Assessment of Ambient Air Quality of Lucknow City During

PRE~DEEPAWALI
DEEPAWALI &
POST~DEEPAWALI
2019

सीएसआईआर-भारतीय विषविज्ञान अनुसंधान संस्थान, लखनऊ
CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH, LUCKNOW

Assessment of Ambient Air Quality during Pre-Deepawali, Deepawali and Post-Deepawali Festival, October 2019

Environmental Monitoring Division
CSIR-Indian Institute of Toxicology Research
Vishvigyan Bhawan, 31 Mahatma Gandhi Marg, Lucknow – 226001, UP

CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow conducted Air Quality survey at 9 locations (Aliganj, Vikasnagar, Indiranagar, Gomtinagar, Charbagh, Aminabad, Chowk, Alambagh and Amausi) of Lucknow city to assess the impact of fireworks on the environment during the Deepawali festival, 2019. Monitoring results revealed that the respirable particulates during pre-Deepawali, Deepawali and post-Deepawali are well above the National Ambient Air Quality Standards of 60 and 100 µg/m^3 for $PM_{2.5}$ and PM_{10} respectively (Table 1).

During the major event on Deepawali night October 27th, 2019 the mean level of $PM_{2.5}$ increased from 159.2 to 346.5 µg/m^3 over the pre-Deepawali night and reduced to 190.7 µg/m^3 during post-Deepawali night. Similarly on Deepawali night, the level of PM_{10} also increased from 234.1 to 536.5 µg/m^3 over the pre-Deepawali night and reduced to 307.7 µg/m^3 during post-Deepawali night. The bursting of crackers is responsible for the increasing trend of particulate levels as the other sources such as traffic and industrial activities were at the minimal contribution levels during the period on account of Deepawali holidays.

On the Deepawali night $PM_{2.5}$ increased by 117.6% whereas the increase in PM_{10} over the pre-Deepawali night was 129.1%. Further, the higher levels of particulates continued during post-Deepawali night by 19.7% and 31.4% for $PM_{2.5}$ and PM_{10} respectively over pre-Deepawali night levels (Fig. 1).

In case of SO_2, the mean level was found to be within prescribed limits. However, mean level of SO_2 on the Deepawali night increased from 12.9 to 35.7 µg/m^3 and on post-Deepawali mean SO_2 level was 27.0 µg/m^3, which indicates that the levels increased by 176.5% and 109.7% on the Deepawali night and post-Deepawali night respectively over the pre-Deepawali night.

The mean level of NO_2 was found to be within prescribed limits. On Deepawali night the mean NO_2 value increased from 31.6 to 100.7 µg/m^3 over the pre-Deepawali night. On the post-Deepawali night, mean level of NO_2 was increased to 59.3 from 31.6 µg/m^3 on pre Deepawali night. In terms of percentage, NO_2 level increased by 218.1% on Deepawali night and increased by 87.5% on post-Deepawali night over the pre-Deepawali night.

However, the pollution levels were found to be lower this year as compared to 2018. Reduction in particulate matter PM_{10} and $PM_{2.5}$ from last year was found to be about 46% and 49% respectively. This may be due to public awareness campaigns run by our institute CSIR-IITR and other initiatives taken by district administration, Government of Uttar Pradesh and Government of India.

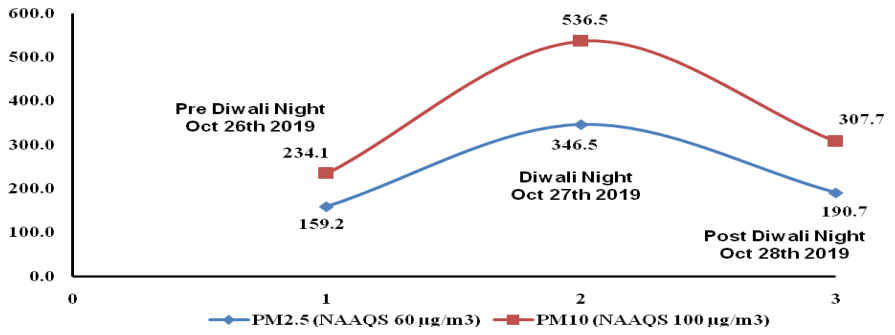

Fig. 1. Profile of respirable particulates (in µg/m^3) during the night time of Deepawali Festival.

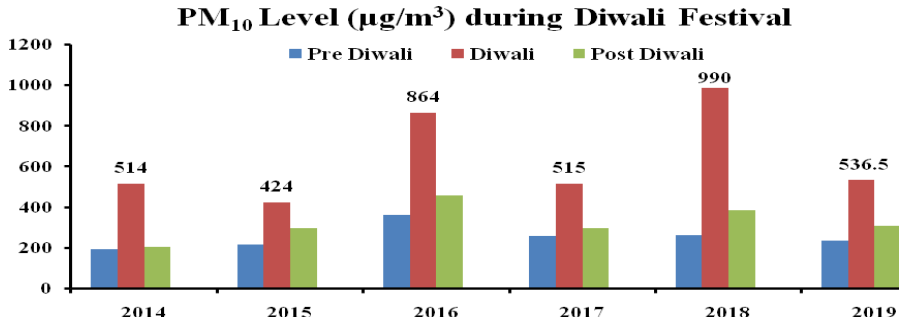

Fig. 2. Levels of respirable particulates (PM_{10}) concentration during 2014, 2015, 2016, 2017, 2018 and 2019 (Night time Deepawali Festival).

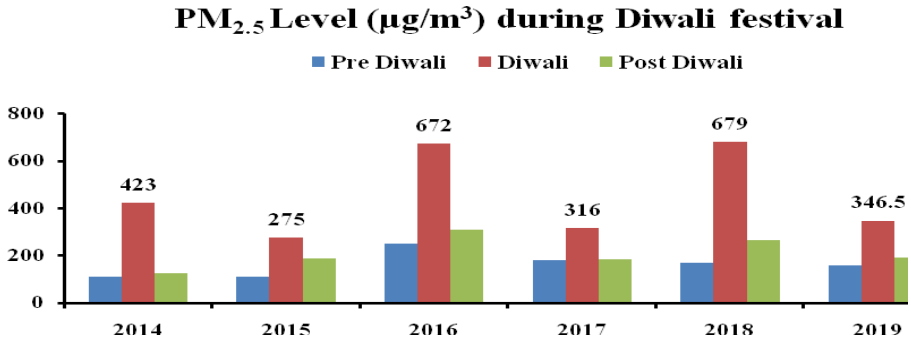

Fig. 3. Levels of respirable fine particulates ($PM_{2.5}$) concentration during 2014, 2015, 2016, 2017, 2018 and 2019 (Night time Deepawali Festival).

Table 1. CSIR-IITR Deepawali 2019 Pollution Survey

Pollutants/ Locations	**Pre-Deepawali 2019** (October 26th 2019)		**On-Deepawali 2019** (October 27th 2019)		**Post-Deepawali 2019** (October 28th 2019)	
PM_{10} ($\mu g/m^3$)	Day (6:00 am to 6:00 pm)	Night (6:00 pm to 6:00 am)	Day (6:00 am to 6:00 pm)	Night (6:00 pm to 6:00 am)	Day (6:00 am to 6:00 pm)	Night (6:00 pm to 6:00 am)
Aliganj	103.30	198.28	142.15	528.66	267.37	394.66
Vikas Nagar	163.85	175.14	211.47	586.75	305.28	351.58
Indira Nagar	120.42	171.01	213.75	517.18	284.13	302.82
Gomti Nagar	110.36	316.28	245.00	498.61	189.96	307.31
Charbagh	160.75	306.51	383.28	656.11	216.94	281.13
Alambagh	184.76	ND	171.83	489.73	255.20	259.42
Aminabad	216.28	226.46	193.91	549.92	289.83	363.65
Chowk	219.82	310.70	172.39	553.66	162.94	298.61
Amausi	175.62	168.78	248.02	447.48	110.20	210.09
$PM_{2.5}$ ($\mu g/m^3$)						
Aliganj	67.41	73.34	67.25	279.81	113.56	173.19
Vikas Nagar	91.89	101.45	125.02	433.33	210.16	240.53
Indira Nagar	73.46	84.43	104.78	346.82	187.08	233.38
Gomti Nagar	ND	247.36	168.10	298.12	128.17	173.57
Charbagh	115.42	239.86	248.20	486.98	180.39	195.80
Alambagh	132.57	118.53	106.91	310.11	150.33	136.70
Aminabad	167.62	177.78	116.05	386.76	181.81	268.17
Chowk	157.14	266.13	120.41	322.07	104.23	181.97
Amausi	140.83	124.24	97.21	254.24	84.77	112.54
SO_2 ($\mu g/m^3$)						
Aliganj	8.28	11.87	20.97	45.96	17.87	22.24
Vikas Nagar	3.48	5.64	19.24	47.38	16.25	21.18
Indira Nagar	3.55	13.20	23.25	28.96	15.09	32.62
Gomti Nagar	6.77	11.15	15.31	27.47	17.14	28.86
Charbagh	14.81	20.17	29.20	37.99	17.58	21.48
Alambagh	10.19	ND	24.54	27.09	18.46	30.00
Aminabad	5.04	7.82	26.46	24.43	24.40	28.55
Chowk	12.86	19.22	30.29	44.30	25.76	38.99
Amausi	12.49	14.10	18.98	37.36	15.77	19.44
NO_2 ($\mu g/m^3$)						
Aliganj	22.09	31.32	35.17	55.28	34.06	27.25
Vikas Nagar	24.90	29.15	19.25	114.99	29.14	54.09
Indira Nagar	21.64	44.02	83.41	107.32	42.42	42.18
Gomti Nagar	30.40	33.39	40.11	55.19	39.20	55.92
Charbagh	31.54	39.28	92.80	165.28	63.68	67.24
Alambagh	38.86	ND	32.91	70.81	43.97	57.50
Aminabad	43.22	29.80	86.46	144.80	38.06	85.30
Chowk	28.59	33.57	89.59	153.44	61.94	105.96
Amausi	11.76	12.64	30.86	39.03	52.60	38.53

ND= Not Done

Weather condition

Besides sources of pollutants the air quality depends on meteorological factors like temperature, wind speed and wind direction, relative humidity etc. To represent the weather condition we have collected temperature, relative humidity, wind speed and wind direction data from CPCB online monitoring station (http:/cpcb.nic.in) at Talkatora Industrial Centre, Lucknow during the study period (26-28th October, 2019) and presented as wind rose diagram (Fig. 4.). The temperature was found to be in the range of 19.01 to 29.10^{o}C with an average of 23.83^{o}C on 26th October, on 27th it was in the range of 19.59 to 29.12^{o}C, with an average of 24.12^{o}C and on 28th the same values were in the range of 20.45 to 27.71°C with an average of 23.90°C. In case of relative humidity on 26th, 27 and 28th October the mean values were 75% (47.81 to 95%), 67.09 % (46.9 to 86.34) and 68.61 (50.8 to 88.16%) respectively. The wind speed values on 26th, 27th and 28th October were found to be 0.19 m/s (0.07 to 40 m/s) , 0.53 m/s (0.09 to 1.06 m/s) and 0.24 m/s (0.03 to 0.59 m/s) respectively.

During the study period the predominant wind direction was W (West) for 8.21% of the time. The other dominant directions were WSW (West South West) and WNW (West North West) each one for 5.47% of the time. For most of the time (78.08%; calm period) wind speed remained <1.8 km/h and 13.6% of the time it was in between 1.8 to <3.6 km/h (Fig. 4).

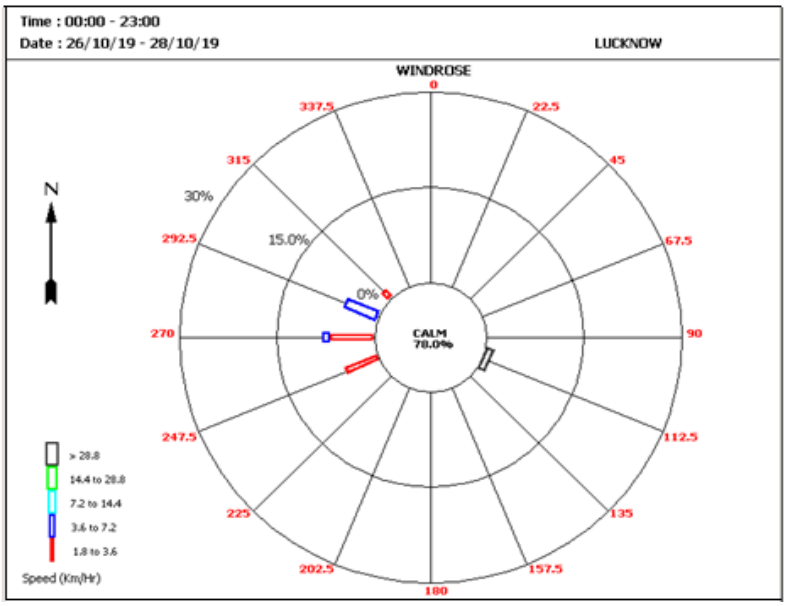

Fig. 4. Windrose diagram during study period (26th to 28th October, 2019) at Talkatora centre, Lucknow (data source htpp:/cpcb.nic.in)

Noise level

Noise level was recorded during Pre-Deepawali, Post-Deepawali and On-Deepawali night to observe the impact of bursting of fire cracker at seven locations. The monitoring was carried out during 7 pm to midnight for near about 30 minutes at each location. The maximum noise level was recorded as 82.1 dB(A) at Indiranagar area whereas minimum was recorded as 71.3 dB(A) at Aminabad on Deepawali night. The sound waves generated from the bursting of crackers at a level higher than 80 dB(A), may damage eardrum and may induce temporary or permanent deafness. Exposure to high levels of noise may trigger problems like annoyance, irritation, hypertension, stress, hearing loss, headache and sleep disturbance. The recorded noise levels are given in Table 2.

Table 2. Noise Level in dB(A) on Pre-Deepawali, Deepawali and Post-Deepawali night

Locations	**Pre-Deepawali** (October 26th, 2019)	**On-Deepawali** (October 27th, 2019)
Charbagh (10:00-10:30 PM)	68.6	80.2
Chowk (11:00- 11:30 PM)	70.2	78.5
Aliganj (09:00- 30:00 PM	64.2	78.9
Vikas Nagar (07:00- 08:00 PM)	64.6	76.8
Indira Nagar (9:00-9:30 PM)	63.3	82.1
Aminabad (10:00-11:00 PM)	65.6	71.3
Gomti Nagar (08:30 -9:00 PM)	64.8	75.7

CSIR-IITR is constantly working to take forward its mission towards clean environment through programmes like Outreach and Jigyasa and exhibitions during all events organized in the Institute. Under such activities efforts are made to connect the citizens, particularly students to the cause of clean environment. The campaign to minimize the use of fire crackers in the light of adverse health effects of noise and air pollution have been taken up under these awareness programmes. However, it is observed that during festive season like Deepawali, noise and air pollution tends to increase due to firing of crackers. The change in meteorological conditions in the beginning of winter season i.e. low wind speed and low temperature restricts dispersion, dilution and transport of air pollutants. During winter this kind of situation usually prevails in most of the cities in northern India where Air Quality Index (AQI) was reported in the category of poor, very poor or severe by CPCB.

The results of survey during Deepawali festival clearly indicate significant deterioration of air quality in Lucknow city on festival day from the pre-Deepawali day. On post Deepawali day it again dropped and reached close to pre-Deepawali day. Children, senior citizen and people suffering from respirable diseases are at risk due to air pollutants generated from firing of crackers. Particularly, smoke and fumes from firing of crackers include elements such as aluminum,

antimony, sulphide, perchlorate, barium nitrite, lithium, copper, strontium, cadmium etc., which may cause Alzheimers disease, thyroid imbalances, gastrointestinal problems, muscular weakness, respiratory problems, hormonal disbalance etc. It may also cause cancer. Besides human, affects are also seen on other animals due to high levels of air and noise pollution. Firework events also affect surface soil quality and ultimately create water pollution and generate huge quantity of additional solid waste. Therefore the storage, sale and use of crackers creating noise more than prescribed levels and emitting toxic smoke and fumes should be checked as per the guidelines. As far as possible the use of fire crackers should be discouraged and minimized to maintain clean air quality in the festival season.

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