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Airborne Particulate matter levels in randomly selected areas in Bhilai

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ABSTRACT

Increased industrialization and urbanization of Bhilai has resulted in excessive rise in pollution. Our study examines the level of $PM_{2.5}$ and PM_{10} in different areas in Bhilai in December 2022. Based on the results, the air is classified as clean, unqualified, or polluted. A portable air sampler was used to measure the amount of Particulate matter. During the course of our research, we found that the primary causes of pollution in studied areas we looked at commercial and industrial activities, vehicular traffic, constructions, open-air burning of coal, wood, dry leaves, paper, plastics, etc. The studied area result has been compared with the NAAQS (National Air Quality Standards, India).

Key words *: Particulate matter ($PM_{2.5}$ and PM_{10}), Bhilai, Air pollution, Portable air sampler.*

Introduction

Bhilai-Durg is the third most polluted area in Chhattisgarh, after Korba and Raipur, according to comprehensive environmental pollution index (CEPI). Bhilai, is a major hub of urbanization, industrialization, and road traffic, which ultimately increases pollution and affects the organ systems by damaging them, resulting in breathing problems, lung damage, bronchitis, cancer, irritation in the eyes, nose, and throat, damage to the nervous system, and reduced resistance power. Industrial emissions are a major contributor to increasing air pollutants. The burning of fossil fuels emits many pollutants, as particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen oxide, carbon monoxide, sulphur dioxide, and hydrocarbons. Pollutants have chronic and acute effects on humans' health; they can enter through food, water, and air and cause many diseases (Guttikunda *et al.,* 2019; Hussain *et al.,* 2019; Trivedi *et al.,*2020; Ahamad *et al.,* 2021).

Particulate matter

The term "Particulate matter" (PM) refers to the tiny airborne particles. PM_{10} and $PM_{2.5}$ refer to fine particles that are less than 10 and 2.5µg in size, respectively. A mixture of solid and liquid droplets makes up Particulate matter. The main source of Particulate matter emissions is from power plants, industrial processes, diesel vehicles etc. (Mirhosseini *et al.,* 2013; Trivedi *et al.,*2020; Ahamad *et al.,* 2021). Respirable size of PM can easily inhale can induce lung cancer, and have an adverse effect on other organ systems (Guttikunda *et al.,* 2019; Chauhan and Pawar 2010; https://www.epa.gov/pm).

Our work is focused on the particulate matter level in different areas, in Bhilai. Particulate matter ($PM_{2.5}$ and PM_{10}) is monitoring through SMILEDRIVE portable air sampler machine (Hussain *et al.,* 2019). Air sampling survey is conducted around 5.00 to 08.30p.m. in all sites.

Objective of the Present study: Particulate Matter Levels ($PM_{2.5}$ and PM_{10}) at Different areas in Bhilai.

Materials and Methods

Study area: Bhilai, Chhattisgarh (India) at 81.20^0 E longitudes, 21.30^0 N latitudes.

Site selection- Site selection was done on the basis of different activities in the areas, under construction (roads, bridges, houses etc.), heavy traffic due trucks, buses, autorickshaws, motorbikes, cars, etc., and industrial areas. The study area is shown in the figure 1.

Monitoring Procedure-Monitoring of particulate matter was done in different locations, from Nehru Nagar Road to Ramnagar Road and from Power House to Bhilai-3 Road. During the monitoring for PM levels, we placed the device at the site to get the $PM_{2.5}$ and PM_{10} levels, as well as the air quality. At each location, monitoring was done when traffic was very active and construction was also running.

Observation- We have checked the Particulate matter ($PM_{2.5}$ and PM_{10}) level in 33 locations. The monitored values of $PM_{2.5}$ and PM_{10} of randomly selected areas in Bhilai are shown in figure 2.

We observed that the maximum value of PM_{10} level is highest 511µg/m^3 in Babadeep Singh Nagar, and the minimum value is 49µg/m^3 in Sector-10 Street, Bhilai. The average value of the PM_{10} level is 127.73µg/m^3. The monitored values of $PM_{2.5}$ were found in 33 locations of Bhilai. The maximum value of $PM_{2.5}$ level is 441µg/m^3 in Babadeep Singh Nagar, and the minimum value is 43µg/m^3 in Sector-10 Street, Bhilai. The average value of the $PM_{2.5}$ level is 120.22µg/m^3.

Apart from the graphics data, we checked the air quality in some locations in Bhilai like Garage Road, where the underbridge is still under construction, light industrial area, Chavani Nagar, Bhilai. This study was done on different days in December. We found that the air quality was unqualified; $PM_{2.5}$ and PM_{10} had exceeded 80-100 µg/m^3. We observe that, during the study, the PM level was higher than the NAAQS limit in all selected locations in industrial and non-industrial areas.

Since the fly ash is main contributor for increasing the PM level. So, we also conducted a survey in a fly ash-exposed area, and we found the air was unhealthy. $PM_{2.5}$ and PM_{10} levels are above 100-130µg/m^3 in Purena village.

Fig. 1. Map of the study area is shown

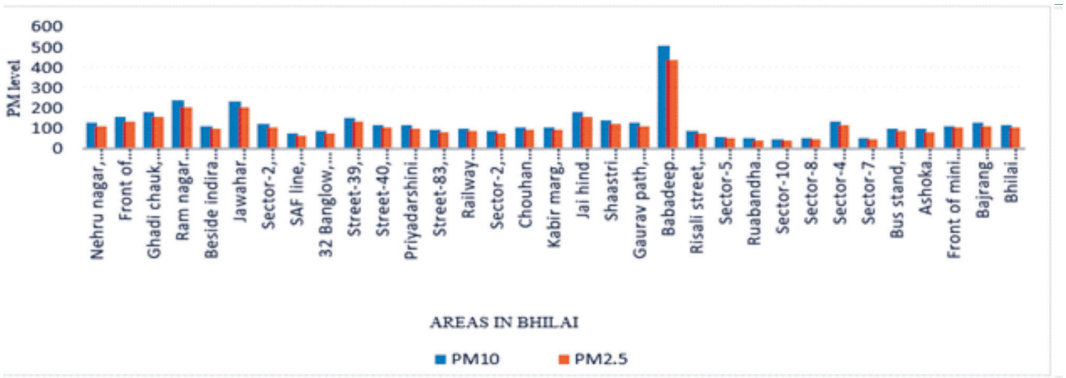

Fig. 2. Monitored $PM_{2.5}$ and 10 level in 33 areas of Bhilai

Results and Discussion

In present study, the particulate matter ($PM_{2.5}$ and PM_{10}) level of randomly selected areas in Bhilai, and we found that PM level was as given below:

- $PM_{2.5}$ level varies from 43 to 441µg/m^3.
- PM_{10} level varies from 49 to 511µg/m^3.
- Average value of PM was found to be between 120.22 to 127.73µg/m^3.

Air quality of 28 locations is unqualified and 5 locations are highly polluted, namely Babadeep Singh Nagar, Jai hind Chowk Supela, Ghadi Chowk Supela, Jawahar Nagar and Ramnagar road. Prolonged exposure to such air can be harmful to sensitive people, elderly, and children (Guttikunda *et al.,* 2019; Tiwari *et al.,* 2019).

During our study the weather was "occasionally cloudy'' during the study in December 2022, the average temperature in Bhilai was +25^{0}C and the wind speed was 2-3 m/s, E and NE. The wind direction was W and NW in the last week of December. The pressure was 1017-1023hpa, and the humidity was 20-43% (https: //weather-forecast.nz.).

During the study, the PM level was higher than the NAAQS limit in all selected locations in industrial and non-industrial areas, due to which the air is unhealthy or polluted in those areas.

NAAQS (24 Hourly): PM10=100 µg/m^3, PM2.5=60 µg/m^3 (for residential/ industrial/ rural/ other areas and ecologically sensitivity areas) (https://cpcb.nic.in/upload/NAAQS_2019.pdf). In the course of our study, we have observed that the main reasons for pollution in those places were industrial activities, vehicular traffic, and the construction. Open-air burning of coal, wood, dry leaves, paper, plastics, etc. is also one of the major reasons for air pollution, and peak traffic volumes during weekdays were higher than 8.00-10.00 hours.

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