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Effect of air pollution by thermal power plant in Chandrapur district

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Abstract

Chandrapur district consists of coal based power plants, coal mines, coal washeries, cement industries, hence there is need to know air quality, which impact on human and plant health. Air pollutants namely SO₂, NO₂, RSPM, SPM and AQI were monitor during 2019, 2020 and 2021 at various recording station and compared with national ambient air quality standards. SO₂ and NO₂ concentration were under the limit. Highest SO₂ concentration was recorded by old MIDC station, whereas highest NO₂ concentration was monitored by SRO office station. Ghuggus was most polluted station due to high concentration of RSPM, SPM and AQI.

Keywords: Air pollution, thermal power plant, SO₂, NO₂, RSPM, SPM, AQI

Introduction

Air pollution has been a matter of serious concern in all the urban cities in India. Maharashtra has a number of metropolitan cities; air pollution is an issue of social and economic importance (Motghare V. M. *et al.*, 2020) [5]. Coal is the only natural resources and fossil fuel available in abundance in India, consequently also as fuel for thermal power plants producing electricity (Mishra U. C. 2004) [4]. More than 65% of India's electricity generation capacity comes from thermal power plants, with 85% of the country's thermal power generation being coal-based. Maharashtra consists of 27 thermal power plants. As of 31st December 2021, Maharashtra leads in coal based power generation capacity (23856 MW). The Chandrapur super thermal station is a 2920 MW power plant in Chandrapur, Maharashtra. It is the biggest state power plant operated by the Maharashtra state power generated capacity.

Combustion process converts coal into useful heat energy, but it is also a part of the process that produce greatest environmental and health concerns. Combustion of coal at thermal power plants emits mainly carbon dioxide (CO₂), sulphur oxides (SO₂), nitrogen oxides (NO_x), CFCS other trace gases and air borne inorganic particulates, such as fly ash and suspended particulate matter (SPM). Chandrapur region has been constantly exceeding the RSPM levels. This is because of the operations related to coal mining, thermal power plant and rice and paper mills along with constitution activities. (Shamshad Ahmad *et al.*, 2012) [8].

In areas having high vehicular movement/traffic, the level of NO_x found to be significantly higher as it gets released as part of vehicular emissions, headache, eye irritation and lung related problems. Thus necessary mitigation step was taken by the Indian Ministry of Road Transport and Highway (MORTH) on Bharat stage VI (BS-VI) emissions standards which would help considerably to lower the NO_x emissions. The SPM also includes RSPM (Respirable suspended particulate matters) and both types of fine particles normally spread over 25 kms from the thermal power station. These pollutants cause respiratory and related ailments to human beings and animal kingdom. Because of deposition of SPM on the plants, photosynthesis process of plants is affected very badly. These particles penetrate inside the plants through leaves and branches thereby creating imbalance of minerals micro and major nutrients in the plants. All these affect the plant growth very badly. Due to this no big industrial zone is developed within 20 kms radius of the source and the habitations too are facing severe problems. Spreading and deposition of SPM on soil disturbs the contents of minerals, micro and major nutrients. Continuous and long term deposition of SPM causes the fertile and forest land to be unproductive for plants and farming.

Due to continuous and long emission of SO₂, NO₂, which are the principal pollutants coal structures too are, affected very badly due to corrosive (acid rain) reactions. It is also worth to note that very high amount of carbon dioxide (CO₂) emission (0.9 – 0.95 kg/kWh) from

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thermal power plants contribute to global warming leading to climate change (Pokale W. K. 2012)^[6].

Materials and Methods

Ambient air quality monitoring stations are installed in Chandrapur district at plot no. 8-17. old MIDC, office of Nagar parishad (SRO Office), M/s, Multiorganic Pvt. Ltd. (MIDC) Chandrapur, office of Gram Panchayat Ghuggus, Rajura, Ballarshah, and Tadali MIDC to collect pollutant data by Maharashtra Pollution control board. The daily or hourly concentration of air pollutants including sulphur dioxide (SO₂), nitrogen dioxide (NO₂), respirable suspended particulate matter (RSPM), suspended particulate matter (SPM) Air Quality Index (AQI) have been obtained from Maharashtra pollution central board online portal for the years 2019, 2020 and 2021. It was compared with National Ambient Air Quality Standards to know the quality of air also

impact of air pollution on human and plant health.

Results and Discussion

All the stations were recorded SO₂ concentrations in the range of 4.19 to 9.81 µg/m³ during 2019, (Table 1), 4.00 to 13.24 µg/m³ during 2020 (Table 2) and 4.00 to 11.80 µg/m³ during 2021 (Table 3). Among these stations, highest annual average concentration was recorded by old MIDC, Chandrapur station; however it was less than annual standard (50µg/m³). It was recorded highest (13.24 µg/m³) during year 2020 than 2019 and 2021. The reason of highest concentration at old MIDC, Chandrapur was coal burning industries, coal mines and thermal power plants. Hence, appropriate mitigative measures must be taken to keep emissions under control. Its causes skin and eye irritation, cough, asthma, chronic bronchitis, lung function impairment. It promotes opening of stomata causing excessive water loss.

Table 1: Status of Ambient Air Quality (Annual Average) for 2019

Sr. No.	Station	Concentration in Pollutant of Ambient Air				
		SO ₂ µg/m ³	NO ₂ µg/m ³	RSPM µg/m ³	SPM µg/m ³	AQI
1.	Old MIDC	9.81	19.53	74.38	NA	75
2.	SRO Office	4.27	32.36	90.22	196.56	89
3.	MIDC Chandrapur	4.27	29.14	91.09	205.84	90
4.	Ghuggus	4.28	28.57	220	302	186
5.	Rajura	4.19	29.00	168.49	265.79	69
6.	Ballarshah	4.22	29.30	135.27	234.04	114
7.	Tadali MIDC	4.20	29.24	110.11	188.10	105

Annual average NO₂ concentration was recorded at all stations and represent in Table 1, Table 2 and Table 3 and it was ranging from 13.18 to 34.00 µg/m³ less than annual standard (40 µg/m³) during all three years. The highest NO₂ concentration was recorded at SRO office, Chandrapur (32.36 µg/m³) during 2019, 34.00 µg/m³ during 2020 and 34.00 µg/m³ during 2021. It was highest during 2020 and 2021 at SRO office, Chandrapur than 2019. Highest NO₂ concentration (34.00 µg/m³ was only 15% less than standard

limit. Vehicular exhaust is the primary reason behind NO₂ pollution. The government of India is taking concrete measures in curbing the pollution levels causing due to vehicular emissions by using Bharat stage VI (BS-VI) emission standards. Its impact on human is nose eye and throat irritation, headache, reduced being function, reduced oxygenation of body tissues. Foliage damage, stunted growth, increased susceptibility to frost damage of plants.

Table 2: Status of Ambient Air Quality (Annual Average) for 2020

Sr. No.	Station	Concentration in Pollutant of Ambient Air				
		SO ₂ µg/m ³	NO ₂ µg/m ³	RSPM µg/m ³	SPM µg/m ³	AQI
1.	Old MIDC	13.24	14.40	60.76	NA	67
2.	SRO Office	4.00	34.00	102.00	NA	101
3.	MIDC Chandrapur	4.39	27.93	94.49	196.71	93
4.	Ghuggus	4.36	27.73	175.91	250.26	153
5.	Rajura	4.37	27.66	153.24	239.78	134
6.	Ballarshah	4.38	27.35	112.23	196.14	107
7.	Tadali MIDC	4.18	27.67	118.00	215.92	111

Annual RSPM concentration was recorded ranging 60.76 µg/m³ to 253.96 µg/m³, which was higher than standard limit (60 µg/m³). The lowest concentration was observed (60.76 µg/m³) by old MIDC, Chandrapur during 2020 (Table 2) whereas highest concentration was observed (253.96 µg/m³) at Guggus during 2021 (Table 3). Overall RSPM concentration was recorded at Guggus highest during all three years 2019, 2020 and 2021. The reason might be presence of coal industries, Cement Company, steel plant, coal washeries and other industrial units. Effective mitigative measures need to be undertaken to curb the air pollution problem. It can cause lung and heart problems and delivering harmful chemicals to the blood system. It can also cause irritation of eyes; nose, throat, cough, breathing difficulty, premature

death, aggravated asthma, acute respiratory symptoms including aggravated coughing, and chronic bronchitis reduce lung function. It can clog stomata opening of plants and interfere with the functions of photosynthesis.

Annual Suspended Particulate matter (SPM) was recorded to all station as 178.96 µg/m³ as 178.96 µg/m³ to 335.82 µg/m³ which was higher than standard limit (40 µg/m³). Highest SPM concentration was recorded at Ghuggus station i.e. 302 µg/m³ during 2019, 250.26 µg/m³ during 2020 and 335.82 µg/m³ during 2021. Air Quality Index (AQI) reflects air quality of an area in terms of health impacts on the population during 2019. AQI was satisfactory at old MIDC, SRO office, MIDC and Rajura as it was within range of (51 – 100), whereas it was moderate (101 – 200) at Ghuggus, Ballarshah

and Tadali MIDC (Table 1). AQI was satisfactory for old MIDC, MIDC whereas, it was moderate at SRO office, Ghuggus, Rajura, Ballarshah, Tadali MIDC whereas, it was poor (201 -300) at Ghuggus 210 $\mu\text{g}/\text{m}^3$ during 2021. It was

observed that AQI was highest at Ghuggus during all three years; the air population was more at Ghuggus than other stations.

Table 3: Status of Ambient Air Quality (Annual Average) for 2021

Sr. No.	Station	Concentration in Pollutant of Ambient Air				
		SO ₂ $\mu\text{g}/\text{m}^3$	NO ₂ $\mu\text{g}/\text{m}^3$	RSPM $\mu\text{g}/\text{m}^3$	SPM $\mu\text{g}/\text{m}^3$	AQI
1.	Old MIDC	11.80	13.18	97.32	NA	89
2.	SRO Office	4.0	34.00	102	302	101
3.	MIDC Chandrapur	7.46	33.60	95.47	178.96	95
4.	Ghuggus	7.19	30.04	253.96	335.32	210
5.	Rajura	7.04	25.26	182.58	263.89	154
6.	Ballarshah	6.92	28.22	135.43	221.37	124
7.	Tadali MIDC	7.21	26.64	131.47	220.21	124

Conclusions

Air pollution monitoring stations of Chandrapur district were recorded annual SO₂ concentration less than 20 $\mu\text{g}/\text{m}^3$ and were relatively clean with respect to SO₂ pollution. Chandrapur city (SRO office) recorded highest NO₂ but less than recommended standard. Necessary mitigative steps especially in case of curbing vehicular emissions must be taken to mitigate the issue of NO₂ pollution. High levels of RSPM, SPM and AQI were recorded mainly at Ghuggus. Appropriate operation and maintenance practices at mines and quarry sites like use of water mists, wind screens, low dump sites, construction of even and smooth roads and strict norms for the construction sector should be regulated.

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