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Ambient Air Quality of Nashik City 2017 (Maharashtra, India)

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ABSTRACT

Ambient air quality of Nasik city was monitored during the year 2017. Criteria pollutants selected for the monitoring was, sulphur dioxide (SO_2) & nitrogen dioxide (NO_2) and PM10 (Particulate Matter having aerodynamic diameter less than or equal to 10 µm) for the period of January 2017 to December 2017. Sampling was done for successive periods of about 4 hours for sulphur dioxides (SO_2), nitrogen dioxide (NO_2) and 8 hours for Respirable suspended particulate matter (PM10) for 24 hours. For Air Quality Monitoring, four representative sites were selected i.e. Industrial-S1-I-VIP, Commercial- S2-R-RTO and Residential-S3-C-NMC and Industrial-S4-I-UB. High volume air sampler were used to measure the concentration of nitrogen dioxide (NO_2), sulphur dioxides (SO_2) and Respirable suspended particulate matter (PM10). The results reported pertain to an eight hour successive continuous air sampling exercise carried out at each of the four selected locations in Nasik city. The value of PM10 (Particles ≥ 10µ, PM 10µg/m^3) was noted to be crossing the permissible limit and exceeded the National Ambient Air Quality Standard (NAAQS) at all locations. The concentration of SO_2 and NO_2 was within the National Ambient Air Quality Standard (NAAQS, National Ambient Air Quality Standers, November 18, 2009) at all the locations.

Keywords: PM10, Ambient Air Quality (AQI), National Ambient Air Quality Standard (NAAQS), Pollutant, Urban air sampling, Transport emissions.

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INTRODUCTION:

"Clean air is considered to be a basic requirement of human health and well- being. However, air pollution continues to pose a significant threat to health worldwide" (WHO, 2005). We could go days without food and hours without water, but we would last only a few minutes without air. Ambient air is the outdoor air in which mankind and other organisms survive and respire (Daly, 2007). Ambient air quality refers to the quality of outdoor air in our surrounding environment. The term "air quality" means the state of the air round us. Good air quality refers to clean, clear, unpolluted air. Air pollution occurs when the air contains substances in quantities that could harm the comfort or health of humans and animals, or could damage plants and materials. These substances are called air pollutants and can be either particles, liquids or gases in nature (Alias, *et al.*, 2007). The atmosphere, which makes the largest fraction of the biosphere, is a dynamic system that continually absorbs a wide range of solids, liquids and gases from both natural and man-made (Anthropological) activities (Mahindra S.P and Krishnamurthy D.,2005). Various types and amounts of material enters, interact within and with atmosphere. Polluted air, polluted space, polluted land and polluted water are the resulting undesired by-products. Awareness of air contamination and measures to monitor and control air quality are inadequate considering the rapidity of the increase in pollution levels. Many epidemic effects of air pollutants are prevalent (Brunekreef, Dockery, and Krzyzan. *et al.*, 1995, CPCB, 2012). The assessment of the Air Quality is presently linked to the Air pollution levels and to the size of populations. To protect the health, the concentrations of selected harmful air pollutants should be limited and related to given ambient air quality standards (Ahmed Haytham, 1999).

The major objectives of monitoring air pollutant levels is to provide an early warning system for pollutant levels, which may have the potential for endangering public health; to assess air quality in light of established public health and welfare standards; to track air pollution trends and changes in ambient air quality due to changes in the amount of pollutants emitted; to produce information for city planning, e.g. Location of new industries and housing and to access the environmental impact of industry and other activities.

MATERIALS AND METHODS:

Ambient air quality was monitored during the year 2017 (January2017 to December 2017), concentrations of sulphur dioxides (SO_2), nitrogen dioxide (NO_2) and PM10 (Particulate Matter having aerodynamic diameter less than or equal to 10 µm) were collected over successive periods of about 4 hours and 8 hours in a day respectively. Four representative sites were selected for the study, Industrial-S1-I-VIP, Commercial-S2-R-RTO and Residential-S3-C-NMC and Industrial-S4-I-UB. High volume air sampler was used to measure the concentration of nitrogen dioxide (NO_2), sulphur dioxides (SO_2) and Respirable suspended particulate matter (PM10).

Repirable Suspended Particulate Matter (PM10) was measured by Cyclonic Flow Technique. Nitrogen oxides were measured by Modified Jacobs and Hochheiser Method (Sodium Arsenite method). Sulphur oxides were measured by Modified West and Gaeke Method

About the study area**:** Nasik, a thickly populated poorly ventilated air basin being polluted by the ever-expanding transport, construction, and commercial activities. Nasik is amongst the fastest growing cities, it rates fourth in India and sixteenth in the world, and hence, it is necessary to forecast the impact of pollutants from the various sources located in the city for the purpose of arriving at a comprehensive air pollution scenario. Nasik is one of the four places where Kumbha Mela is held once every 12 years. For the Hindus, Nasik is one of the holiest cities. Nasik is located in the "Western Ghats" on the western edge of the "Deccan" on the banks of river "Godavari".

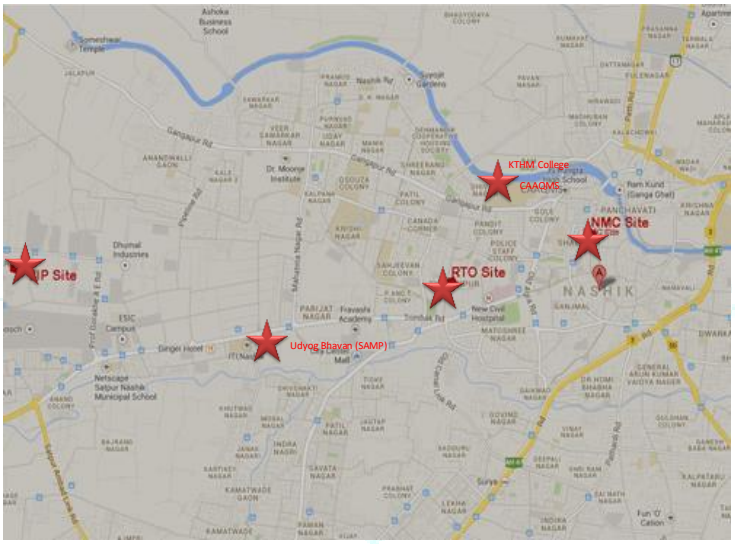


Figure: Map of Nasik City with Ambient Air Quality Monitoring Locations

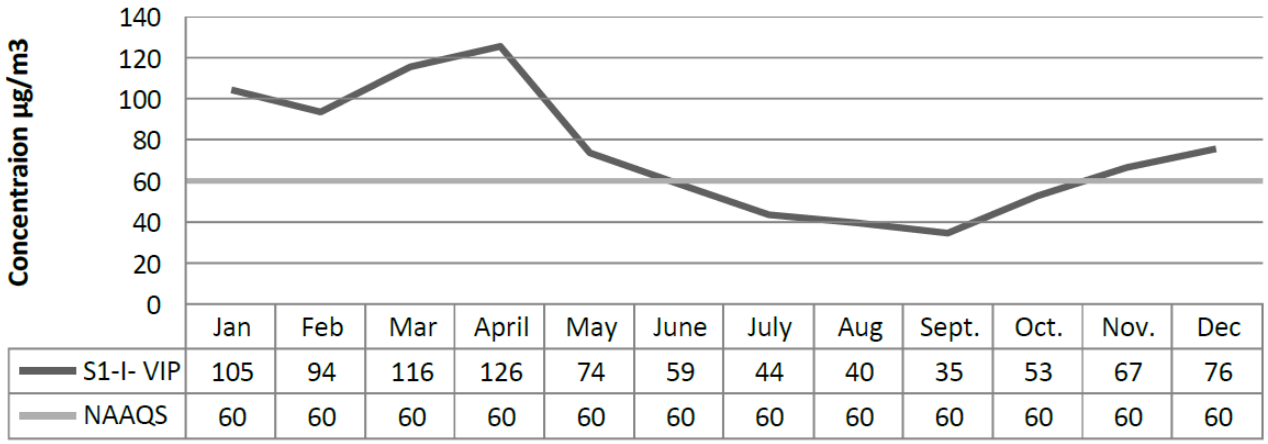
RESULTS AND DISCUSSION:

Concentrations of selected criteria pollutants (i.e. PM10, SO_2 and NO_2) on selected air quality monitoring sites (i.e. S1-I-VIP, S2-R-RTO, S3-C-NMC & S4-I-U.B.) were measured and calculated for respective period. Concentration of those pollutants was compared with National Ambient Air Quality Standards (NAAQS) for the period of January 2017 to December 2017.

Table1: Concentration of Criteria pollutants i.e. SO_2, NOx & PM10 on S1-I-VIP site for the period of January 2017 to December 2017(Concentration in µg/m^3)

S1-I-VIP*						
Month	SO_2 µg/m^3		NO_2 µg/m^3		PM10 µg/m^3	
	Average	Maximum	Average	Maximum	Average	Maximum
January	15	42	25	37	107	200
February	17	43	26	38	94	160
March	18	35	26	40	116	196
April	19	42	26	38	126	227
May	13	40	24	38	74	146
June	10	23	19	34	59	112
July	8	14	13	34	44	106
August	8	16	13	18	40	67
September	9	14	15	21	35	95
October	8	15	19	53	53	208
November	7	19	19	32	67	125
December	4	20	17	32	76	138
Annual Average	11	42	20	40	74	227

* S1- Site 1, I-Industrial, VIP- Name of Site location i.e. VIP company, MIDC Area, Satpur Nasik



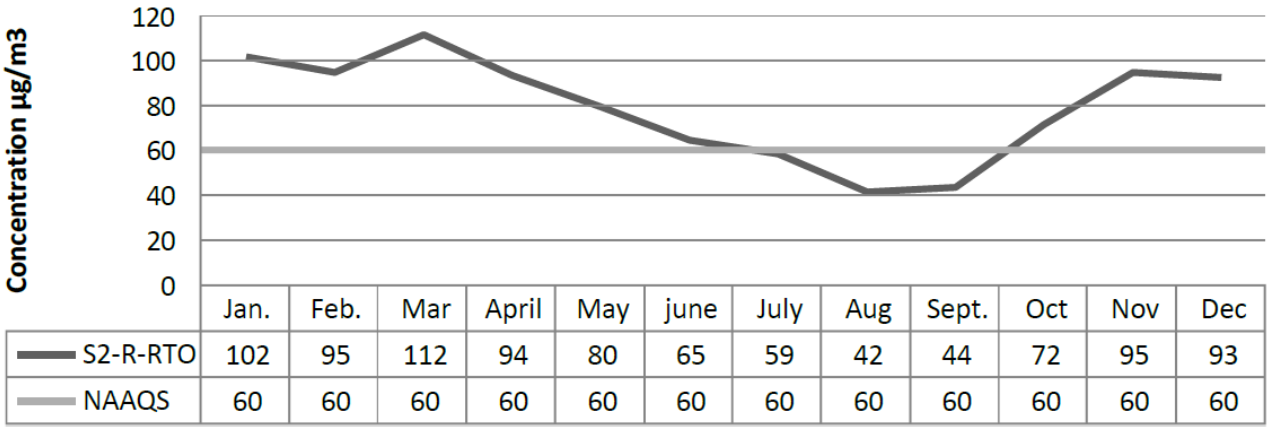
Graph 1: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S1-I-VIP site for the period of January 2017 to December 2017(Concentration in µg/m^3)

Graph 1 displays the monthly concentration of criteria pollutant PM10 on S1-I-VIP air quality monitoring site against NAAQS in the year 2017. PM10 concentration remains more than the average NAAQS from January 2017 to May 2017, November and December 2017. In April 2017 PM10 concentration was126 µg/m3, this is 66µg/m^3 more than the annual NAAQS average. PM10 Concentration remains lower than the NAAQS from June to October 2017. was observed from November onwards.

Table2: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S2-R-RTO site for the period of January 2017 to December 2017(Concentration in µg/m^3)

S2-R-RTO*						
Month	SO2		NO2		PM10	
	Average	Max.	Average	Max.	Average	Max.
January	17	44	28	42	102	189
February	19	48	29	43	95	132
March	21	42	30	46	112	185
April	22	46	28	42	94	178
May	13	38	26	38	80	147
June	11	22	22	36	65	143
July	9	15	15	21	59	131
August	9	16	15	27	42	60
September	9	15	16	22	44	87
October	10	19	20	59	72	205
November	8	20	22	35	95	169
December	4	14	19	46	93	202
Annual Average	13	48	22	59	79	205

* S2- Site 2, R-Residential, RTO- Name of Site location i.e. NMC Water Tank, Near Golf Club, Nasik



Graph 2: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S2-R-RTO site for the period of January 2017 to December 2017(Concentration in µg/m^3)

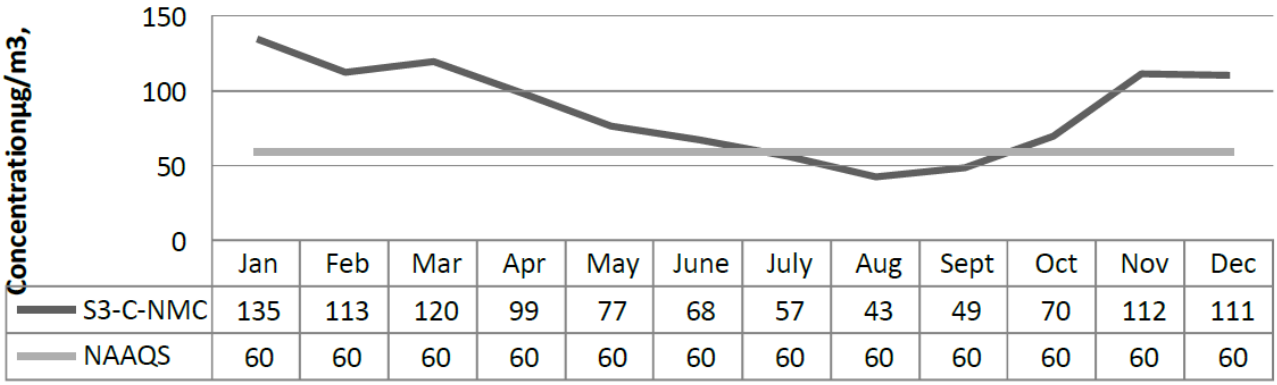
Table 2 shows the concentrations of criteria pollutants during the monitoring period on S2- R-RTO site for the period of January 2017 to December 2017. Annual average concentration measured during the sampling period was, 13µg/m^3 and 22µg/m^3 for SO2 and NO2 respectively, which were within the permissible limit of NAAQS. Concentration of PM PM10 was 79µg/m^3, which is more than National Ambient Air Quality Standards. Maximum concentration for the 8 hours sampling was 205µg/m^3 in the month of April 2017.

Graph 2 displays the monthly concentration of criteria pollutant PM10 on S2-R-RTO air quality monitoring site against NAAQS in the year 2017. PM10 concentration remains more than the average NAAQS from January 2017 to June 2017, November and December 2017. In March 2017 PM10 concentration was 112µg/m3, this is 52µg/m^3 more than the annual NAAQS average. PM10 Concentration remains lower than the NAAQS from June to October 2017.

Table 3: Concentration of Criteria pollutants i.e. SO_2, NOx & PM10 on S3-C-NMC site for the period of January 2017 to December 2017(Concentration in µg/m^3)

S3-C-NMC*						
Month	SO2		NO2		PM10	
	Average	Max.	Average	Max.	Average	Max.
January	17	49	28	41	135	270
February	20	50	27	40	113	204
March	19	44	29	41	120	273
April	21	43	28	41	99	183
May	14	44	25	41	77	204
June	10	21	22	36	68	133
July	9	15	14	23	57	116
August	9	17	14	21	43	64
September	10	14	16	21	49	110
October	9	22	19	47	70	187
November	6	19	21	32	112	161
December	4	11	20	29	111	192
Annual Average	12	50	22	47	83	273

* S3- Site 2, C-Commercial, NMC- Name of Site location i.e. Nashik Municipal Corporation Build. Nasik



Graph 3: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S3-C-NMC site for the period of January 2017 to December 2017(Concentration in µg/m^3)

Table 3 shows the concentrations of criteria pollutants during the monitoring period on S3- C-NMC site for the period of January 2017 to December 2017. Annual average concentration measured during the sampling period was, 12µg/m^3 and 22µg/m^3 for SO2 and NOx respectively, which were within the permissible limit of NAAQS. Concentration of PM PM10 was 83µg/m^3, which is more than National Ambient Air Quality Standards. Maximum concentration for the 8 hours sampling was 273µg/m^3 in the month of April 2017.

Graph 3 displays the monthly concentration of criteria pollutant PM10 on S3-C-NMC air quality monitoring site against NAAQS in the year 2017. PM10 concentration remains more than the average NAAQS from January 2017 to June 2017, November and December 2017. In January 2017 PM10 concentration was 135µg/m3, this is 75µg/m^3 more than the annual NAAQS average. PM10 Concentration remains lower than the NAAQS from July to October 2017.

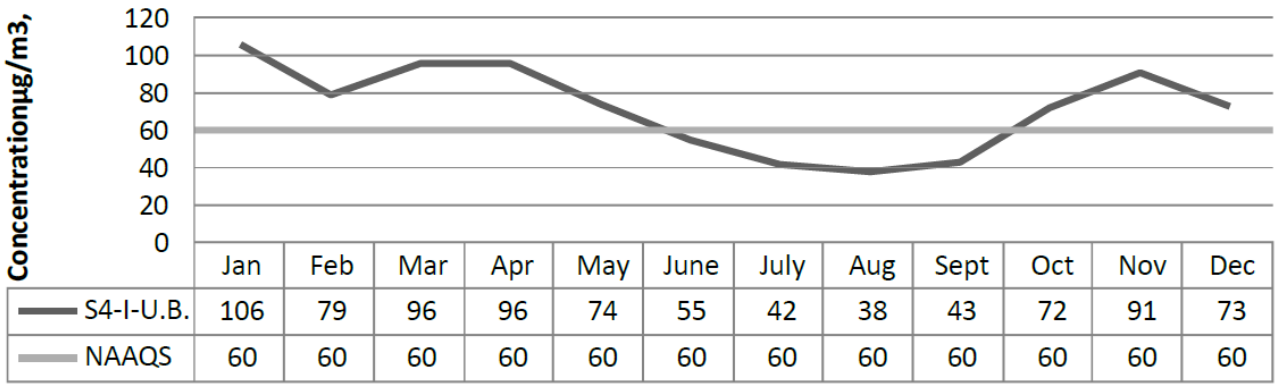
Table 4: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S4-I-UB site for the period of January 2017 to December 2017(Concentration in µg/m^3)

S4-I-UB*						
Month	SO2		NOx		PM10	
	Average	Max.	Average	Max.	Average	Max.
January	16	47	28	28	106	327
February	19	49	28	45	79	229
March	20	42	28	44	96	247
April	22	47	31	42	96	210
May	15	44	26	41	74	208
June	11	24	23	37	55	171
July	10	22	15	44	42	120
August	9	18	14	21	38	98
September	9	18	16	22	43	105
October	10	28	22	82	72	229
November	7	19	23	39	91	301
December	5	20	21	102	73	202
Annual Average	13	31	23	46	72	204

* S4- Site 4, I-Industrial, UB- Name of Site location, i.e. Udyog Bhavan, Trimbak Road,Satpur, Nasik

Table 4 shows the concentrations of criteria pollutants during the monitoring period on S4- I-UB site for the period of January 2017 to December 2017. Annual average concentration measured during the sampling period was, 13µg/m^3 and 23µg/m^3 for SO2 and NOx respectively, which were within the permissible limit of NAAQS. Concentration of PM PM10 was 72µg/m^3, which is more than National Ambient Air Quality Standards.

Maximum concentration for the 8 hours sampling was 204µg/m^3 in the month of April 2017.



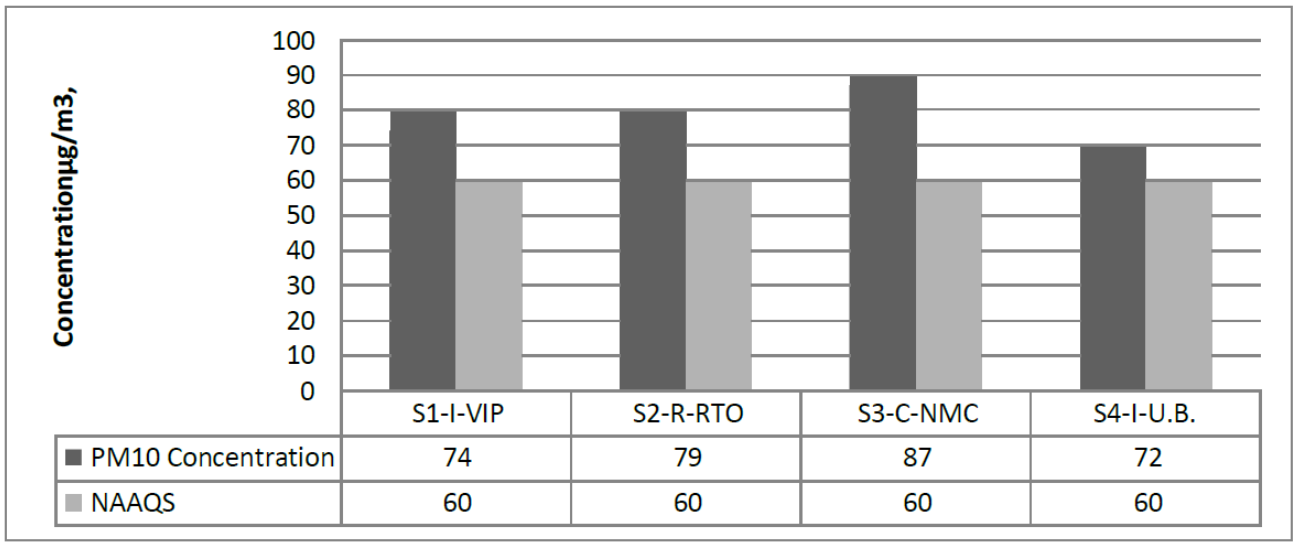
Graph 4: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on S3-C-NMC site for the period of January 2017 to December 2017(Concentration in µg/m^3)

Graph 4 displays the monthly concentration of criteria pollutant PM10 on S4-I-UB air quality monitoring site against NAAQS in the year 2017. PM10 concentration remains more than the average NAAQS from January 2017 to May 2017, November and December 2017. In January 2017 PM10 concentration was 106µg/m3, this is 46µg/m^3 more than the annual NAAQS average. PM10 Concentration remains lower than the NAAQS from June to October 2017.

Table 5: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on all sites for the period of January 2017 to December 2017(Concentration in µg/m³)

City	Station Name	Class	SO_2 (µg/m³)		NO_2 (µg/m³)		RSPM (µg/m³)	
			Max	Avg.	Max	Avg.	Max	Avg.
Nashik	S1-I-VIP	I	27	11	34	20	148	74
	S2-R-RTO	R	28	13	38	23	152	79
	S9-C-NMC	C	29	12	34	20	175	87
	S4-I-U.B.	I	32	13	46	23	204	72
Annual Average			32	12.25	46	21.5	204	78

Table 5 shows the concentrations of criteria pollutants during the monitoring period on all selected site for the period of January 2017 to December 2017. Annual average concentration measured during the sampling period was, 12.25µg/m^3 and 21.5µg/m^3 for SO2 and NOx respectively, which were within the permissible limit of NAAQS. Concentration of PM PM10 was 78µg/m^3, which is more than National Ambient Air Quality Standards. Maximum concentration for the 8 hours sampling was 204µg/m^3 in the month of April 2017.



Graph 5: Concentration of Criteria pollutants i.e. SO_2, NO_2 & PM10 on all sites for the period of January 2017 to December 2017(Concentration in µg/m³)

Graph 5 displays the monthly concentration of criteria pollutant PM10 on All air quality monitoring site against NAAQS in the year 2017. PM10 concentration remains more than the average NAAQS. Maximum concentration noted at S3-C-NMC which is representing the commercial area.

CONCLUSION

This work represents an in-depth investigation of the status and condition of ambient air quality of Nashik city during the period of January 2017 to December 2017. The concentration of SO_2 and NO_2 observed to be within the limits of National Ambient Air Quality Standards (NAAQS) on all selected air quality monitoring sites. But, the concentration of PM10 observed to be much higher than National Ambient Air Quality Standards (NAAQS) on all selected air quality monitoring sites. It is observed that PM10 concentration crosses the predicable limits during summer and winter seasons, while in rainy season, dust steeled down on the ground which lower the PM10 concentration. Being Nasik is one of the fastest growing cities in Maharashtra (India), Transport related emissions are the major sources of air contamination, increasing civil construction activities also contribute to particulates. The exponential rise in the number and volume of vehicles, disadvantageous traffic flow pattern, differing driving cycle pattern, old and outdated transport vehicles and human interceptions deserve due attention.

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