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Comparative study of the seasonal variation of NO_2 gas in polluted air

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Abstract

Diesel, fossil fuel, coal and industrial processes are the sources of nitrogen di oxide gas which causes air pollution (Alary R, Donati J and Vie lard H, 1994). It contributes to the formation of photochemical smog, which can have significant impacts on human health. Concentration of NO_2 in the environment depends upon the quality of fuel and the condition of the vehicular engine. In this paper we represent the concentration of nitrogen dioxide in the environment of Faizabad city at different stations throughout the year and comparative study of the seasonal variation of nitrogen di oxide.

Keywords: *Pollutant, vehicle engine, photochemical smog, concentration*

1. Introduction

The term nitrogen oxides (NOx) describes a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), which are gases produced from natural sources, motor vehicles and other fuel burning processes. Nitric oxide is colorless and is oxidized in the atmosphere to form nitrogen dioxide. Nitrogen dioxide has an odour and is an acidic and highly corrosive gas that can affect our health and environment. Nitrogen oxides are critical components of photochemical smog (Baumbach G, 1995). They produce the yellowish-brown color of the smog. In poorly ventilated situations, indoor domestic appliances such as gas stoves and gas or wood heaters can be significant sources of nitrogen oxides
(Ravichandran C, Edwin G, Chandrasekaran R, Anuradha and Radhika T, 1996)

2. Materials and Method

2.1Instrument:

Spectronics-2000 (Bausch and Lomb), atomic absorption spectrophotometer (Perkin Elmer model 5000), high volume sampler APM 415 – 411 (Envirotech Instrument India), HPLC model LC 10D (Shimadzu) equipped with UV visible detector and electronic digital balance (AFCO SET). Camera – Canon make model EOS 500 were used.

2.2 Reagents:

2.2a. Absorbing solution of NOx:
It was prepared by 4.0g of NaOH and I g of sodium arenite in 1000ml of distilled water.

2.2b. Sulphanilamide Solution:
10g of sulphanilamide dissolved in 250ml of concentrated phosphoric acid (8.5%) diluted.

2.2c. Hydrogen Peroxide:
0.2% of H2O2 (30%) diluted with 250 ml of distilled water.

2.2d. 1-naphthyle ethyl diamine hydroxide (NEDA):
0.05% g of NEDA was dissolved in the 50ml of distilled water.
(all the reagents were stored in the amber bottle at refrigerated temperature for a week).

2.2e. Standard nitrite Solution:
The amount of sodium nitrite was calculated as:

2.2f. $$G = \frac{\mathbf{1.5}\ \mathbf{x}\ 100}{A}$$

Where G = Amounting of sod. Nitrite
A = Assay percent of sodium nitrite used
1.5= Gravimetric conversion factor.
Sodium nitrite (assay 97%) 1.5464g was dissolved in the 1000ml of distilled water, Stock solution contains 1000 µg NO_2/ml.

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2.3 Method

2.3a. Calibration Curve:

2.5 ml of stock sodium solution (1000 µg/ml) was diluted to 100 ml with distilled water. The solution contained 25 µg NO_2/ml. The standard curve was prepared by taking different concentration of NOx ranges 0.5 – 5.0 µg NO2/ml. The standard solution was further processed as per procedure described below for unknown sample.

2.3b. Sample Collection:

The air was drawn through 10 ml of absorbing solution (0.4% NaOH solution) at the flow rate of 0.51/m for 8 hours. The sample was carried to lab for analysis.

2.3c. Analysis:

10ml of sulphanilamide was added into 10.0 ml of sample followed by the addition of 1.0ml of H_2O_2 and 1.4 ml of NEDA. Blank was prepared in the similar fashion. The test tube was inverted up and down several times. Absorbance was recorded at 540nm on the spectrophotometer after 30 minutes.

2.3d. Calculation:

$V = F \times T \times 10^6$

Where F=Average flow rate of gas.

T = Time

$$Vs = \frac{V(760-Pm)}{760} \times \frac{298.2}{(t+273.2)}$$

Where V =volume of air in litre measured during sampling time
Pm = Barometric pressure in mm of Hg during sampling time.
T = temperature recorded in degree calicoes (0C) during

Sampling time

$$NOx(\mu g/m3) = \frac{(\mu gNox/ml)x(10mlof\ sample)}{0.45 \times Vs}$$

3. Results

3.1Oxides of Nitrogen:

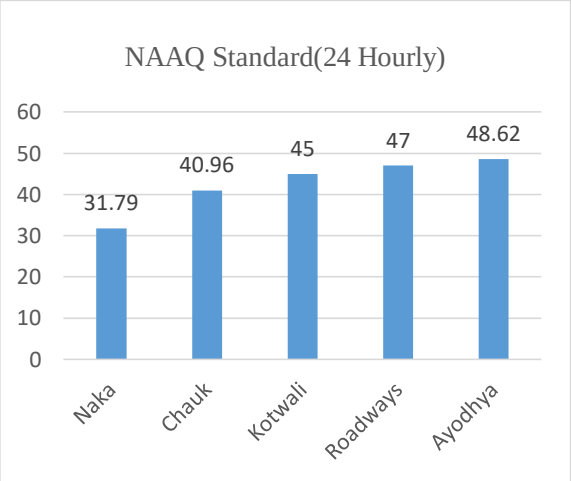
Oxides of nitrogen include NO, and NO_2, Source of NOx is natural anthropogenic. Environmental concentration of oxides of Nitrogen depends upon the source and fuel. It is primary pollutant and emitted by all type of fuels.
Concentration of NOx varies seasonally. Monthly mean and average NOx concentration were within the prescribed limit of CPCB for ambient air quality. The average concentration of the NOx year wise in the Table 1

Annual average concentration of oxides of nitrogen in the ambient air of Faizabad city

Table 1: Annual average concentration of the NOx in different location

Naka	Chauk	Kotwali	Roadways	Ayodhya
31.79	40.96	45.0	47.0	48.62

Concentration (µg/m^3)



3.2 Seasonal Variation of Oxides of Nitrogen:

3.2a. Summer Season

The average concentration of oxides of nitrogen in the ambient air during summer season in Table 2 and 3

Table 2: Average Concentration of the NOx in Summer season in different location

Naka	Chauk	Kotwali	Roadways	Ayodhya
36.75	46.85	49.40	52.50	54.15

Concentration (µg/m^3)

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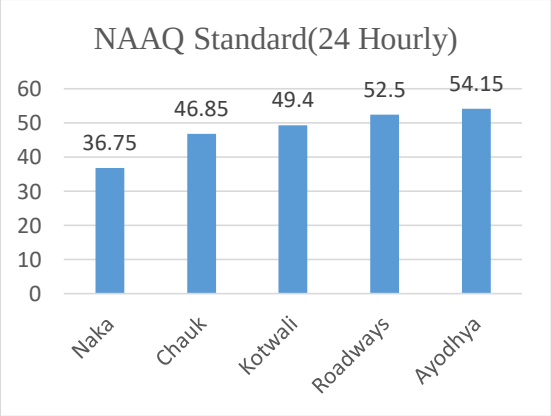

Table3: Monthly Observed Concentration of NOx during summer season

Month	Naka	Chauk	Kotwali	Roadway	Ayodhya
March	40.14 42.16	51.33 53.00	50.02 56.94	60.92 63.02	64.69 62.88
April	39.33 35.94	48.32 50.66	52.83 50.02	59.00 55.32	60.23 58.62
May	34.01 37.82	45.16 47.16	48.33 51.62	50.12 52.24	54.33 50.23
June	33.23 31.32	40.14 38.82	45.33 40.12	40.34 39.01	42.24 40.01
Minimum	31.35	38.84	40.12	39.02	40.02
Maximum	42.17	53.02	56.95	63.02	64.70
Average (N=8)	36.75	46.83	49.40	52.50	54.15

Concentration (µg/m) N= no. of sample

3.2b. Monsoon:

The average concentration of oxides of nitrogen in the ambient air during monsoon season given in the table

Table 4: Average Concentration of NOx in different location in Monsoon

Naka	Chauk	Kotwali	Roadways	Ayodhya
20.75	26.71	31.10	34.50	35.22

Concentration (µg/m^3)

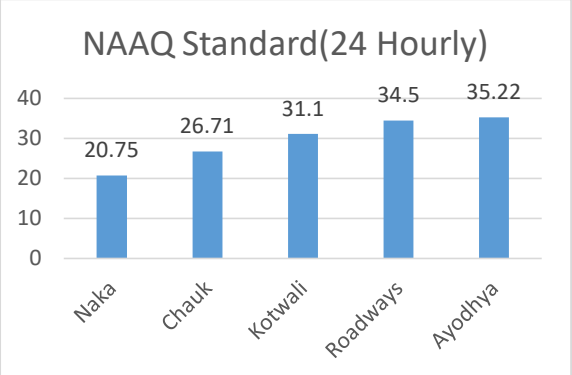

Table 5: Observed Concentration of NOx in ambient air during monsoon season

Month	Naka	Chauk	Kotwali	Roadways	Ayodhya
July	20.33 16.19	27.32 20.05	35.22 30.29	35.13 31.24	39.09 38.08
August	17.32 15.68	20.68 18.30	25.83 23.12	29.48 26.22	35.96 32.11
September	19.21 22.23	30.13 27.03	27.62 32.10	32.34 36.42	40.32 46.20
October	25.31 29.62	32.14 38.12	34.13 40.36	40.65 44.33	49.88 52.54
Minimum	15.70	18.30	23.14	26.33	32.11
Maximum	29.65	38.15	40.35	44.33	52.55
Average (N=8)	20.75	26.74	31.10	35.00	35.22

3.2c. Winter Season

Environmental concentration of NOx was higher in this season as compared to values observed during monsoon and summer. The average concentration of NOx of the season were given in the Table 6

Table6: Average **Concentration of NOx in different location in winter**

Naka	Chauk	Kotwali	Roadways	Ayodhya
37.85	49.70	51.83	54.01	57.00

Concentration (µg/m^3)

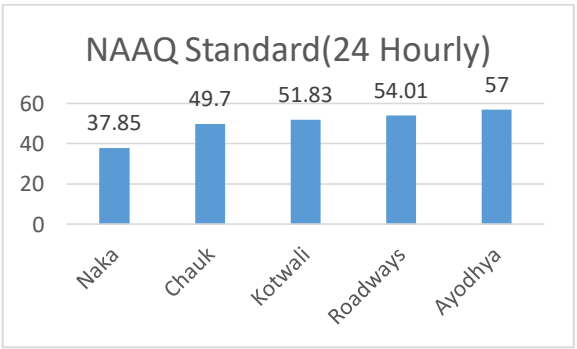

Table 7: Observed **NOx** level (µg/m^3) in ambient air of Faizabad city during winter.

Month	Naka	Chauk	Kotwali	Roadways	Ayodhya
November	30.14 28.58	46.00 44.00	48.02 45.93	50.32 49.00	54.14 52.65
December	35.19 39.74	48.02 50.63	48.95 50.02	50.93 52.24	53.34 56.75
January	40.26 42.45	48.23 46.02	53.24 55.02	56.78 55.29	56.00 28.57
February	40.82 45.02	56.01 59.65	61.13 58.30	58.23 60.16	59.15 62.15
Minimum	28.58	44.00	42.02	49.00	52.65
Maximum	45.00	59.65	61.15	60.17	62.15
Average (N=8)	37.85	49.70	51.83	54.02	57.00

Concentration (µg/m^3)

N= No. of sample

4.Conclusion:

The level of NOx was little bit higher but magnitude was less than the prescribed limits of CPCB at all the locations in all seasons. Study reveals that the maximum concentration of NOx was in the Kotwali and Roadways while in Naka and Chauk it was moderate and minimum in the Ayodhya area. The automobile statistics indicated that the consumption of petrol and diesel is increasing day by day (Greenberg A, Davack F, Harkov, 1985). The marginal increase in the concentration of NOx is attributed due to frequency of motorized travel, which has increased in the city. Registration of vehicle exhibit the percentage of two wheelers is highest in the city as compared to other vehicles. The two wheelers are based on two-stroke engine technology, which emit higher amount of NOx gases due to high combustion of temperature and availability of oxygen (CPCB). Such pattern of the use of motorized travel further contributes more NOx in the environment. As the automobiles are considered the major source of NOx the load of NOx may further increase due to increase in motorized travel (Bufalin TJ , 1971) has shown that NO2 can be toxic to certain biological systems and acute exposure to NO_2 has been reported to affect both the cellular and humoral immune system (Calabrese EJ, 1981)

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