INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Effect of RSPM and SPM Pollutants in Ujjain City

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Abstract:
The aim of this study was measuring the concentration of various ambient air pollutants in different seasons. During Jan 2013 – December 2013, concentration of Respirable Suspended Particulate Matter (RSPM) and Suspended Particulate Matter (SPM) were collected over successive period of eight hours at three sites. High volume air sampler was used to measure the concentration of Respirable Suspended Particulate Matter (RSPM) and suspended particulate matter (SPM). The results reported pertain to an eight hour successive preliminary air sampling exercise carried out at each of the two select locations i.e. Industrial area and Sensitive area in Ujjain City. Criteria pollutants RSPM and SPM measured are found to have either crossed or on the average of crossing the limits, necessitating the immediate installation of a continuous monitoring and control mechanism. While transport related emissions are the major sources of air contamination, increasing civil construction activities also contribute to particulates. The exponential rise in volume of vehicles, disadvantageous traffic flow pattern, differing driving cycle pattern and human interceptions deserve due attention. The concentrations of some of the pollutants were exceeded the National Ambient Air Quality Standard (NAAQS) at different locations.

Keywords: *Respirable Suspended Particulate Matter, Suspended Particulate Matter, National Ambient Air Quality Standard, Criteria Pollutant, Transport emissions*

1. Introduction

Developed and developing economy and globalization have resulted in migration of fast changing energy intensive life style, mechanization and automation as a consequence of scientific advances including those of newer branches of science (Balashanmugam et.al.2012). The greatest impact on air pollution on human health, however, results from continued exposal to low concentration under unexceptional condition as chronic effects it is believed that these effect occur through continued irritation by pollutants which interact with other environmental or biological factors to initiate disease or intensify previously existing disease (Cadle et.al.1993).

The quality of the air that we breathe can have important effects on our health and quality of life. It can also have major impacts on the ecosystems. About 60 percent of air pollution in Indian cities is due to automobile exhaust emission. Automobiles produces volatile organic compounds (VOC), suspended particulate matter (SPM), oxides of sulfur (Sox), oxides of nitrogen (Nox) and carbon monoxide (CO), which have adverse effects on surrounding ecosystem. Air pollutants exert a wide range of impacts on biological, physical, and economic systems. The decrease in respiratory efficiency and impaired capability to transport oxygen through the blood caused by a high concentration of air pollutants may be hazardous to those having pre-existing respiratory and coronary artery disease (Rao et.al. 2000). Air pollution in urban centers are associated with sudden occurrence of high concentration of vehicular exhaust emissions (VEEs), which are generally governed by the local meteorology and dispersion mechanism (Nagendra and Khare 2002a). The task to assess the impact of air pollution sources, requires in some cases, to evaluate the apportionment of a few number of possible sources to the measured concentration at a given receptor point. This kind of inverse problem has been studied intensely for ambient aerosols where multi elemental analysis of particulate matter and data collected in several sites allow the use of receptor models to evaluate source apportionment (Hopke, 1991; Hopke and Dattner, 1982). Air quality prediction helps significantly in the management of our environment. In places where geographical and meteorological conditions allow for poor air circulation, and where there is a large population living in a not always well designed city, episodes of critically high atmospheric pollution enforce extreme actions as closing of schools and industries and restriction of motor vehicles circulation. If it were possible to predict these

episodes one or two days in advance, more efficient actions could be taken in order to protect the citizens (Patricio et.al.2000). Today forecasting of air quality is one of the major topics of air pollution studies due to the health effects caused by these airborne pollutants in urban areas during pollution episodes. Therefore, the development of effective forecasting models of AQI for major air pollutants in urban areas is of prime importance (Kumar et.al.2011).

2. Experimental Procedure

2.1. The Study Area

Ujjain is situated at an altitude of 491.75m. Above mean sea level on the malwa plateau. The Malwa plateau is noted for its cool & comfortable night even in the hottest time of the year. An Ujjain lie in subtropical climate zone of India. Ujjain is cited among the seven cities of sacred merit in India. Mahakaleshwar temple and the holy Shipra have always attracted countless people to visit Ujjain throughout the ages. The crowd of pilgrims and saints of various sects running into millions during the Sinhastha presents a picture of mini India at Ujjain and one can well visualize here, as to what invisible forces bind this great Nation together. As a great religious center, Ujjain ranks equal to Banaras, Gaya and Kaschi. These places are subjected to different stresses due the geographical position, different degree of pollution, great variety of typology of materials and consequent status of conservation. All together these factors contribute to the different modality of gaseous attack. Population of Ujjain city in recent counting year 2014 is approximately 6.0 lacks. Number of vehicles two lakh at present in Ujjain city.

2.2. Description of Sampling Sites

Two sites were selected for Ambient Air Quality (AAQ) monitoring in Ujjain City .The selected sites were places of maximum population, heavy traffic, and commercial areas. Geographical locations of the sampling sites were measured from the meteorological department.

2.2.1. Mahankal Temple. (Sensitive Area)

This site has two way traffic signal, Vehicle queuing and heavy traffic flow. There are a large number of bus operations, queuing, and frequent stop-go and repeated driving cycles. Percentage traffic shares of four wheelers/ two wheelers/ three wheelers/ light vehicles / heavy vehicles were 64, 88, 43, 26and 25 respectively.

2.2.2. District Industries Office (DIC) Ujjain. (Industrial Area)

This site faces large number of bus operations, vehicle queuing, frequent stop- go operation, acceleration, cruising, deceleration, and non –smooth vehicle flow. Percentage traffic shares of two wheelers / three wheelers / light vehicles / heavy vehicles were 2, 0, 0 and 98 respectively.

3. Materials and Method

3.1. Air Pollutants Monitoring Instruments

The monitoring instrument is usually composed of three components, air remover, transducer and recorder. The air remover measures the flow rate of air and the pressure under which gas pollutants exist. The transducer measure a physical property, while the recorder notes change in physical property of gaseous pollutant. The instrument should be checked for response time, specificity, sensitivity, noise level, maintenance and downtime and overall accuracy.

3.2. Measurement of SPM

High volume air sampler was used for the monitoring for suspended particulates matter. Before sampling, the watt man filter GFA (20.3cm x25.4cm) of the high volume sampler was kept at 15-34 °C, 50% relative humidity for 24-hour and then weighed. The filter paper was placed into the filter holder of the high volume sampler and air was drawn through a 410 cm^2 portion of the filter at the flow rate of 1.70 m3/min. The filter was removed after sampling. The concentration of suspended particulates in ambient air can be calculated by measuring the mass of particulates collected and the volume of air sampled.

4. Results and Discussion

In this survey and after the experimentation it was found that the air pollutants were greatly affected the selected areas in years 2012-2013. As shown in figure 1 and 2 the concentration of pollutants RSPM and SPM were found to be less in Sensitive area as compared to Industrial area. It was found that levels of pollutants sometimes are just to be on limits at different sites. It is likely that the alarming levels of all the pollutants will be revealed if a continuous monitoring is carried out, in the place of random sampling. At the bus terminus heavy vehicles with a major share of 98 percent dominate. There is considerable correlation between pollutant levels and activities at the sites. At bus terminus with intensive transport activities SPM are found to cross the limits, At places with one way traffic system and location specific restricted automobile mobility, the pollutant levels are observed to be relatively lower. The variation is due to vehicular flow pattern, sensor proximity, and environment. The results of the investigations on ambient air quality in Ujjain City are on the anticipated lines, making a clear case warranting immediate installation of a "continuous ambient air quality monitoring process" on stream.

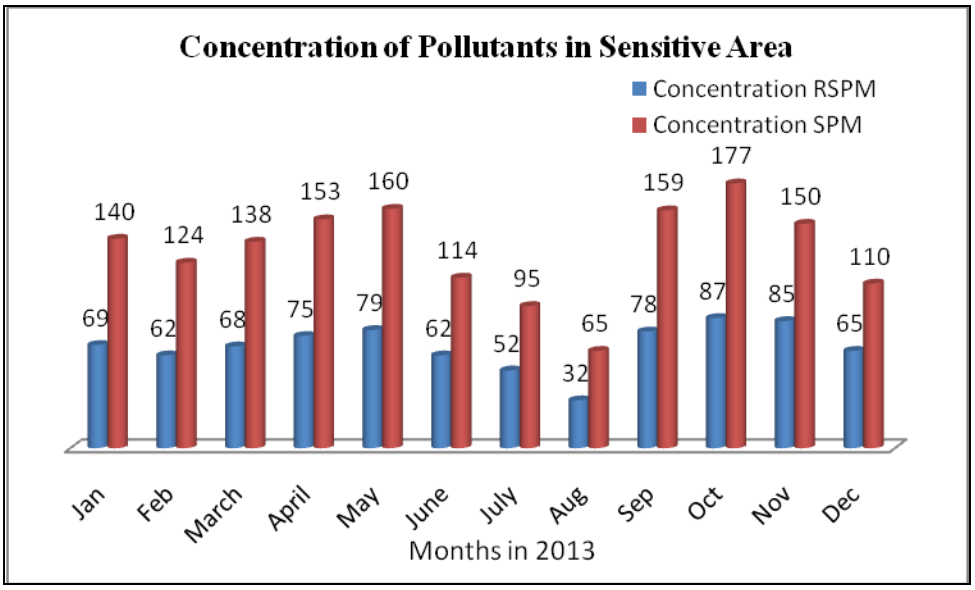

Figure 1: Concentration of Pollutants in Sensitive Area in Year 2013

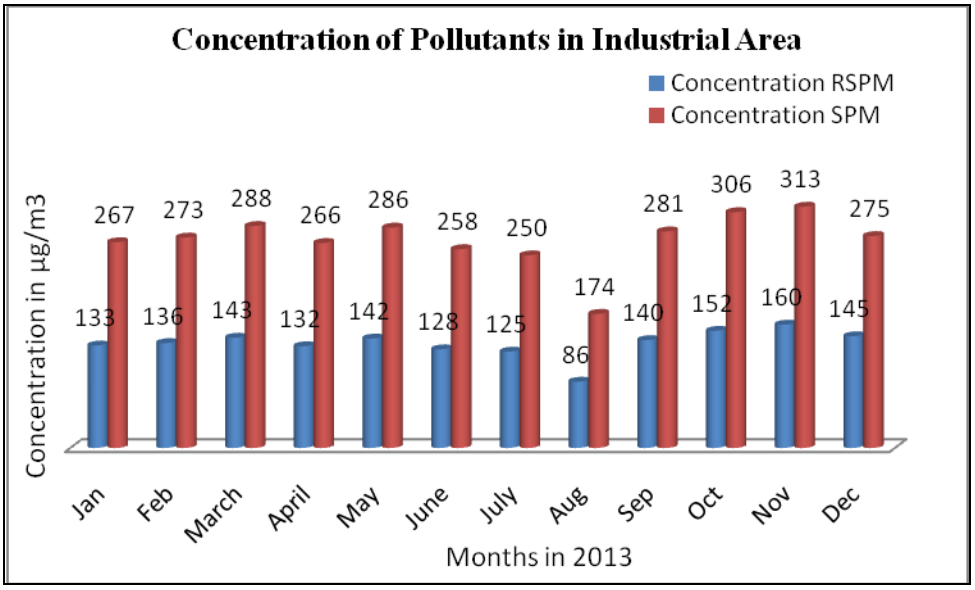

Figure 2: Concentration of Pollutants in Industrial Area in Year 2013

5. Conclusion

Criteria pollutant levels of SPM are found to be just on the limits in the single day per site random sampling. It is likely that right now the levels of both the pollutants have crossed the limits at both the sites, but not revealed due to random nature of sampling. The alarming situation will worsen further in future due to further addition of two, three and four wheelers on the road. Preliminary random studies in all pollution prone towns / cities irrespective of the grade to quantify the pollutant levels will throw light on the range of pollutant level, cause-effect correlations, trend evaluation, remedial strategies and priorities for the installation of continuous monitoring and control mechanism.

Ujjain City is a stronger case for continuous monitoring of ambient air quality. Traffic diversions, better traffic regulation, restricting vehicles with emission features, staggering office / school timings, provision of alternate routes, by-pass infrastructures and encouraging other modes of transport are worthy considerations.

Phasing out of older vehicle versions, arranging for periodic vehicle maintenance, encouraging multimode transport system and strengthening of related researches are some of the remedies, Safety measures against poor ambient air quality are to be evolved and implemented. Priority locations (like bus stand, road junction, and level crossing) and priority occupants like the drivers, traffic control personnel, and theatre employees are to be paid due to consideration and attention.

Continuous monitoring shall include all the six criteria pollutants ground level ozone (O3), Carbon monoxide (CO2), Sulfur dioxide (SO2), Small particulates (PM10), Nitrogen dioxide (NO2), and the lead (Pb). Additrally CO2 and volatile organic compounds like

benzene the class A human carcinogen also need to be quantified. Global attempts to combat air pollution need to attract the support of institutions like World Health Organization, World Bank and United Nations Organization.

6. Suggestions

On the basis of findings of the study, the suggestions are made:

- The local inhabitants, shopkeepers, pedestrians including the school children are at the health risk from ambient dust.
- Asphalting of the unpaved roads largely prevent re-suspension of particulates and will reduce the ambient particulate concentration.
- The areas with unmanaged waste dumping, unhygienic slaughter houses have high chances of air-borne diseases and hence public sanitation and hygiene measures of these areas must be addressed to save from potential air-borne epidemics.

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