

Status of Air Quality and Noise Level of Udaipur City, India during Diwali Festival

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Abstract

Diwali is one of the most important and commonly celebrated festivals by Hindu religion followers in India which falls normally during period October-November every year. This festival extensive burning of firecrackers, especially in the evening hours, is witnessed with hence burnt crackers releases various gaseous and particulate air pollutants and toxic metals in significant quantity and became responsible for degradation of the air quality as a whole in the adjoining areas. It has been observed that the widespread use of sparklers leads to short-term air quality degradation. So, for assessment of the effect of fireworks on the air quality on ambient concentrations of various air pollutants (SO₂, NO₂, SPM, RSPM) and Noise level during Diwali festival in Udaipur city (India), data were collected in November 2014. The levels of these pollutants during study schedule were recorded as moderately high, than the National standards, which can cause serious health hazards in local population.

Keywords: Diwali festival; Rise in Pollution; Fireworks; Noise level; Health hazards

Introduction

In India, Diwali which means lighting the lamp festival in India is one of the major festival where burning of crackers during the festival is an integral part of the celebrations. Sound-crackers and fireworks are manufactured by using large amount of nitrates and sulphates of lead, cadmium, potassium, ammonium and magnesium. During bursting of these crackers take place, toxic metal fumes and gases like carbon dioxide, sulphur dioxide and nitrogen dioxide, as well as, particulate matter (PM) is emitted in considerable amounts. Several reports are available indicating on the effect of fireworks' activities which add air pollutants like particulate matter, its components and trace gases during various festivals all over the world. Emissions and accumulation of metals were reported in the atmosphere due to crackers and sparkles during Diwali festival in India [1]. Similarly, air pollution caused due to the burning of fireworks during the Lantern Festival in China [2]. Impacts of fireworks on air-borne particles were indicated [3]. Ambient air quality of Lucknow City (India) was assessed after use of fireworks on Diwali festival [4]. Noise pollution was studied during Diwali festival in a small township of Haridwar City of Uttarakhand, India [5]. Recorded temporal variation in ambient air quality during Diwali festival in India [6,7]. Atmospheric PM in Delhi, India, got chemically characterized during different periods of the year including Diwali festival [8,9]. Impact of ground-level fireworks display on the air quality during the traditional Yanshui Lantern Festival in Taiwan was observed [10]. Aerosol behavior was quantified on the basis of morphological characteristics during many festival events in India [11]. Likewise, elaborative study on impact of Diwali celebrations on urban air and noise quality in Delhi, India was made [12]. During Diwali festival all over Kolkata [13] and during 19th Commonwealth Games at Delhi, India; ambient air quality was assessed [14]. Aerosol particle behavior was analyzed during dust-storm and Diwali over an urban location in north-western India [15].

Material and Methods

Study area

Udaipur (state Rajasthan, India) known as 'city of lakes' which is situated about 600 m above the sea level and is located among the lush

green hills of Aravali range between 24°35' N latitude and 73°42' E longitude. There are three major lakes around Udaipur and within, e.g., Fateh Sagar, Swaroop Sagar and Pichhola and Udai Sagar, which is 10 Km, away from Udaipur. The city has a population around 0.6 million and has a distinct tropical climate with marked monsoonal effect with uncertainty in rainfalls. The Indian Climate is divided into three distinct seasons, i.e., summer (March-June), rain (July-October) and winter (November-February). The annual Mean rainfall of the city ranges between 62.5 cm to 125 cm during normal monsoon regime.

Sample collection

For recording the data of the study, two locations within the city of Udaipur were selected See in Figure 1. One is the residential area around Kalka Mata Road Ganesh Nagar (24°28'06.90"N and 73°40'05.40"E), and other is an urban Commercial area near Town (24°34'45.95"N and 73°41'46.31"E) which is near National highway. Ambient air monitoring and noise level recording were carried out during festival (on the day of Diwali) and non-festive (2 days before Diwali) in November 2014 at both sites. The concentration of different air pollutants, viz., Sulfur dioxide (SO₂), Nitrogen oxide (NO_x), Suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM) were monitored into 100 transects (100 × 100 m) with a difference of 10 meters. All the observations indicate mean value of these two sites, on the basis of minimum difference recording at three times in a day, i.e., morning 7 AM, noon 12:00 PM and evening 06:00 PM.

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Figure 1: Burning of crackers producing smoke and light.

Methodology

Ambient air samples were collected using High volume sampler (Envirotech model, APM-410) and Respirable dust sampler (Envirotech model APM 460) with suitable gas attachment. Suspended particulate matter and Respirable suspended particulate matter were collected on glass fiber filter papers by using high volume sampler and respirable dust sampler [16]. Particulate concentrations were determined gravimetrically by recording pre- and post-sampling filter weights and considering the sampled air volume. Gaseous pollutants were scrubbed separately in 0.1 M potassium tetrachloromercurate and sodium hydroxide (0.1N), respectively. These absorbing solutions were later analyzed colorimetrically for SO₂ through the modified [17] method and NO₂ through the modified [18] method. Results present significant differences between sites. Noise levels were recorded between 18:00 PM to 6:00 AM with the help of with the help of digital Sound Level Meter TES-1350 A as main activity of fireworks cracking, etc. takes place during night only.

Results

The results of the intensive ambient air and noise monitoring at selected two locations in the city are summarized below in Tables 1-4 and Figures 2-4. The study clearly shows that the SO₂, NO₂, SPM and RSPM.

Discussion

Excessive use of noisy crackers turns the festival of Diwali a nightmare for the people as excessively high levels of noise pollution come dangerously close to the prescribed upper tolerance limit on this festival whereas National Standard permit sound levels for residential areas at 55dB during the day and 45 dB during the night. The exposure to high levels of noise impairs the physical and physiological functioning of human organs and cause nausea, vomiting, fatigue, etc. Atmospheric inversion of cold Diwali night contributes to build up of pollutants and trapping of pollutants under same conditions result in the formation of smog. The fire-crackers release pollutant and generate noise in the ambient air which has adverse impact on the general health of the living beings residing in the area. On Diwali festival health risk from the sulphur

Parameters Studied	Commercial area near Town Hall		Residential area around Kalka Mata road	
	Festive Day	Non Festive Day	Festive Day	Non Festive Day
SO ₂	11.3	8.9	9.5	7
NO ₂	45.4	41.2	46	33.3
SPM	655	550	500	440
RSPM	300	150	291	101

Table 1: Mean concentration (in terms of µg/m³) of SO₂, NO₂, RSPM and SPM, at selected sites in Udaipur city.

Time (Hours)	Commercial area near Town Hall		Residential area around Kalka Mata road	
	Festive Day	Non Festive Day	Festive Day	Non Festive Day
18:00	89.8	72.3	66.4	67.1
19:00	80.7	71.9	71.9	69.6
20:00	83.2	70.1	72.1	71.1
21:00	88.9	69.3	81.8	70.5
22:00	86.4	67.2	81.4	67.1
23:00	79.6	58.6	74.5	63

Table 2: Mean noise level (dB) at selected sites in Udaipur city.

Type of area	Category of area	Limits in dB (A)Leq*	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence area	50	40

Table 3: Noise pollution standards as prescribed by the Central Pollution Control Board, New Delhi, India.

Pollutant	Time	Industrial Area	Residential, Rural & other Area	Ecological Sensitive Area
SO ₂	Annual Average	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hr	120 µg/m ³	80 µg/m ³	30 µg/m ³
NO ₂	Annual Average	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hr	120 µg/m ³	80 µg/m ³	30 µg/m ³
SPM	Annual Average	360 µg/m ³	140 µg/m ³	70 µg/m ³
	24 hr	500 µg/m ³	200 µg/m ³	100 µg/m ³
RSPM	Annual Average	120 µg/m ³	60 µg/m ³	50 µg/m ³
	24 hr	150 µg/m ³	100 µg/m ³	75 µg/m ³

Table 4: Air pollution standards as prescribed by the Central Pollution Control Board, New Delhi, India.

oxides and particulate pollution are very high because the crackers contain chemicals such as arsenic, sulphur, Mg, Sodium, iron, potassium chlorate, Cu, Mn, Cd, Pb, Zn, nitrates, etc. The increasing concentration of pollutant in the atmosphere during Diwali festival definitely affects the respiratory system of the residents and increasing level of noise causes irritation, hearing loss and aggravates conditions of asthma and bronchitis [4]. High aerosol loading causes dust and other pollution burst in the form of haze and smoke from burning of biomass and firecrackers during major festivals resulting in poor air quality and also causes short, as well as, long-term health effects [19,20]. Physical characterization of aerosol particles was done during the Chinese New Year's firework events [21]. Airborne black carbon concentrations over an urban region

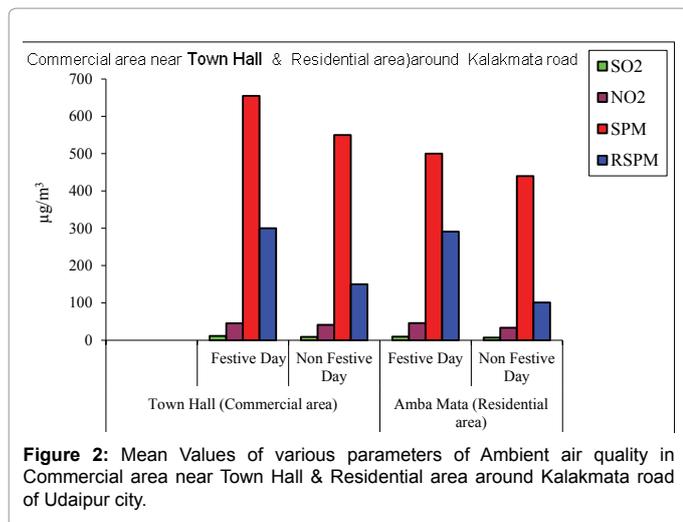


Figure 2: Mean Values of various parameters of Ambient air quality in Commercial area near Town Hall & Residential area around Kalakmata road of Udaipur city.

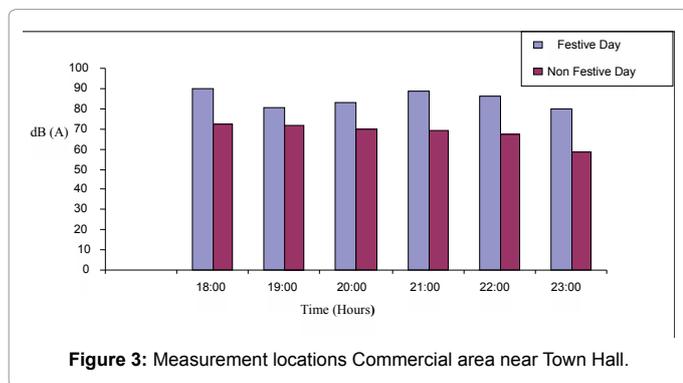


Figure 3: Measurement locations Commercial area near Town Hall.

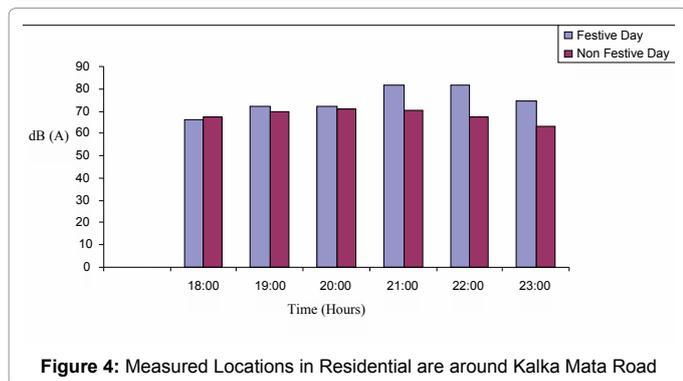


Figure 4: Measured Locations in Residential area around Kalka Mata Road

in western India based on temporal variability, effects of meteorology, and source regions were reported [22]. Air quality status during Diwali festival of India [23] and major pollution events (dust, haze, and two festival events) at Agra, India were characterized [24]. An assessment of air pollution and its attributable mortality in Mongolia indicate clearly that the RSPM, SPM, SO₂, NO₂ and noise levels in ambient atmosphere on the festive day were higher and unbearable as compared to the values observed on the non-festive day, on account of Diwali festival celebration and of bursting of fire crackers [25] because the noise level exceed the prescribed limit at the both sites during festive day. Same types of observations were made about ambient air quality and noise monitoring during Diwali festival in Haridwar city of Uttarakhand state (India).

Conclusion

The excessive use of firecrackers transforms the clean and jolly atmosphere to a hazy air full of smokes of explosives and unbearable noise pollution. Air pollution caused by increased levels of particulate matter, especially during a limited period of time (event), has a significant impact on local atmospheric chemistry and that ultimately would lead to affect human health which is not desirable by any means and it must be brought to permissible level to avoid dangerous effects of air pollution on local residents.

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