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Research Article

Impact Assessment of Air Pollution in Industrial Areas of Rajasmand and Udaipur Districts

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ABSTRACT: Weather and climate have integrated impact on human activities resulting in worldwide concentration of the particulates of environmental pollution, viz., carbon dioxide, methane, nitrogen oxide, lead and several other dust and gaseous particles. The present study was conducted at Rajpura Dariba mines of Rajasmand, Hindustan Zinc Smelter, Debari, Madri Industrial Area and Sukher (marble processing Industrial area) of the Udaipur district of Rajasthan. The air quality monitoring conducted around industrial plants at above sites indicated that the pollutant concentration were highest at sampling station 1 which was closest to the factory.

Keyword: Vehicle wastes, Particulate matters, CO_2, Air pollution.

INTRODUCTION

Now-a-days, air over major cities throughout the world has become overburdened with gases produced by automobiles and industrial units. With passage of time, people realized that polluted air has serious effects on their health, climate and economics. Air pollution in India has been aggravated by a number of developments such as the growth in the size of cities, rapid economic development, industrialization and increasing traffic and levels of energy consumption. Increase in industrial activities, population both endemic and floating and vehicular population, etc., have led to a number of environmental problems including air pollution. These arise both from natural processes and human activity. Industrialization is an important condition for an economic growth of any country[1],[2] studied ambient air quality at selected sites in Bangalore city. Wilson[3] studied levels of suspended particulate matter and quantification of lead in the ambient air of Bangalore city, Karnataka. Hosamani and Doddamani[4] evaluated air pollution in Mysore City. Durbin et al[5]. Studied population density, particulate emission characterization, and impact on the particulate inventory of smoking vehicles in the South Coast Air Quality Management District. Agarwal[6] reviewed air Quality Monitoring and Management. The environment has been laden with increasing effluents, pollution, levels of CO_2, global warming, depleting ozone layer, etc.. Air borne emissions from various industries are cause of major concern. These emissions are of two kinds, viz., solid (SPM) and gaseous (SO_2, NO_x, CO, etc.). Indian cities face high levels of air pollution and their inhabitants pay high price for the deterioration in air quality, e. g., in Delhi there are approximately 126,000 small and medium scale industrial units (GNCTD, 2000a). Patil[7] studied environmental management scenario in stone crusher industry sector and cleaner production possibilities. Gorman et al[8]. Studied the clinical toxicology of carbon monoxide. Thote and Heath [9] studied air quality management in opencast mines as need of the hour. Further comparative studies were carried out on some tree species commonly found in Udaipur and its adjoining areas and it revealed that tree species, viz., *Mangifera indica* L., *Pongamia pinnata* (L.) Pierre and *Holoptelea integrifolia* L. act as efficient sink for air pollutants and help rejuvenating the industrial and urban environment[10-14].

MATERIAL AND METHODS

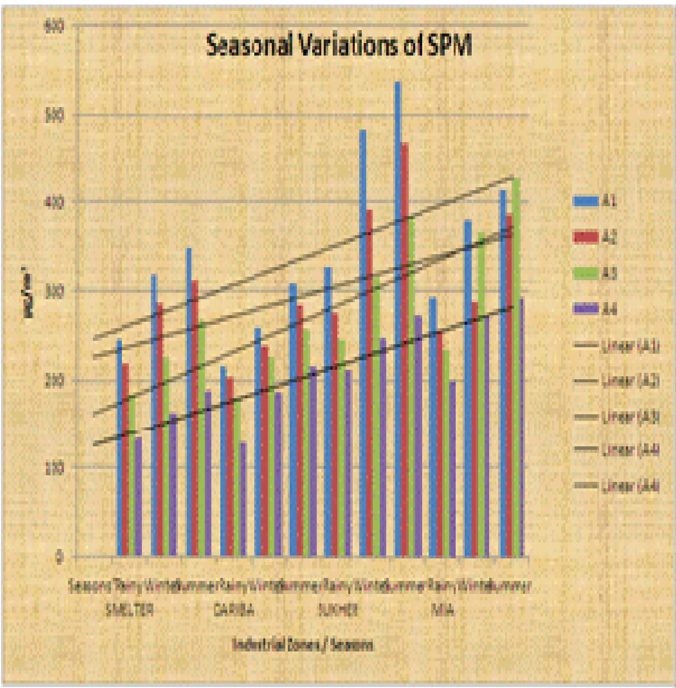
Rajasthan, the largest state of India, is situated between 23°3' N and 30°12' N latitude and 69°30' E and 78°17' E longitude. Rajasthan is located in the north-western part of the sub-continent. The climate varies throughout the state. The series of rising western hills safeguard Udaipur basin from the vagaries of dust storms and hot dry winds of western Rajasthan. For present study suspended particulates were trapped on a glass fiber filter paper attached to the hopper of HVS, the particulates deposited were computed as the net mass divided by the volume of sampled air and sulphur dioxide from air in a solution of potassium tetrachloro-mercurate (TCM) was absorbed. A dichloro-sulphitomercurate complex, which resists oxidation by the oxygen in the air, is formed. Nitrogen dioxide (NO_2) was collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. Carbon monoxide has been analyzed by using carbon monoxide analyzer. This technique is mainly based upon non-dispersive infra-red (NIDR) spectroscopy measurements for the monitoring purpose were in the range of 0.1–10 ppm. The present study was conducted at Rajpura Dariba mines of Rajasmand, Hindustan Zinc Smelter, Debari, Madri Industrial Area (MIA) and Sukher (marble processing Industrial area) of the Udaipur district of Rajasthan. In addition important industrial units in the district include Hindustan Zinc Smelter, PI Industries Ltd., Secure Meters Ltd., and Liberty Phosphate, etc. Meteorological data are presented in the **Table 1.**

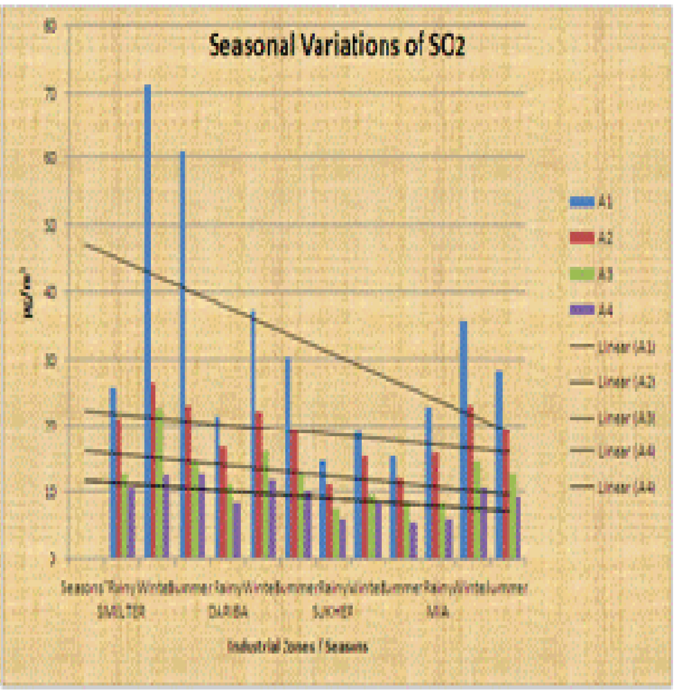
RESULTS

Fig.1 present the seasonal variations in gaseous pollutants concentrations at four industrial zones selected around the Udaipur city and inside the Rajsamand districts for year 2005. The 8-hourly mean concentration of suspended particulate matter ranged between 128.35 $\mu g/m^3$ (Zone-2, Station-4; rainy season) to 538.27 $\mu g/m^3$ (Zone-3, core area; summer season), sulphur dioxide ranged between 5.92 $\mu g/m^3$ (Zone-3, station-4; rainy season) to 71.15 $\mu g/m^3$ (Zone-1, core area; winter season), nitrogen dioxide ranged between 4.05 $\mu g/m^3$ (Zone-2, Station-4; rainy season) to 46.36 $\mu g/m^3$ (Zone-4, core area; winter season) and carbon monoxide ranged between 351.28 $\mu g/m^3$ (Zone 2, station 4; rainy season) to 1790.32 $\mu g/m^3$ (Zone 4, core area; summer season) during the period of study. Significant seasonal variations were observed for the SPM, SO_2, NO_x and CO.

Table-1: Meteorological parameters for seasons during 2005-2006.

Months	Temperature		Humidity (%)		Windkm/ha Direction			Sunshine hrs.	Rain (mm)	Weather
	Max	Min	Max	Min						
Jan	25.3	4.9	88.6	30.9	3.3	0.0	16.9	0	0.0	30.2
Feb	31.5	9.3	83.3	24.4	2.2	0.5	16.4	0	00.0	2.6
Mar	30.9	11.9	77.8	33.5	3.3	1.9	20.1	5.7	00.0	2.9
Apr	36.1	17.4	50.9	18.4	4.1	12.5	21.9	0	33.6	16.8
May	39.2	25.4	54.0	26.3	6.7	20.5	22.8	0	4.8	2.4
Jun	37.8	26.2	61.2	37.2	7.2	17.9	20.7	119.6	74.8	97.2
Jul	30.2	24.5	85.8	71.7	6.7	15.0	22.2	203.6	256.1	229.9
Aug	28.2	22.9	89.4	78.2	5.5	20.8	23.2	593.8	152.8	373.3
Sep	31.1	21.6	89.0	61.3	3.9	15.9	24.0	655.4	363.1	509.3
Oct	32.2	15.8	86.1	36.0	2.0	1.0	16.4	0	00.0	0.0
Nov	28.9	10.3	89.3	31.6	1.5	1.1	13.1	0	00.0	0.0
Dec	25.7	7.5	90.7	40.7	2.0	0.0	10.6	0	00.0	0.0





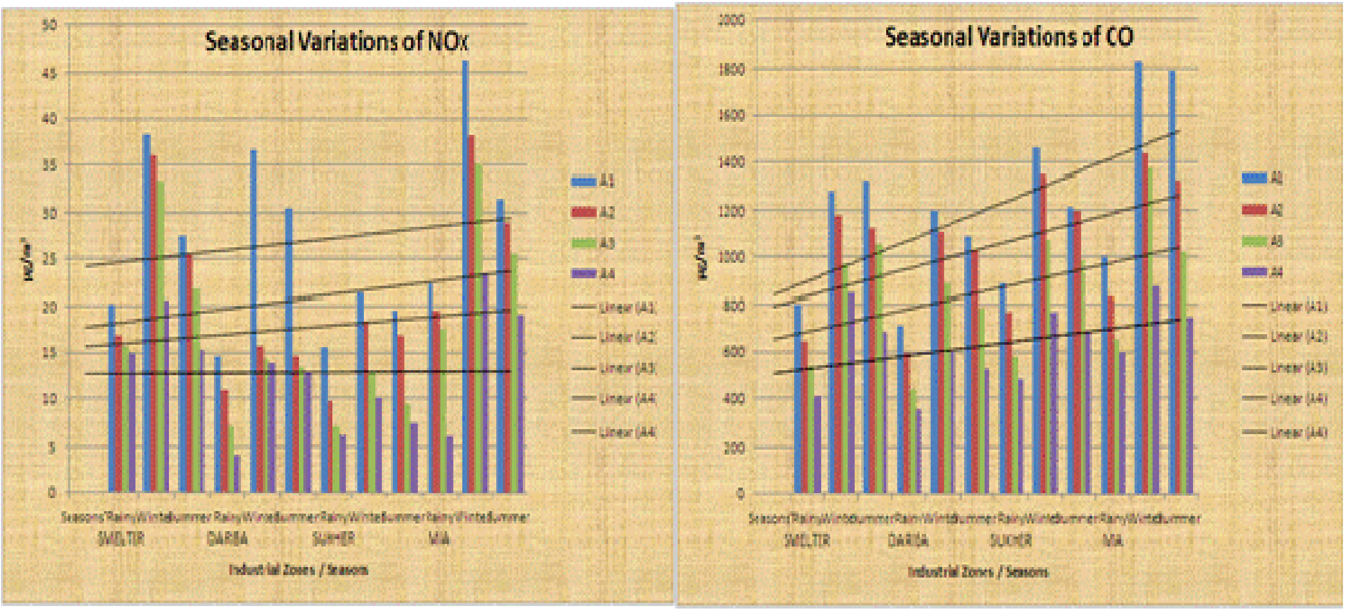


Fig.1: Seasonal variations in gaseous pollutants concentrations at four industrial zones under study.

DISCUSSION

Zone-1: ***Zinc Smelter***- situated at east of Udaipur city, is a hydrometallurgical plant. SO_2 concentrations were observed to be very high in this zone. Zinc Smelter is a smelting plant and zinc sulphide is used as raw material in this plant. Zinc sulphide ore is converted to zinc oxide to make it soluble for leaching resulting in release of sulphur dioxide. Maximum sulphur dioxide is then used in the manufacture of sulphuric acid but still remaining amount increases the sulphur dioxide concentration into the atmosphere. Fossil fuel emissions or emissions from energy production could be the possible reasons for enhancing the background level of SO_2 concentration. Station-1 was the place nearby core area. Value of SO_2 was high at station-1 and low at station-4 due to dilution and dispersal of pollutants. Concentration of primary pollutant in the ambient air is generally proportional to the frequency of emissions sources and distance from source of emission. Zinc Smelter receives pollution from adjoining National highway also. Direct emissions from running traffic and resuspended particles from road surfaces on the highway are important source of pollution especially for carbon monoxide, nitrogen oxides and suspended particulate matter. The measurements by Larssen and Hagen (1997) showed that wearing of street surfaces caused by studded tires has a significant influence on concentrations of PM_{10} in major cities. Pollutant concentration gradually declined from station-1 to station-4.

Zone-2: ***Rajpura Dariba Mines***- Objective of Rajpura Dariba Mines is to feed the zinc concentrate requirements for its smelters. Ore produced through mining process are mainly sulphide ores. Mining is done through vertical crater retreat and blast hole stopping. Ore is crushed underground before hoisting and stockpiling for secondary and tertiary crushing. These sulphide ores are oxidized to sulphur dioxide by atmospheric oxygen which in turn increase the sulphur dioxide emissions. This was one of the possible reasons for higher concentration of sulphur dioxide in zone-2 in comparison to that of zone-3 and zone-4 with some minor exception in case of MIA. Dariba mines is an underground mine and this could be possible reason for low concentration of SPM although fugitive dust is generated due to different mining operations such as drilling, blasting, ore transportation, beneficiation plant and excavation with shovel, etc. High concentration at station-2, Rajpura is due to the proximity to the mines compared to that of station-3 (Dhaneriya) and station-4 (Railmagra).

Least populated residential area, low traffic density and absence of other industrial units are responsible for low concentration of CO, NO_x and SPM compared to that of other zones. Concentrations of NOx vary with that of zone-3. Values of NO_x at zone-1 were higher compared to that of zone-2 with few minor exceptions at station-2 in zone-2 during winter and summer season. Pollutant concentration gradually declined from station-1 to station-4. A low concentration at station-3 and station-4 is also due to existing vegetation and trees surrounding these areas and dilution and dispersal of pollutants. Zone-3, ***Sukher*** is a marble processing zone. In zone-3 suspended particulate matter concentration were observed to be very high at station-1 and zone-3 considering data of three seasons together. The monitoring station-4 was 7 Km away from station-1 and station-1 was the core area of Sukher plant. Many marble cutting industries and marble scutters, exist in this zone-might be the main reason.

While marble blocks are cut by gang-saws, water is used as a coolant and marble slurry is generated as waste/by-product during cutting of marble and nearly 20% of the total weight of the marble processed results into marble slurry. When dried, the fine particles become air borne, i.e., suspended particulate matter and cause severe air pollution. Apart from occupational health problems, it also affects machinery and instruments installed in industrial areas. Road transport of freight or loading and unloading of marble and granite blocks are responsible for high concentration of carbon monoxide in the zone. For SPM, in the entire zones exceedence factor (the ratio of annual mean concentration of a pollutant with that of respective standard) did not exceed 1.00 (high pollution) and 1.5 (critical pollution) except in Sukher and Madri industrial area, where exceedence factor exceeded 1.00 and 1.5. In zone-4, ***MIA*** most of the industrial units use raw materials like metallic ore, coal, and crude oil which burn and emit sulphur dioxide along with particulate matter, carbon monoxide and nitrogen dioxide into the atmosphere. High frequencies of emission sources are mainly accountable for high concentration of nitrogen dioxide and carbon monoxide in Zone-4. This zone-includes NH-8 Pratap Nagar by-pass which is high traffic density area. Energy industries and road transport might be significant contributors towards increasing the concentration of SO_2, NO_x, CO and SPM. Re-suspension of road dust, stone crushers, refuse burning, wood combustion and diesel vehicle exhaust were identified as the major contributors to the total suspended particulate matter.

Similarly, for sulphur dioxide (SO_2) emissions, the major contributors were industrial fuel oil combustion and power plants. Public transport, private transport and road transport of fright were the important source of emissions. At zone-4, exceedence factor crossed the value 1.00 in case of SPM violating the standards particularly at station-1 and station-2 during summer and winter season. While all other pollutants fall under the category of moderate pollution. Concentration of gaseous pollutants varied with season. With few exceptions, concentrations of SO_2, NO_2 and CO were highest during winter and that of suspended particulate matter were highest during summer. Although there exist considerable variations, but almost similar trend was observed for other gaseous pollutants. Air pollutants concentration varied widely at different zones, the patterns of seasonal variations can be explained as a major means which trigger associated changes in meteorological variables.

This region is characterized by three distinct seasons: summer, winter and rainy. With few exceptions concentration of SO_2, NO_2 and CO were high during winter characterized by lower ambient temperature, high pressure, calm conditions, lower mixing depth, pollution inversion and high traffic density on the roads. Winds mostly flow from North-West direction, thus facilitating distribution of air pollutants. The temperature inversion phenomenon during which mixing height remains minimum is a recurring feature during winter, which restricts and confines pollutants dispersion and dispersal. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated help in buildup of pollutants in vicinity of pollution sources.

In contrast, SPM concentrations were high during summer characterized by high temperature, frequent change in wind speed/direction and turbulence in the atmosphere. Local disturbances in environment cause frequent dust-storm and hazy conditions. During monsoon frequent rains wash down the air-borne particulates and other gaseous pollutants. Therefore, the period between July to mid-October is the cleanest period in the year and frequent rain check pollutants to build up to higher concentration in ambient air though the pollutant generating sources remain the same throughout. The co-variation in pollutant pairs provides information about the relationship between the air pollutants and, to a greater extent, their common source of emission. However, such relationship also depends on the nature of raw material and the process of their information, efficiency of scavenging system and, to some extent, on the residence time of the pollutants in the air. The results of correlation studies of pollutants showed that these pollutants bear positive correlation. This is expected as these pollutants are emitted from same emission source.

CONCLUSION

The air quality monitoring conducted around industrial plants at Udaipur indicated that the pollutant concentration were highest at station 1 which was closest to the factory. The pollutant concentration declined with increasing distance in the order A1>A2>A3>A4. Pollutant concentrations varied with season, gaseous pollutant being highest during winter whereas SPM was maximum during summer season. All pollutants were low during rainy season indicating the effect of rain wash. Year-wise variation in pollutant concentration was not significant. Pollutant concentrations varied depending upon the distance, emission sources and metrological conditions.

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