

ANALYTICAL STUDY ON URBAN AIR POLLUTANTS OF SOLAPUR CITY

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Abstract

The Central Pollution Control Board (CPCB) has initiated National Ambient Air Quality Monitoring program (NAMP) in 98 cities in India to monitor air pollution in urban areas. Following paper sheds light on the analytical comparison of the concentration of various pollutants for the city of Solapur a major town on the Karnataka Maharashtra border for a period of past three years i.e. from 2017 to 2019. Solapur, which is agro climatically dry for most of the year except Monsoon, is showing an increasing trend in terms of vehicular emissions especially NOx and Ozone parameters. The dry conditions further add to the RSPM component of the particulates and city has shown alarming levels of suspended particulate matter (PM 10) and respirable suspended particulate matter (PM 2.5). The average Air Quality is also plummeting with a dramatic fall in the AQI for the month of August last year in 2019.

Keywords: Air pollution, Air quality, Particulate Matter, vehicular emissions, Sox, NOx.

INTRODUCTION

Rising levels of particulates and deteriorating air quality in urban areas of Indian cities is meddling with the day to day life of its residents and causing detrimental effects on health and atmosphere (Maji *et al.*, 2016).

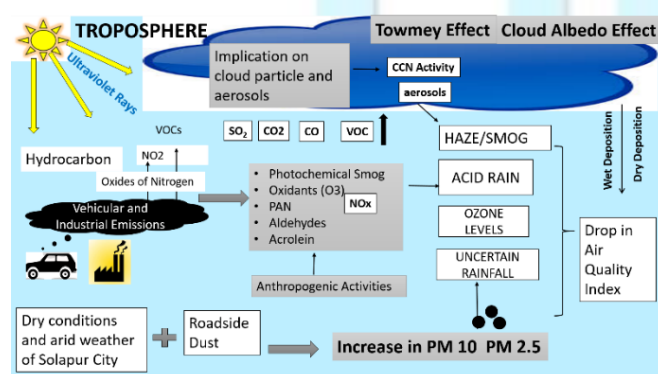


Figure 1: Sources and Effect of major air pollutants on Troposphere

Solapur city falling under rain shadow region faces scanty and uncertainty in rainfall where the monsoon period lasts from beginning of June lasting till end of September. The average rainfall for the district is 620.57mm (Board, 2001). Industrial and vehicular emissions are responsible for deteriorating urban air quality with SPM and RSPM at alarming levels. In order to monitor the air quality, the Central Pollution Control Board (CPCB) has initiated continuous monitoring under Continuous Ambient Air Quality Monitoring Stations (CAAQM) and National Ambient Air Quality Program (NAMP) program to analyse and monitor the increase in trends of different air pollutants across 98 Indian cities. At the State level, Maharashtra Pollution Control Board (MPCB) monitors the air quality across Maharashtra through a network of 71 active Ambient Air Quality Monitoring Stations (AAQMS) spread over 25 cities. (AQI report)

The following study deals with the comparative analysis of air pollutant parameters at three different locations in the Solapur City of Maharashtra falling in Pune Division. The paper compares the concentration of Carbon Monoxide, Ozone, Sulphur dioxide, oxides of Nitrogen and particulates, over the period of past three years i.e from 2017 to 2019 to help assess the regional and seasonal changes affecting the different levels of gaseous and particulate pollutants throughout the year in the monitored area.

MONITORING LOCATIONS AND PARAMETERS

Following air quality parameters CO, SO₂, NO₂, SPM, RSPM and ozone are chosen as a part of urban air analysis of pollutants at three different locations within the city. Continuous monitoring is done under CAAQMS at Solapur Municipal Corporation building premises. Whereas monitoring twice a week is done under NAMP at Saat Rasta, a major road circle of the city and Walchand Institute of Technology, Ashowk Chowk, premises of a well renowned Engineering, college.

TABLE 1
RANKING OF SOLAPUR CITY FOR 2017 AND 2018
AQI REPORT.

Pollution Index		
Cities	2017 Global Ranking	2018 Global Ranking
Gurugram	1	1
Ghaziabad	2	2
Faridabad	6	4
Mumbai	113	71
Aurangabad	241	142
Pune	276	153
Solapur	272	233

Source: IQ Air Visual 2018 World Air Quality Report

TABLE 2
NATIONAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT	TIME WEIGHTED AVERAGE	CONCENTRATION IN AMBIENT AIR		
		INDUSTRIAL AREA	RESIDENTIAL AREA RURAL AREAS AND OTHER AREAS	SENSITIVE AREA
SULPHUR DIOXIDE (SO ₂)	Annual average	80 µ/m ³	60 µ/m ³	15 µ/m ³
	24 Hour average	120 µ/m ³	80 µ/m ³	30 µ/m ³
OXIDES OF NITROGEN (NO ₂)	Annual average	80 µ/m ³	60 µ/m ³	15 µ/m ³
	24 Hour average	120 µ/m ³	80 µ/m ³	30 µ/m ³
SUSPENDED PARTICULATE MATTER (SPM)	Annual average	360 µ/m ³	140 µ/m ³	70 µ/m ³
	24 Hour average	500 µ/m ³	200 µ/m ³	100 µ/m ³
RESPIRABLE PARTICULATE MATTER (RSPM)	Annual average	120 µ/m ³	60 µ/m ³	50 µ/m ³
	24 Hour average	150 µ/m ³	100 µ/m ³	75 µ/m ³
LEAD (PB)	Annual average	1.0 µ/m ³	0.75 µ/m ³	0.50 µ/m ³
	24 Hour average	1.5 µ/m ³	1.0 µ/m ³	0.75 µ/m ³
	Annual average	50. mg/m ³	2.0 mg/m ³	1.0 mg/m ³

CARBON MONOXIDE (CO)	24 Hour average	10.0 mg/m ³	4.0 mg/m ³	2.0 mg/m ³
AMMONIA (NH ₃)	Annual average	0.1 mg/m ³		
	24 Hour average	0.4 mg/m ³		

GASEOUS POLLUTANTS-OZONE CONCENTRATIONS

In 2018-19, the CAAQMS at Solapur, recorded Ozone concentrations exceeding the standard limit of 100 µg/m³ (Fig 2). In Solapur, the months of March (100.2 µg/m³), April (124.6 µg/m³) and May (110.9 µg/m³) recorded a high O₃ concentration, while the concentration was within the standard limit of 100 µg/m³ during the rest of the year (Maharashtra pollution control board, 2018).

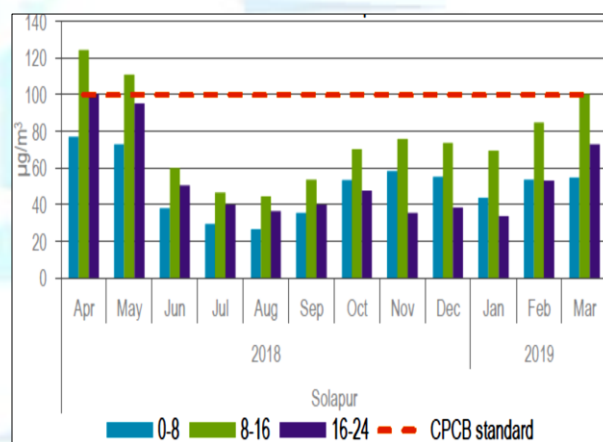


Figure 2: 8 Hourly Average Ozone concentrations recorded by CAAQMS Solapur

Source: Air Quality Status of Maharashtra 2018-19

CARBON MONOXIDE(CO) CONCENTRATIONS

CO concentrations are within the limit except post Monsoon. Among all the locations, CAAQMS at Solapur recorded CO concentrations exceeding the limit for seven consecutive months from September 2018 to March 2019. The highest concentration of CO was in the month of November (3.34 mg/m³) (Maharashtra pollution control board, 2018). Solapur exceeded 8-hourly concentration standards of 2 mg/m³ post monsoon (Fig 3).

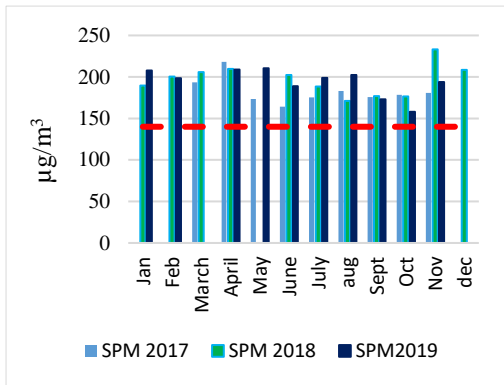


Figure 3: 8 Hourly Average CO Concentrations recorded by CAAQMS Solapur

Source: Air Quality Status of Maharashtra 2018-19

NOX AND SOX CONCENTRATIONS

NOx levels has shown consistent rise for all the three years (Fig 4). The Municipal Corporation area of the city has consistently recorded increased levels of NOx with the highest being in the year 2019 about 93.33 µg/m³. There is huge difference between the NOx levels measured at Municipal corporation and other two monitored stations where the former has surpassed the permissible limit of 60 µg/m³ for residential areas for two consecutive years. Solapur CAAQMS has recorded SOx levels which are well within the permissible limit highest being recorded as 18.84 µg/m³ for the year 2019 at Saat Rasta and 18.64 µg/m³ for the year 2017 at Municipal Corporation Area (Fig 5)

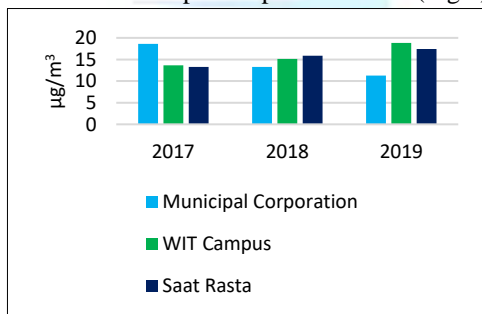


Figure 4: Average SOx Concentrations

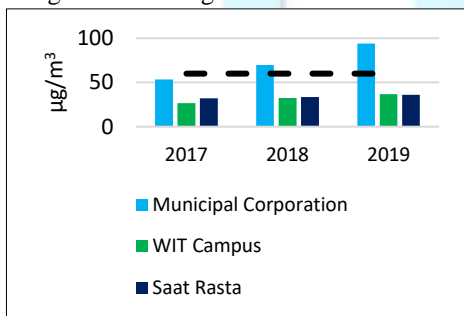


Figure 5: Average NOx Concentrations

SUSPENDED PARTICULATE MATTER (PM 10) AND RESPIRABLE PARTICULATE MATTER (PM 2.5) CONCENTRATIONS

RSPM i.e. Particulate Matter 2.5 which are particulates smaller than 2.5 micron and SPM i.e suspended particulate matter PM 10 which are particulates smaller than 10 microns are the major problem for the city as PM 2.5 levels are increasing at an alarming rate. Average RSPM levels has shown an increasing trend in all the monitored areas.

Municipal corporation area has shown a consistent rise in RSPM levels highest being recorded as 110.49 µg/m³ for the year 2017. This number exceeds the annual average limit of 60 µg/m³ prescribed for residential areas. (Fig 6).

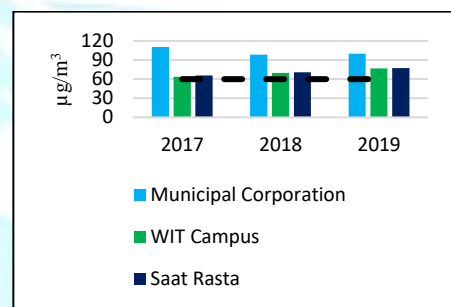


Figure 6: Average RSPM Concentrations

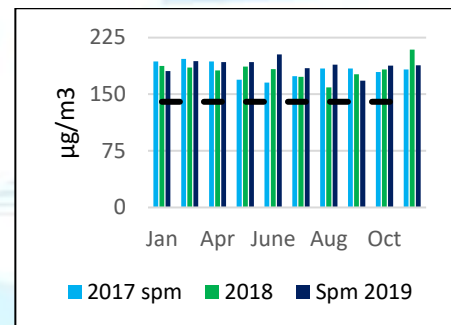


Figure 7: Average SPM Concentrations at WIT, Ashowk Chowk

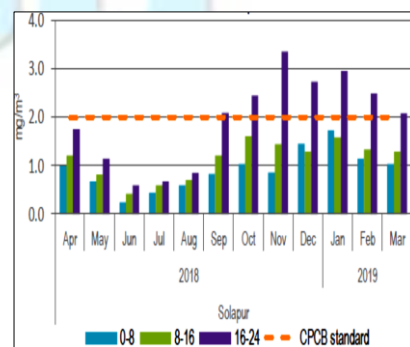


Figure 8: Average SPM Concentrations at Saat Rasta

Similar trends are observed at the WIT station where the annual average SPM levels had crossed the prescribed limit of $140 \mu\text{g}/\text{m}^3$ for all the months and the highest being recorded as $209.05 \mu\text{g}/\text{m}^3$ for the month of November in 2018 (Fig 7). Increasing trends in average SPM concentrations at Saat Rasta area were observed for almost all the years and a level high of $233 \mu\text{g}/\text{m}^3$ was recorded for the month of November 2019 (Fig 8)

AVERAGE AIR QUALITY INDEX

Except for Monsoon season when the AQI is Healthy to Moderate, average Air Quality falls in the ‘unhealthy for sensitive groups category’ i.e from 101-150 throughout the year. Dramatic fall in AQI was observed for the month of August 2019 post monsoon and a high of 220.84 was recorded (Fig 9)

TABLE 3
AIR QUALITY INDEX

Index Value	Name	Color	Advisory
0 to 50	Good	Green	None
51 to 100	Moderate	Yellow	Unusually sensitive individual should consider limiting prolonged outdoor exertion
101 to 150	Unhealthy for Sensitive group	Orange	Children, active adults, people with respiratory disease such as asthma, should limit prolonged outdoor exertion
151 to 200	Unhealthy	Red	Children, active adults, people with respiratory disease such as asthma, should avoid prolonged outdoor exertion; everyone else should limit prolonged outdoor exertion
201 to 300	Very Unhealthy	Purple	Children, active adults, people with respiratory disease such as asthma, should avoid outdoor exertion; everyone

			else should limit outdoor exertion
301 to 500	Hazardous	Maroon	Everyone else should avoid all physical activity outdoor.

CONCLUSION

It can be concluded that the rise of pollution in Solapur city can be because of anthropogenic activities, biomass burning and vehicular emissions. Topographically Solapur falls in a rain shadow region. The dry conditions and arid weather of the city further adds to the dust component of the particulates. Roadside dust is a major cause of increasing SPM and RSPM levels leading to drastic air pollution in the city especially in the beginning of year. Since Solapur CAAQMS recorded high concentrations of Carbon monoxide and Ozone continuously for a prolonged period of time for past two years, the problem needs to be addressed and the concentration levels need to be brought down (CPCB, 2015). Solapur needs to take concrete steps to alleviate RSPM and SPM levels in order to mitigate air pollution.

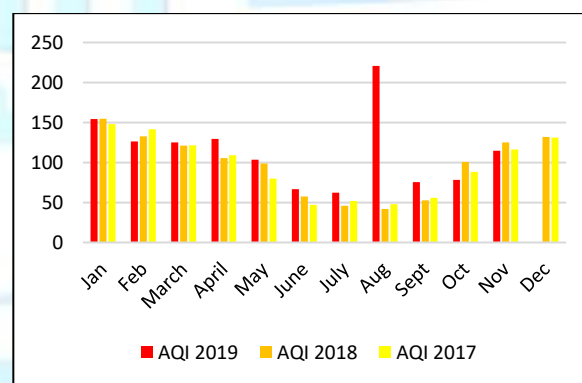


Figure 9: Average AQI for Municipal Corporation.

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