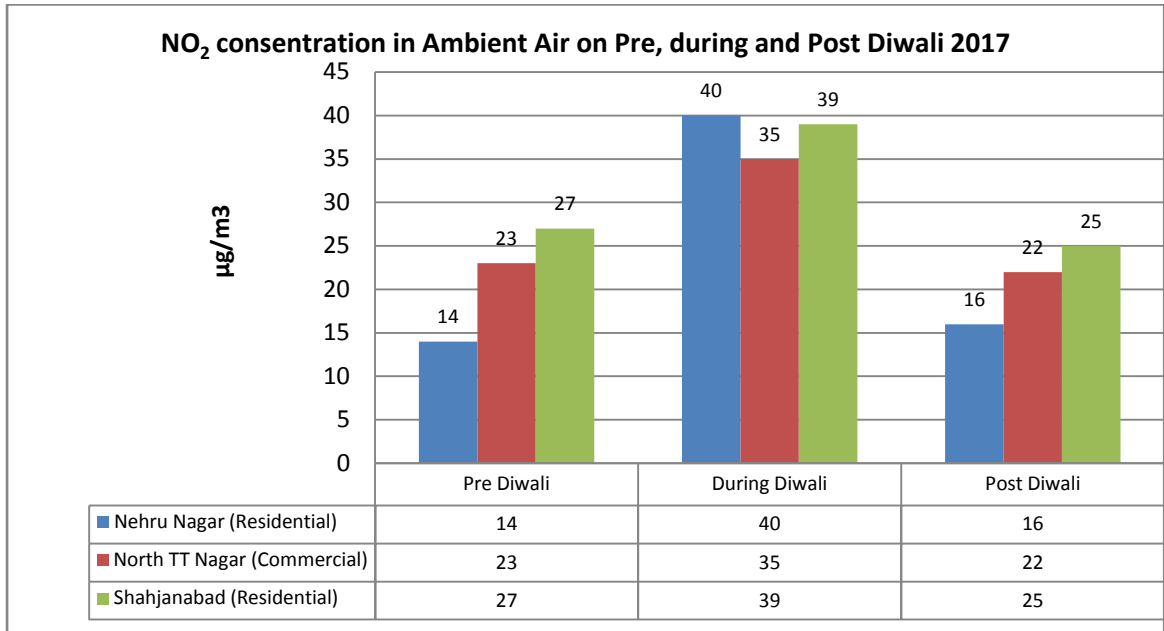
The PM_{2.5} concentration has been monitored at the 3 locations during the post-Diwali day in Bhopal city and the values were detected at Nehru Nagar - 56 µg/m³, North T.T Nagar- 40 µg/m³ and Shahjahanabad – 45 µg/m³. The levels of PM_{2.5} of all the locations were found within the AAQM standard during post diwali. The PM_{2.5} monitoring not carried out during pre-diwali and on diwali day.

PM_{2.5} Monitoring data result on Post Diwali (22.10.2017)

Location	Category	Result Value PM _{2.5} (µg/m ³)	AAQ Standard:24 Hrs (µg/m ³)
Nehru Nagar	Residential	56	60
North TT Nagar	Commercial	40	
Shahjahanabad	Residential	45	

C. Nitrogen Dioxide (NO₂):

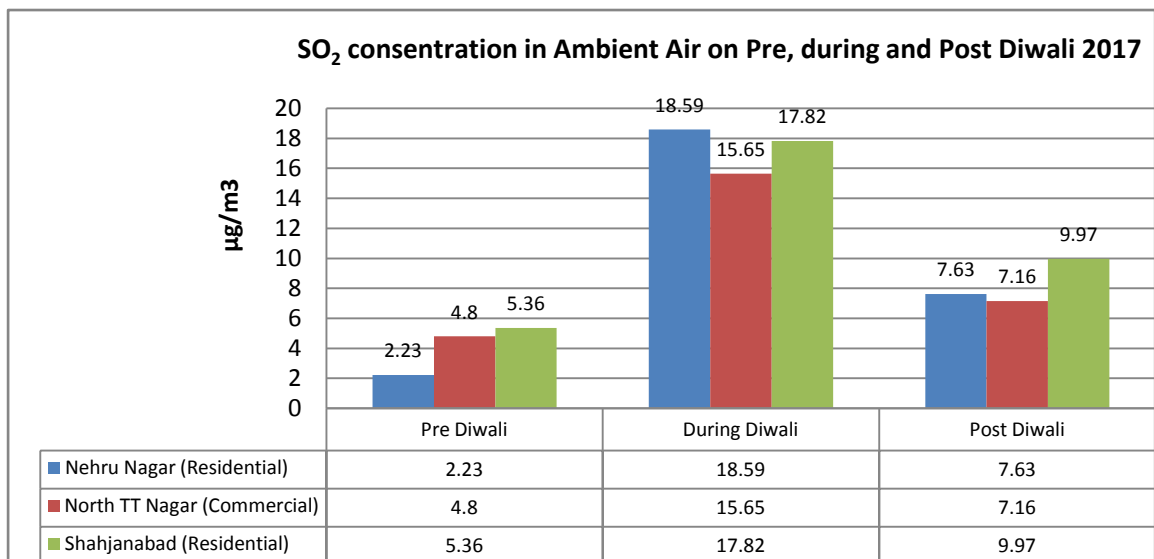
- Monitoring result of NO₂ level was detected in the range of 12 µg/m³ - 17 µg/m³ at Nehru Nagar during pre Diwali while on the festival day NO₂ was observed between 15 µg/m³ - 80 µg/m³ and the post diwali values found to be 10 µg/m³ - 22 µg/m³
- At the Shahjahanabad during pre Diwali the NO₂ level was found between 14 µg/m³ - 37 µg/m³ while on Diwali day was found between 18 µg/m³ – 65 µg/m³ due to bursting of fire crackers and these location covered under residential category and the post diwali values found to be 15 µg/m³ - 40 µg/m³
- At the North T.T Nagar the level of NO₂ was detected between 11 µg/m³ - 35 µg/m³ on pre-Diwali while on Diwali day was found between 18 µg/m³ - 58 µg/m³ and the post diwali values found to be 11 µg/m³ - 36 µg/m³.
- All the NO₂ values during pre, on & post diwali are within the ambient air quality standards (24 hours average).
- The average NO₂ concentrations are shown below in the graph no.2.



Graph 02: NO₂ level on Pre, on Diwali & Post Diwali Day 2017

D. Sulphur Dioxide (SO₂):

The maximum concentration of SO₂ was detected at Diwali day during evening time (06:00 PM – 10:00PM) at Nehru Nagar, Shahjanabad & North TT Nagar i.e. 38 µg/m³, 34 µg/m³ & 35 µg/m³ respectively due to bursting of fire crackers. The average concentrations of SO₂ found during pre diwali is at Nehru Nagar-2.23(BDL) µg/m³, Shahjanabad-5.36 µg/m³ & North TT Nagar-5.07 µg/m³ . During the post-Diwali day the level of NO₂ & SO₂ were decreased and reached almost pre-diwali concentrations. All the SO₂ pre, on & post diwali values are within the ambient air quality standards. The average SO₂ concentrations are shown below in the graph no.3.



Graph 03: SO₂ level on Pre, on Diwali & Post Diwali Day 2017

4. 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 colour. 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 pronounced in people with lung and heart diseases.
>401	Severe	May cause respiratory effects even on healthy people and serious health effect on people with lung/heart diseases.

Air Quality Index of pre diwali day, Diwali day and post Diwali day is as given below :

Location	Pre Diwali Monitoring 12.10.2017			During Diwali Monitoring 19.10.2017			Post Diwali Monitoring 22.10.2017		
	AQI	Category	Prominent Parameter	AQI	Category	Prominent Parameter	AQI	Category	Prominent Parameter
Nehru Nagar (Residential)	65	Satisfactory	PM ₁₀	175	Moderate	PM ₁₀	63	Satisfactory	PM ₁₀
North TT Nagar (Commercial)	89	Satisfactory	PM ₁₀	146	Moderate	PM ₁₀	77	Satisfactory	PM ₁₀
Shahjahanabad (Residential)	92	Satisfactory	PM ₁₀	162	Moderate	PM ₁₀	72	Satisfactory	PM ₁₀

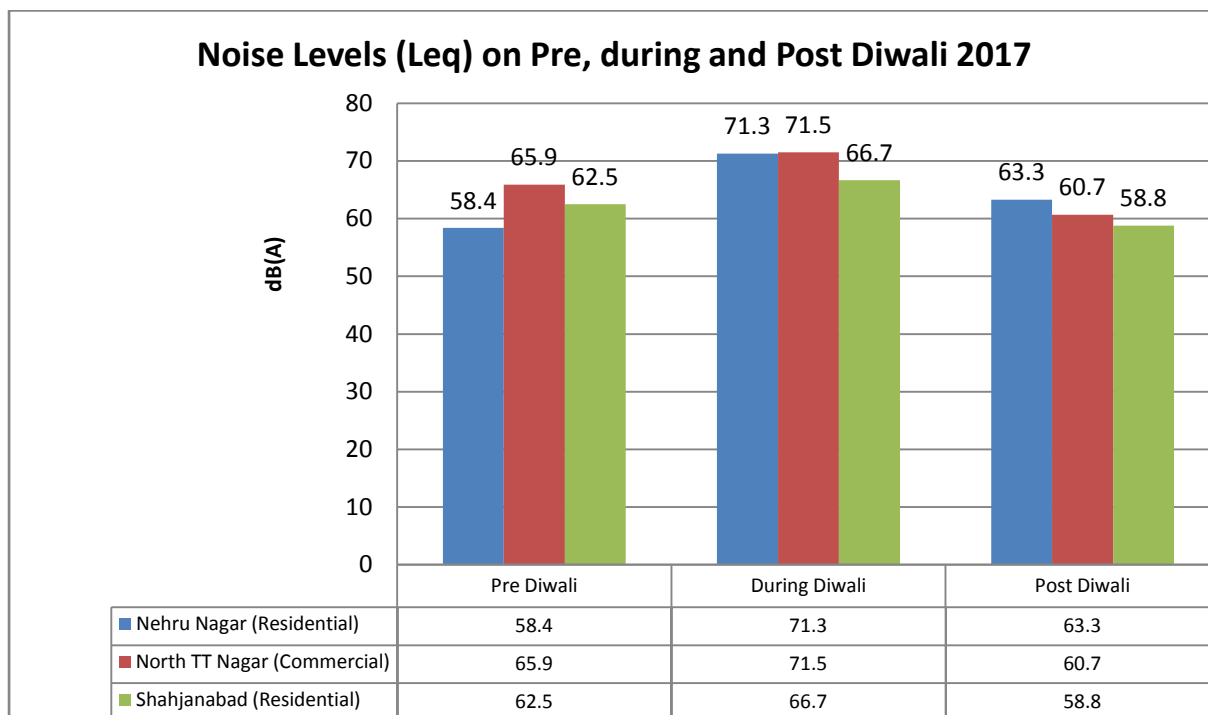
- PM₁₀ was found prominent parameter out of monitored 4 parameters i.e. PM₁₀, PM_{2.5}, SO₂ & NO₂.
- The air quality index is moderate on diwali and satisfactory during post and pre diwali.
- The AQI values found in the range of 65-92 during pre diwali, 146-175 during diwali and 63-77 during post diwali.

5. Monitoring of Ambient Noise levels:

The noise level measurement during before, on Diwali and post Diwali day was carried out using Delta OHM HD2110L instrument. Monitoring was carried out from 18.00hrs to 24.00hrs as per the prescribed protocol for L_{eq}, L_{min}, L_{max}, L₅₀ & L₉₀ parameters.

Location	Time Duration	Pre Diwali (12.10.2017)			During Diwali (19.10.2017)			Post Diwali (22.10.2017)		
		L _{min}	L _{max}	L _{eq}	L _{min}	L _{max}	L _{eq}	L _{min}	L _{max}	L _{eq}
Nehru Nagar (Residential)	18:00hrs- 19:00hrs	47.3	72.9	57.4	52.0	94.5	70.8	49.9	88.4	62.1
	19:00hrs- 20:00hrs	48.2	69.2	55.3	52.9	93.0	64.8	46.7	95.6	73.0
	20:00hrs- 21:00hrs	53.6	64.2	53.9	52.4	112.8	74.1	47.7	98.9	81.9
	21:00hrs- 22:00hrs	61.7	73.3	69.7	49.7	106.2	76.2	46.9	76.5	55.0
	22:00hrs- 23:00hrs	55.6	65.1	58	42.8	106.7	73.2	43.9	85.2	57.4
	23:00hrs- 24:00hrs	41.1	64.6	56.1	43.9	96.6	68.8	39.6	88.0	50.1
	Average (18:00hrs- 24:00hrs)	51.2	68.2	58.4	48.9	101.6	71.3	45.8	88.8	63.3

North TT Nagar (Commercial)	18:00hrs-19:00hrs	58.4	74.4	65.0	60.8	78.6	66.6	62.8	80.6	63.1
	19:00hrs-20:00hrs	62.1	75.8	68.0	61.2	100.1	75.1	61.8	74.8	64.5
	20:00hrs-21:00hrs	60.5	78.4	66.8	59.0	103.8	78.5	61.5	77.1	63.1
	21:00hrs-22:00hrs	59.3	80.8	67.2	58.9	94.7	72.1	57.2	72.4	61.7
	22:00hrs-23:00hrs	60.6	81.8	66.1	59.9	102.8	72.0	53.4	67.8	60.8
	23:00hrs-24:00hrs	60.9	65.6	62.4	49.8	84.9	64.8	49.7	60.3	51.2
	Average (18:00hrs-24:00hrs)	60.3	76.1	65.9	58.3	94.2	71.5	57.7	72.2	60.7
Shahjahanabad (Residential)	18:00hrs-19:00hrs	58.9	82.7	64.8	55.6	65.8	58.1	49.2	87.2	59.7
	19:00hrs-20:00hrs	50.8	79.3	62.6	55.6	77.7	62.4	51.0	83.0	60.4
	20:00hrs-21:00hrs	58.9	70.4	61.4	55.5	89.5	66.6	51.1	90.0	62.7
	21:00hrs-22:00hrs	58.8	67.5	61.5	61.3	92.2	71.7	49.9	85.7	57.9
	22:00hrs-23:00hrs	48.2	76.9	60.9	61.3	106.1	74.6	51.5	73.8	56.6
	23:00hrs-24:00hrs	56.2	77.6	63.5	57.0	88.2	66.6	50.5	75.9	55.4
	Average (18:00hrs-24:00hrs)	55.3	75.7	62.5	57.7	86.6	66.7	50.5	82.6	58.8



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

5.1 Noise monitoring Results and discussions:

- The minimum and maximum Leq values observed during pre-Diwali at Nehru Nagar- 53.9 dB(A) and 69.7 dB(A), North T. T. Nagar – 62.4 dB(A) and 68.0 dB(A) & Shahjahanabad- 60.9 dB(A) and 64.8 dB(A) was observed.
- The minimum and maximum Leq values observed on Diwali day at Nehru Nagar- 64.8 dB(A) and – 76.2 dB(A), North TT Nagar – 64.8 dB(A) and 78.5, Shahjahanabad- 58.1 dB(A) and 74.6 dB(A) was observed.
- The minimum and maximum Leq values observed during Post-Diwali at Nehru Nagar-50.1 dB(A) and 81.9 dB(A), North T.T. Nagar 51.2 dB(A) and 64.5 dB(A), Shahjahanabad- 55.4 dB(A) and 62.7 dB(A) was observed.
- On Diwali day, due to bursting of crackers at Nehru Nagar, noise level reached maximum upto 112.8 dB(A) and also the average Leq value observed was **71.3 dB(A)** that is above the prescribed residential limit but it is less than the last year results.

5.2 Noise Level Meter Calibration Result

Location	Calibration Result	Date						Instrument Make & Model
		12.10.2017		19.10.2017		22.10.2017		
		94 dB at 1000 Hz	114 dB at 1000Hz	94 dB at 1000 Hz	114 dB at 1000Hz	94 dB at 1000 Hz	114 dB at 1000Hz	
Nehru Nagar (Residential)	Initial	94.0	114.0	94.0	114.0	94.1	114.0	Delta QHM & HD2110L (5)
	Final	94.1	114.2	94.1	114.3	94.2	114.1	
North T.T. Nagar	Initial	94.0	114.0	94.0	114.0	94.0	114.1	Delta QHM & HD2110L (3)
	Final	94.1	114.2	94.2	114.1	94.2	114.2	
Shahjahana bad	Initial	94.0	114.0	94.1	114.0	94.0	114.0	Delta QHM & HD2110L (4)
	Final	94.1	114.1	94.2	114.2	94.1	114.2	

6. Observations:

1. Vehicular movement, traffic jam, Aazan, 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.
2. On diwali day bursting of crackers were started after 8 PM and there was very less crackers busting after 12 mid night.
3. It is observed that this year Diwali festival was celebrated with less crackers bursting when compared with last year Diwali as a result ambient air quality and noise levels were reduced when compared with last year values but all the monitored values are above the limits.
4. Weather was clear, dry and no rainfall on the day of diwali due to which the air dispersion took place as a result the ground level concentration of air pollution levels decreased when compared with last year diwali.
5. The average PM₁₀ values are increased from pre Diwali day to Diwali day is 3 times at Nehru Nagar and 2 times both at North T.T. Nagar & Shahjahanabad.

6. It is observed that the concentration of PM₁₀ decreased from 697 µg/m³ to 213 µg/m³ at Nehru Nagar, 215 µg/m³ to 194 µg/m³ at Shahjahanabad and 217 µg/m³ to 169 µg/m³ at North TT Nagar from last year Diwali to this year Diwali.
7. The NO_x and SO₂ values are increased from pre-Diwali to Diwali Day due to bursting of crackers. Whereas the post-Diwali day levels of NO₂ & SO₂ values were reached almost pre-diwali concentration.

7. Mass Awareness Activities during Diwali 2017

Generally it is observed that during the fire crackers bursting the ambient noise and air quality levels are 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 promote the ill effects of fireworks through advertisements, encourage teachers to convince their students and explain the bad effects of fire crackers and advised not to burst fireworks.

In compliance of the above, CPCB Regional Directorate Bhopal has conducted various programs during October 9 -11, 2017 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 them personally.

Under the mass awareness programme various activities i.e. public talk shows, demonstration of RDS & noise level meter and environmental quiz among the school children have been organized to deliver the message of Eco-friendly diwali. During the mass awareness in schools i.e. Kendriya Vidyalaya No.2, DAV Higher Secondary School, Govt Chandra Shekhar Azad School at Bhopal were visited and organised the awareness programme accordingly.



In public interest an advertisement was also released on behalf of CPCB & MoEF&CC to make Eco-friendly Diwali in colour format in leading Hindi Newspaper Dainik Bhaskar edition in Bhopal (Madhya Pradesh), Jaipur (Rajasthan) & Raipur (Chhattisgarh) on 19.10.2017 (Diwali Day). The Regional Directorate Bhopal continuously making efforts to ensure that people enjoy a safe Diwali through awareness programme and inspiring and motivated the students not to burst firecrackers for safety of environment & health.



The advertisement is titled "पर्यावरण अनुकूल" (Eco-friendly) and "दीपावली मनाएं" (Celebrate Diwali). It features the national emblem at the top. The text explains that Diwali is celebrated by lighting lamps, but the use of firecrackers and fireworks is harmful to the environment and health. It lists five points for an eco-friendly Diwali: 1. Use eco-friendly lamps instead of firecrackers. 2. Avoid burning incense and candles. 3. Use eco-friendly products. 4. Avoid using plastic and paper. 5. Use eco-friendly products. It also mentions that the Central Pollution Control Board (CPCB) and the Ministry of Environment, Forest and Climate Change (MoEF&CC) are promoting this initiative. The advertisement is signed by the National Environmental Engineering Research Institute (NEERI), Lucknow.

दीपावली के पावन पर्व पर जन-सामान्य द्वारा आतिशबाजी का उपयोग किया जाता है। आतिशबाजी/पटाखों के प्रयोग से ध्वनि एवं वायु प्रदूषण के साथ पर्यावरण पर भी प्रतिकूल प्रभाव पड़ता है जिसके कारण मानव स्वास्थ्य भी प्रभावित होता है। आतिशबाजी के फलस्वरूप धुआँ, सूक्ष्म जहरीले कण एवं विभिन्न प्रकृति के रसायनों का उत्सर्जन होता है जिससे परिवेशीय वायु गुणवत्ता प्रभावित होती है एवं स्वास्थ्य संबंधी निम्नलिखित समस्याएँ उत्पन्न होती हैं:-

1. श्वसन संबंधी बीमारियाँ बढ़ जाती हैं
2. आँखों एवं शरीर के दूसरे अंगों को नुकसान होने की संभावना बढ़ जाती है
3. सुनने की क्षमता पर प्रतिकूल प्रभाव पड़ता है
4. अनिद्रा, उच्च रक्तचाप, तनाव, घड़कन बढ़ना आदि समस्याएँ होने लगती हैं
5. पालतू पशु-पक्षियों सहित अन्य जीव-जन्तुओं पर भी प्रतिकूल प्रभाव पड़ता है

अतः पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय एवं केन्द्रीय प्रदूषण नियंत्रण बोर्ड जन-सामान्य से सुरक्षित एवं पर्यावरण अनुकूल दीपावली उत्सव मनाने का अनुरोध करता है।

 **केन्द्रीय प्रदूषण नियंत्रण बोर्ड**
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
भारत सरकार

(Praveen Kumar Jain)
Senior Scientific Assistant

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