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POLLUTION DETECTION IN HIGH TRAFFIC ZONES OF JABALPUR CITY BY MEANS OF AIR QUALITY INDEX

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ABSTRACT

Vehicular traffic has become a major source of air pollution in urban areas. Exposure to vehicular pollution has a major impact over the health dysfunction of the urban inhabitants. A study has been carried out over three selected zones from all over the Jabalpur city where the pollution is caused mainly due to vehicles, under this category sampling points are Chotiline Phatak (HT1), Damohnaka (HT2) and Wright Town Motor Stand (HT3). The methodology opted for the above study is by using national air quality index (NAQI), which was promulgated by USEPA and further agreed upon by CPCB, India. The objective of the present study was to identify the pollution caused due to the atmosphere by the major pollutants viz. particulate matters and gaseous pollutants, characterized by their variation with respect to the major seasons. The study indicates that the HT1 and HT2 are heavily polluted and HT3 is moderately polluted.

INTRODUCTION

The environmental pollution has been increasing with the haphazard growth of industries and population. In the name of industrial development, industrial units have been located unmindfully without any consideration to their sitting and even without thinking their adverse effects on all sorts of life. Factories are releasing toxicants, unabatedly polluting air water and soil affecting human beings, animals, crops and vegetation enormously.

The effect of air pollutants in general would depend on the composition of the air that is inhaled which will depend on the type of fuel used and the conditions of combustion, ventilation and duration for which the inhalation occur. For example the rapid growth of Delhi in recent times has resulted in significant increase in environmental pollution. It is widely perceived that the problem is threatening to get out of hand. Hence, effective and co-ordinates measures for controlling pollution need to be put in place without delay. In view of the seriousness of the issue, the Minister of Environment and Forests decided to Have a series of interactive meetings with concerned government agencies, NGOs, Experts and citizens, with the objective of defining a plan of action to combat the problem. The outcome of these meetings is a White Paper on Pollution in Delhi with an Action Plan (henceforth, Action Plan) covering various aspects of Pollution control, including vehicular and industrial

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pollution, solid waste Management and noise pollution.

Air pollution is a well-known environmental problem associated with urban areas around the world. Various monitoring programmes have been undertaken to know the quality of air by generating vast amount of data on concentration of each air pollutant (e.g., SPM, CO, NOx, SO_2, etc.) in different parts of the world. The large data often do not convey the air quality status to the scientific community, government officials, policy makers, and in particular to the general public in a simple and straightforward manner. This problem is addressed by determining the Air Quality Index (AQI) of a given area.

Rise in population and growth in economic activity has led to increase in pollution. After Independence, the cities of India have become a major center of commerce, industry and education. The growth of government departments and office complexes has also contributed to the spread of the cities. Civic amenities have not kept pace. Unabated in-migration has compounded the problem. Land use regulations have been flouted. The green cover has dwindled.

The volume of transport has grown dramatically over the last few decades and shows no inclination to slow down substantially. This is true in the industrialized countries, and even more so in the emerging economies of the Far East. However, it is in the established economies that the adverse effects of decades of traffic growth are felt most strongly, and where the political drivers for change are located as a consequence.

Tons and tons of pollutants are pumped into the air in the large metropolitan areas every day. Nowadays, the main source emitting those pollutants is the road vehicles, which give them off. Industrial pollution is tending to drop through the introduction of new, less pollutant technologies and the progressive shift away of industry from the city center. It may be seen that the most densely filled roads are liable to produce high levels of atmospheric pollution. Especially in winter when heat inversion does not allow the pollution to be dispersed.

Local air quality affects how we live and breathe. Like the weather, it can change from day to day or even hour to hour. The U.S. Environmental Protection Agency (EPA) and others are working to make information about outdoor air quality as available to the public as information about the weather. A key tool in this effort is the Air Quality Index or AQI. A specific color is assigned to each AQI category to make it easier for you to understand quickly whether air pollution is reaching unhealthy levels in your community. For example, the color orange means that a condition is of "moderate pollution," while red means that conditions may be "unhealthy for everyone and the area is heavily polluted" and so on. The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health. Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, you may experience within a few hours or days after greater the level of air pollution and the greater the health concern.

By an organized effort for achieving ambient air quality standards to minimize aesthetic, environmental and health risks and a systematic planning to reduce or regulate pollutant emissions and ensuring continuous improvement a proper Air Quality Management can be achieve. For this the working of air pollution index (API) can be understand by understanding the purpose of the air pollution index and The purpose of the API is to help you understand how local air quality might affect your Health. There are different types of index made by different countries. The higher the API value the greater the level of air pollution and consequently the greater the health concerns. This data can be particularly beneficial to individuals whose health is adversely affected by air pollution as the information can be used to adjust daily meditation and daily activities.

MATERIAL AND METHODS

Jabalpur city is a premier city of central India and is located at 23.17° N 79.95° E. It has an average elevation of 411 meters (1348 feet) above mean sea level. Jabalpur was previously known as Jabalipuram during the British Raj. For the study there are three selected high traffic zones from all over the Jabalpur city.the names of the selected zones are as follows- High traffic zones – where the pollution is caused mainly due to vehicles, under this category sampling points are –Chotiline phatak. (HT1), Damohnaka. (HT2), Wright town motor stand. (HT3). The different requirement for the study is as follows- Sampling instrument, Spectrophotometer, Balance, Filter paper, Period of sampling for the gaseous and particulate monitoring is 24 hrs respectively and in this study the sampling is done on monthly basis from – (Oct'05 to Sep'06).

In this paper the National air quality index has

been used for the better indexing of the data available by the ambient air monitoring of the three high traffic zones of the city selected. the formula used for the index is as follows–

The national air quality index (NAQI) was promulgated by USEPA and is based upon a combination of different pollutants viz, CO, SPM, SO_2, NO_2, etc. (Rao & Rao, 1989).

$$AQI = \frac{1}{3}\left[\frac{CSPM}{SSPM} + \frac{CSO_2}{SSO_2} + \frac{CNO_2}{SNO_2}\right]100$$

Where, 'C' stands for observed calculated concentration, and 'S' stands for standard concentration. Comparative index values- 0-25= clean air, 26-50 = light air pollution, 51-75 = moderate air pollution, 76-100 = heavy air pollution, more than 100 = severe air pollution..

The CPCB standards of 200μg/m^3 for SPM and 80μg/m^3 for SO_2 and NO_2 have been considered for arriving at the AQI.

For the detection of ambient air quality status of the different high traffic zones the different standard methods used are as follows-

MONITORING OF SUSPENDED PARTICULATE MATTERS

The measurement of SPM was done as per standard procedure laid down by manufacturer of high volume air sampler, and IS: 5182– part IV 1973.

MONITORING OF SULPHUR DIOXIDE

The concentration of Sulphur dioxide in ambient air, Sodium tetra chloromercurate was used as an absorbing reagent. The standard procedure of West and Geake laid down in IS 5182 (Part II) 1969 was followed.

MONITORING OF OXIDES OF NITROGEN

The standard procedure laid down in IS 5182 Part IV 1975 was followed for measurement of NO_2. The estimation of NO_2, in ambient air, is done as per the known, Jacob and Hochheiser, 1958 method.

RESULTS AND DISCUSSION

The result discussed for the dust pollutants in the mentioned high traffic zones for this paper is from Fig. 1–6, i.e. from Fig 1–3, it is for SPM, and from Fig. 4–6 it is for RSPM.

On considering the high traffic zone, the pollutant namely SPM is showing the highest concentration of 211.2 μg / m^3 in Chotiline phatak and in the month of May and in the month of April Chotiline phatak is showing the concentration 201.4 μg / m^3. This can be discussed as the vehicular exhaust account for more than 50% of the total pollution from all the sources put together in all the major cities. These two values are exceeding the limit of 200 μg / m^3 set by CPCB. The minimum concentration has been measured in the month of august (71.4 μg / m^3) for Wright town motor stand. This predicts that rain water fixes the particles in the land i.e. the dust dissolves in the rainwater. Seasonal average of SPM concentration was lowest in the monsoons.

In context to RSPM, the study has also been made to detect this particular pollutants concentration in the atmosphere of the three locations. The individual study detects that Damohnaka is commonly showing the highest concentration of the pollutant and the maximum average concentration is 100μg / m^3 in the month of June, from the result it can be concluded that SPM and RSPM are the main pollutant within the city-the reason being the growing number of automobiles and poorly and congested roads. Poorly maintained auto rickshaws are also the main cause of pollutants. This can be reduced by properly maintained and eco-friendly mass transportation system (Srivastava and Sanchan, 2002), the minimum value of average concentration has been noted in the location namely Wright town motors stand in the month of August and the value is 25.5 μg / m^3

The result for the gaseous parameters i.e.SO_2 and NO_2 has been discussed in Fig 7- 12. Fig 7- 9 is depicting the values for the gaseous pollutant namely sulphur dioxide in the three selected high traffic zones in Jabalpur city. Fig 10-12 is discussing the pollution levels causing due to the gaseous pollutant SO_2 in the selected zone.

Further considering the high traffic zone and calculating the impact of SO_2 and NO_2 in this sector of the city, it has been found that Damohnaka is most polluted by both the pollutants much more than the other sector. In case of SO_2 among the zones of high traffic namely Damohnaka, Chotiline phatak and Wright town motor stand, the location namely Damohnaka and Chotiline phatak is showing the increasing and decreasing concentrations simultaneously in the whole year. The maximum average concentration of 92.9 μg / m^3 for the pollutant SO_2 has been shown in the month of May in Damohnaka. The rea-

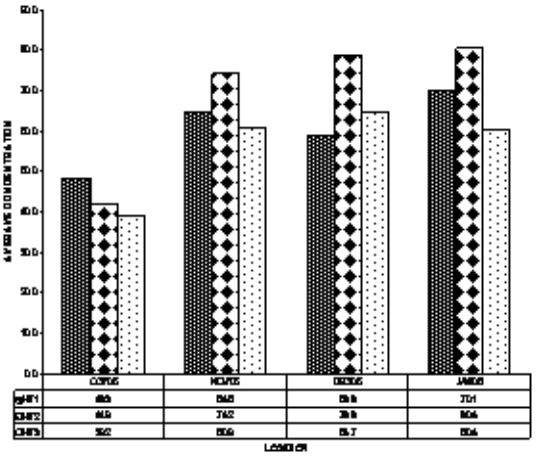

Fig. 1 Avg concentration of spm(μg/m^3) at high traffic zones in winter season.

Fig. 4 Avg concentration of rspm(μg/m^3) at high traffic zones in winter season.

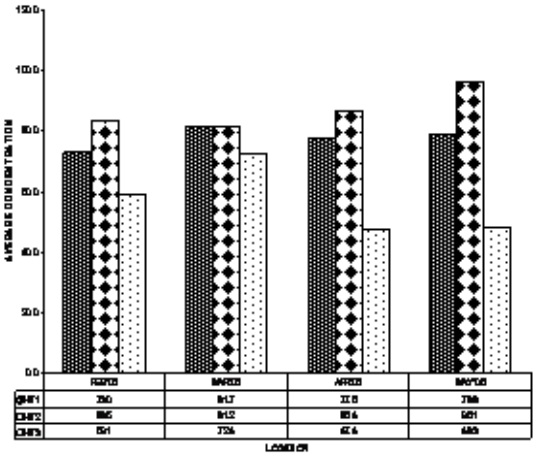

Fig. 2 Avg concentration of spm(μg/m^3) at high traffic zones in summer season.

Fig. 5 Avg concentration of rspm(μg/m^3) at high traffic zones in summer season.

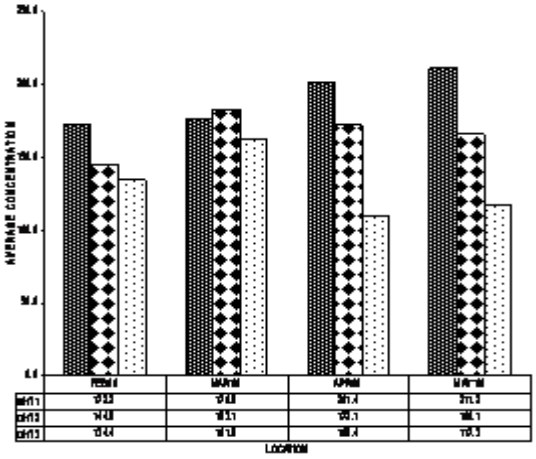

Fig. 3 Avg concentration of spm(μg/m^3) at high traffic zones in rainy season.

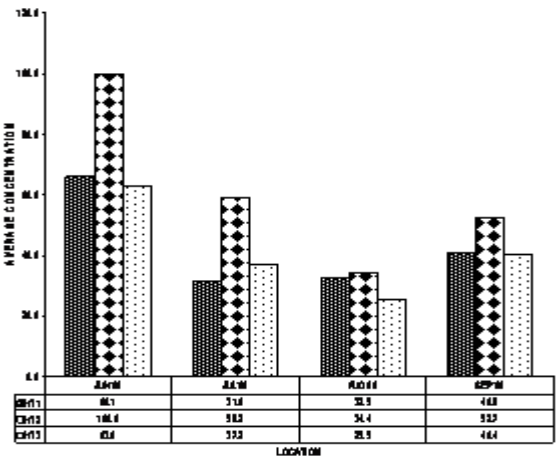

Fig. 6 Avg concentration of rspm(μg/m^3) at high traffic zones in rainy season.

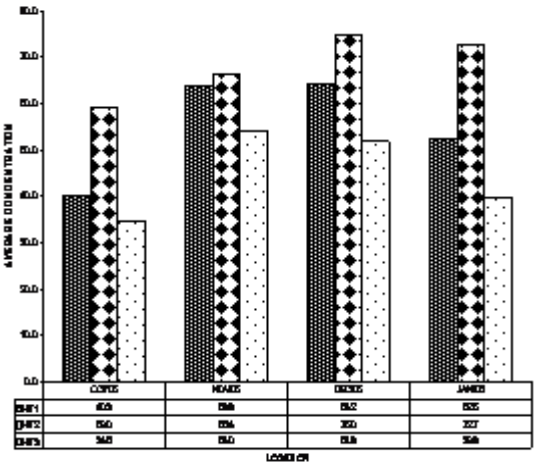

Fig. 7 Avg concentration of no2(μg/m^3) at high traffic zones in winter season.

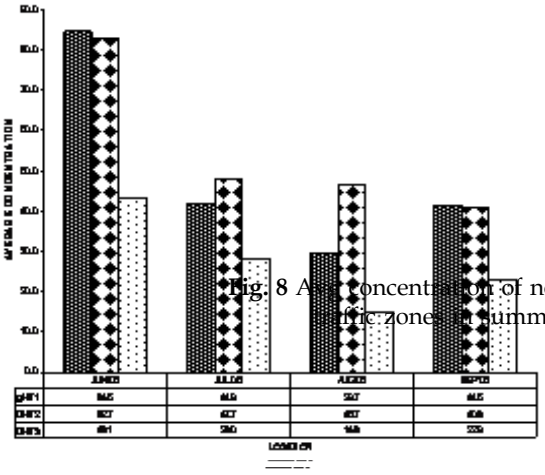

Fig. 8 Avg concentration of no2(μg/m^3) at high traffic zones in summer season.

Fig. 9 Avg concentration of no2(μg/m^3) at high traffic zones in rainy season.

Fig. 10 Avg concentration of so2(μg/m3) at high traffic zones in winter season.

Fig. 11 Avg concentration of so2(μg/m^3) at high traffic zones in summer season.

Fig.12 Avg concentration of so2(μg/m^3) at high traffic zones in rainy season.

son behind this hike of SO_2 concentration, which is exceeding the limits set by the pollution control board, is vehicular population. Vehicular pollution contribution 70% of the total air pollution load in Delhi city is also proving this above concept (Khare and Nagendra, 2000). In case of NO_2 the maximum average concentration of 84.8 $\mu g / m^3$ has been noted in the month of June in Damohnaka. In this case also, the pollutant is crossing the limits set by the pollution control board. The minimum concentration for this particular pollutant has been found in the month of October of 34.6 $\mu g / m^3$ at Wright town. Growing number of automobiles, and narrow roads with heavy traffic congestion are the factors attributed to high levels of air pollution (Ravichandran, *et al*. 1996).

The result for the air quality index is discussed in fig 13. For Choti Line phatak, the value of AQI is 78.1 that mean index calculated is heavily polluted but it is just crossing the limits of medium pollution, that means, it is very near to medium pollution. For Damohnaka, the value of AQI is 77.7 that means it is also showing the heavy pollution but it is also very close to the limits of medium pollution, or we can say that it is indicating the initiation of heavy pollution, In Wright town motor stand, the value of AQI is 54.8 which shows that the spot is having moderate pollution.

Table 1. National Ambient Air Quality Index (Fig- 13).

Location	Index	Remarks
HT1	77.7	Heavy Pollution
HT2	78.1	Heavy Pollution
HT3	54.8	Moderate Pollution

* Note : All the values are rounded to one decimal

CONCLUSION

A small city like Jabalpur needs a small initiation to tackle the big need to fight, with the slowly increasing pollution. For the above mentioned purpose the air quality index is the best way to make people aware of the exact condition for the pollution level of the city.

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