

## Assesment of PM 2.5 and PM 10 in the air sample of Chapra town (Bihar)

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**Abstract:** A sampling campaign was carried out in Chapra town of Bihar for assessing mass concentration of PM 2.5 and PM 2.5-10 so as to correlate it with the air quality of the town. Concentration of a dozen of elements namely Cr, Cu, Cd, Ni, Mn, Zn, Pb, Na, K, Ca and Al were quantified. Sampling was done on nuclear polycarbonate filters. For principal component analysis (PCA) of elements and mass concentration data, three main sources were identified as particulate matter producers. They are resuspended crustal dust, industrial emissions and vehicular exhaust. The effects of weather conditions were also studied. It was found that pollution in summer was higher than those in winter. The PM<sub>2.5</sub>/PM<sub>2.5-10</sub> ratio in summer was found in the range of 0.35-0.9 whereas the same ratio in winter was in the range 0.20-0.50. The concentration of both types of particles exceeded the permissible WHO limits.

**(Key words :** metal pollution, particulate matter pollution, fine and coarse particles, seasonal variation)

### Introduction

Particulate matter present in the air severely affects the climate, environment and health of individual. Finer particles are more dangerous than the coarse particles. The ill effects and the sizes of the particles have inverse relationship between them. The attention of the whole world seems to be attracted towards this menace of air pollution due to particulate matter in recent years<sup>1-14</sup>. Consequently, a program of assessing air quality of Chapra town of Bihar and its relationship with the size of the particulate matter has been launched in the year 2023. The outcome of the study is being communicated in

the present paper.

### Experimental

#### 2. Method and Material

Samples of particulate matter were collected from forty different locations (Table-1) of Chapra town. The collection of samples started from May 2022 and ended in March 2023. Samples were collected on a weekly basis with 24 hours sampling time. Gent Stacked Filter Unit samplers were used for collecting the air samples. Filters were conditioned and weighed before and after collecting the samples. Mettler balance with ten microgram sensitivity was used for weighing. Concentration of particles were analysed gravimetrically. The trace element contents of PM including Cd, Cr, Cu, Mn, Ni, Pb, Zn, Fe, K, Na, Ca, and Al were quantified by Absorption Atomic Spectroscopy techniques.

### 3. Results and Discussion

The data collected for the air samples were processed and processed data are presented in Table-2.

Concentration of fine and coarse particles namely, PM<sub>2.5</sub> and PM<sub>2.5-10</sub> and the ratio between the two are graphically presented in Fig.-1. The annual average concentration of PM<sub>2.5-10</sub> was found to be 107±27.7 microgram/Nm<sup>3</sup>. The same value for PM<sub>2.5</sub> was 52.8±11.8 microgram/Nm<sup>3</sup>. Daily mean concentration values have been presented in Fig-1.

**Table-1**  
**Forty different locations**

| <b>Place Name</b>                   | <b>Pm 2.5</b> | <b>Pm 10</b> | <b>Pm 1.10</b> |
|-------------------------------------|---------------|--------------|----------------|
| Ekma mod                            | 99            | 119          | 80             |
| Chhapra bajar samiti more           | 45            | 49           | 31             |
| Chhapra bajar samiti more main road | 50            | 58           | 38             |
| Saran meat house                    | 42            | 48           | 31             |
| Chhapra manokamna madir             | 35            | 40           | 26             |
| Chhapra kachari station master      | 34            | 39           | 25             |
| chhapra kachari waiting hall        | 37            | 44           | 28             |
| chhapra kachari ticket counter      | 36            | 41           | 27             |
| Hotel ramdut                        | 37            | 44           | 28             |
| Hotel Ashok                         | 41            | 52           | 34             |
| Bank of India muspilti chouk        | 44            | 51           | 33             |
| Chhapra samharnalay                 | 32            | 38           | 25             |
| Pratap sastragar                    | 32            | 38           | 25             |
| Pradhan dak ghar                    | 37            | 41           | 27             |
| Pradhan dak ghar road               | 66            | 83           | 57             |
| Hathuwa mod andar                   | 46            | 56           | 39             |
| Town thana chouk                    | 37            | 42           | 28             |
| Thana chouk champran mit housh      | 75            | 87           | 57             |
| Stat bank men branch                | 48            | 55           | 35             |
| Pankaj cinema                       | 55            | 63           | 42             |
| Sran kachari                        | 40            | 47           | 31             |
| Anumandal karyalay                  | 33            | 38           | 25             |
| Chhapra Lic                         | 30            | 34           | 24             |
| Kshir sagar sweets                  | 40            | 47           | 31             |
| Sadar hospital chhapra              | 42            | 48           | 30             |
| Pir baba chhapra                    | 43            | 47           | 33             |
| Bhgwan bazar station mod            | 36            | 44           | 30             |
| Rajendra collage chhapra            | 36            | 44           | 28             |
| Gudari bazar                        | 35            | 42           | 28             |
| Stat bank                           | 28            | 32           | 21             |
| Shyam chouk mod                     | 24            | 30           | 19             |
| Brhampur ram bhagt hanuman mandir   | 24            | 30           | 19             |
| Vip chemini tekniwash               | 25            | 29           | 19             |
| Tekniwah bazar                      | 23            | 26           | 17             |
| Kopa bazar                          | 30            | 32           | 21             |
| Kopa bazar paschim                  | 38            | 44           | 30             |
| Daudpur ambedkar chouk              | 24            | 27           | 18             |
| Ekma high school                    | 28            | 32           | 21             |
| Ekma thana                          | 26            | 31           | 23             |
| Ekma staion road                    | 73            | 78           | 50             |

| <b>Table-2</b>                                                                                                                          |               |          |               |          |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------|----------|---------------|----------|
| <b>The mean concentration values of the detected elements in the two fractions (in ng/Nm<sup>3</sup>) during winter and summertime.</b> |               |          |               |          |
|                                                                                                                                         | <b>Summer</b> |          | <b>Winter</b> |          |
| <b>Cd</b>                                                                                                                               | 2.44          | 2.20     | 1.95          | 1.76     |
| <b>Cr</b>                                                                                                                               | 73.95         | 52.48    | 91.59         | 66.22    |
| <b>Cu</b>                                                                                                                               | 240.35        | 125.05   | 280.55        | 178.92   |
| <b>Mn</b>                                                                                                                               | 20.19         | 72.38    | 24.66         | 78.01    |
| <b>Ni</b>                                                                                                                               | 195.40        | 153.05   | 144.08        | 140.72   |
| <b>Pb</b>                                                                                                                               | 324.28        | 210.26   | 155.03        | 222.86   |
| <b>Zn</b>                                                                                                                               | 1343.26       | 612.74   | 1465.22       | 697.48   |
| <b>Fe</b>                                                                                                                               | 2045.79       | 2065.61  | 1853.54       | 2150.41  |
| <b>Ca</b>                                                                                                                               | 1095.61       | 12320.56 | 954.57        | 11011.52 |
| <b>Na</b>                                                                                                                               | 591.02        | 2877.47  | 607.32        | 2575.17  |
| <b>K</b>                                                                                                                                | 409.03        | 1607.48  | 386.35        | 1351.93  |
| <b>Al</b>                                                                                                                               | 169.28        | 2112.57  | 98.15         | 1696.98  |

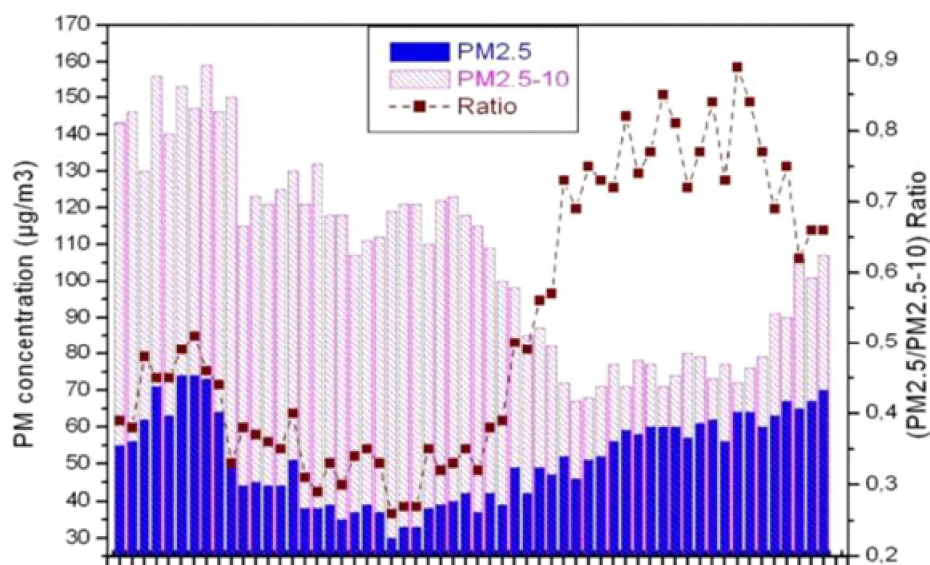


Fig-1: Daily mean concentrations of PM 2.5-10( $\mu\text{m}^3$ ) and PM 2.5-10 ratio during the sampling period (Jun 22 – May 2023)

The data indicates higher value in summer and lower in winter. The difference may be due to differences in dispersion and deposition rate of particulate matter in the two seasons.

### Conclusion

Concentrations of particulate matter of both types, fine and coarse are higher than the WHO permissible limits in Chapra town in both the seasons, summer and winter. Safety measures

must be taken to control the situation by reducing the production particles on one hand and to prevent their stay in suspended state by process of precipitation. Regular use of proper masks can control the entry of these particles in respiratory tract. Coordination between administration and general public may prove beneficial. The results of the present study are in good agreement with the literature<sup>14-15</sup>.

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