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Studies on the ambient air quality status in the Industrial belt of Kashipur, Uttarakhand, India

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Abstract

Industrial activity in Kashipur area, Uttarakhand give rise in to significant level of pollutants in the atmosphere, which affect the quality of life in the industrial area. In the present study, air quality status has been monitored using the AAQSM procedure in the industrial area of Kashipur, Uttarakhand, India. During course of study 24 hr. average criteria pollutants such as sulfur dioxide, oxides of nitrogen, respirable suspended particulate matter and suspended particulate matter for 2011 at ten air quality monitoring stations were measured. All the ten air quality monitoring stations has been analysed against NAAQS for particulate matters (SPM & RMP), SO_2 and NO_x concentrations for monitoring period of 2011. Results of monitoring reflect that ambient air quality of all the stations are under prescribed limits. The study concluded that some area need immediate attention for its proper management to maintain ambient air quality further it is suggested that maintenance of unpaved roads is of utmost importance.

Keywords*: Vehicular pollution; traffic intersection; air quality index; air quality standard; health effects*

Introduction

India has experienced substantial increases in industrial growth and expansion in recent years. The industry has resulted in increased pollutant emissions and the deterioration of environmental quality and human health in major cities in India. After formation of Uttarakhand as a new State rapid industrialization and urbanization took place due to this there is great pressure on the environmental components. Kashipur is an old industrial town of Uttarakhand State, earlier belonging to Uttar Pradesh. This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemical, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical and gas based thermal power. Specifically, pollutant concentrations near industrial sector major intersections and roadways in the city are exceeding the Indian national ambient air quality standards (NAAQS). Thus, users (motorists, pedestrians, residents etc.) in these corridors are exposed to pollution levels (Nagendra *et al.*, 2004). Exposure to vehicular air pollution directly affects respiratory, nervous and cardiovascular systems of humans, resulting in impaired pulmonary functions, sickness, and even death (Hall, 1996). Therefore, this study is carried out to evaluate and validate the present ambient air quality status at Kashipur town of Uttarakhand with specific reference to Industrial area and M/s India Glycols Limited. Several air quality standards and guidelines have been introduced by the Central Pollution Control Board (CPCB) of the Indian Ministry of Environment and Forests to reference and regulate air quality of particular importance are the Air (prevention and control of pollution) Act (1981), the Environmental Protection Act (1986). The Indian NAAQS for criteria pollutants are summarized in Table 1. These standards and guidelines address individual pollutants and are developed based on highest percentile values over various averaging periods (Central Pollution Control Board, 2000). As such, it is difficult to incorporate these standards into a reference scale. Further, the awareness of high air pollution concentrations and or even the frequency

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of with which the NAAQS are exceeded is not sufficient for the citizens to assess urban air quality. The general public needs information on the levels and potential health risks of air pollution presented in a simple, understandable format. However, 2% of the time, it may exceed but not on two consecutive days.

Table 1. National Ambient Air Quality Standard

Indian national ambient air quality standards Pollutants	Time-weighted average	Concentration of pollutants in ambient air		
		Industrial areas	Residential, rural and other areas	Sensitive areas
Sulfur dioxide (SO_2) (lg/m^3)	Annual[a]	80	60	15
	24 h[b]	120	80	30
Oxides of nitrogen as (NO_2) (lg/m^3)	Annual[a]	80	60	15
	24 h[b]	120	80	30
Suspended particulate matter (SPM) (lg/m^3)	Annual[a]	360	140	70
	24 h[b]	500	200	100
Respirable particulate matter (RPM) (<10 lm) (lg/m^3)	Annual[a]	120	60	50
	24 h[b]	150	100	75

a Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.
b 24 hourly/8 hourly values should be met 98% of the time in a year

Description of Study area.

Kashipur has been identified as one of the potential Industrial developing area in Uttarakhand. The study area located in the industrial area of Kashipur in Udham Sing Nagar district of Uttarakhand between 29°10'32.1798' North Latitude and 79°0'24.3457" East Longitude. Major industries in the study area can be categorized broadly into three: viz., Pulp & Paper, Chemical and Steel as given below in Table 2.This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemicals, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical, and gas based thermal power.The primary sources of suspended particulate matter in the ambient air environment of industrial area of Kashipur are process of chemical plant, process of paper industries, from transportation of heavy vehicles and boilers in industries.

Selection criteria of siting the monitoring stations.

A total of 10 stations were set up to monitor the ambient air quality in the study area following standard siting criteria (IS: 5182, Part XIV). Each such sited station represents a unique category of micro environment. Monitoring station was selected based on the criteria mentioned below:

1. Access, security and availability of electricity.
2. Zone of possible pollutant concentration.
3. Area of population exposure.
4. Wind direction.
5. Dispersion of pollutants from other sources located outside the study area.
6. Non-Industrial reference station providing background level

In order to establish the baseline air quality status in a study area, about 10 ambient air quality stations were selected within the 10 Kms radius study area of the proposed project site including one station in upwind direction. These stations were selected on the basis of even distribution over the study area taking in to consideration various factors like topography of the region, proximity of sensitive establishment and human settlements, industrial activities in the area and its proximity, down wind direction etc. Location plan of the sited ambient air quality monitoring station is presented in Figure 1 and each station site is briefly described below:

On Site i.e. India Glycols Limited is located around 7 km east of Kashipur city. Uniqueness of this station is the fact that we are taking it as base

station and all other station are within 10 km radius of this station.

Ginni Khera is a very small village located around 3 km north east of Prolific Papers (P) Limited. Uniqueness of this station is that, it is away from industries (except one paper plant) and city. The selected study station is considered to be agriculture land and exhibit intense agri-business and ruler activity.

Nandrampur is a village located around 2 km north east of India Glycols and around 500 m north east of Highway .Uniqueness of this station is the fact that it in down wind direction of chemical industry and highway. There is heavy traffic of heavy vehicles in the highway due to industrial transportation.

Dhakia Kalan is a village located around 7 km north east of India Glycols and around 6 km north east of Highway .Uniqueness of this station is it is away from industries thus it can be use for reference data.

Dabhaura Mustahkam is a village located around 3.5 km south east of India Glycols and around 2.5 and 2 km east of Chima Paper and Multiwall Paper respectively. Uniqueness of this station is the fact that it in up wind direction of paper and chemical industry and highway. This station has taken as reference station providing background level.

Barkheri is a village located around 2 km west of Chima Papers and around 2 km South of India Glycols Limited. Uniqueness of this station is the fact that it is affected with pollution load of paper and chemical industry and unpaved road.

Berkhera Pandey is a village located in the west of Shravanti Energy and North of Flexi Tuff. Uniqueness of this station is the fact that it in down wind direction of a Flexy Tuff.

Kharakpur Devipura is a village located around 4 km west of India Glycols Limited and in between India Glycols Limited and Kashipur City. Uniqueness of this station is that, it is away from industries and city. The selected study station is considered to be agriculture land and exhibit intense agri-business and ruler activity.

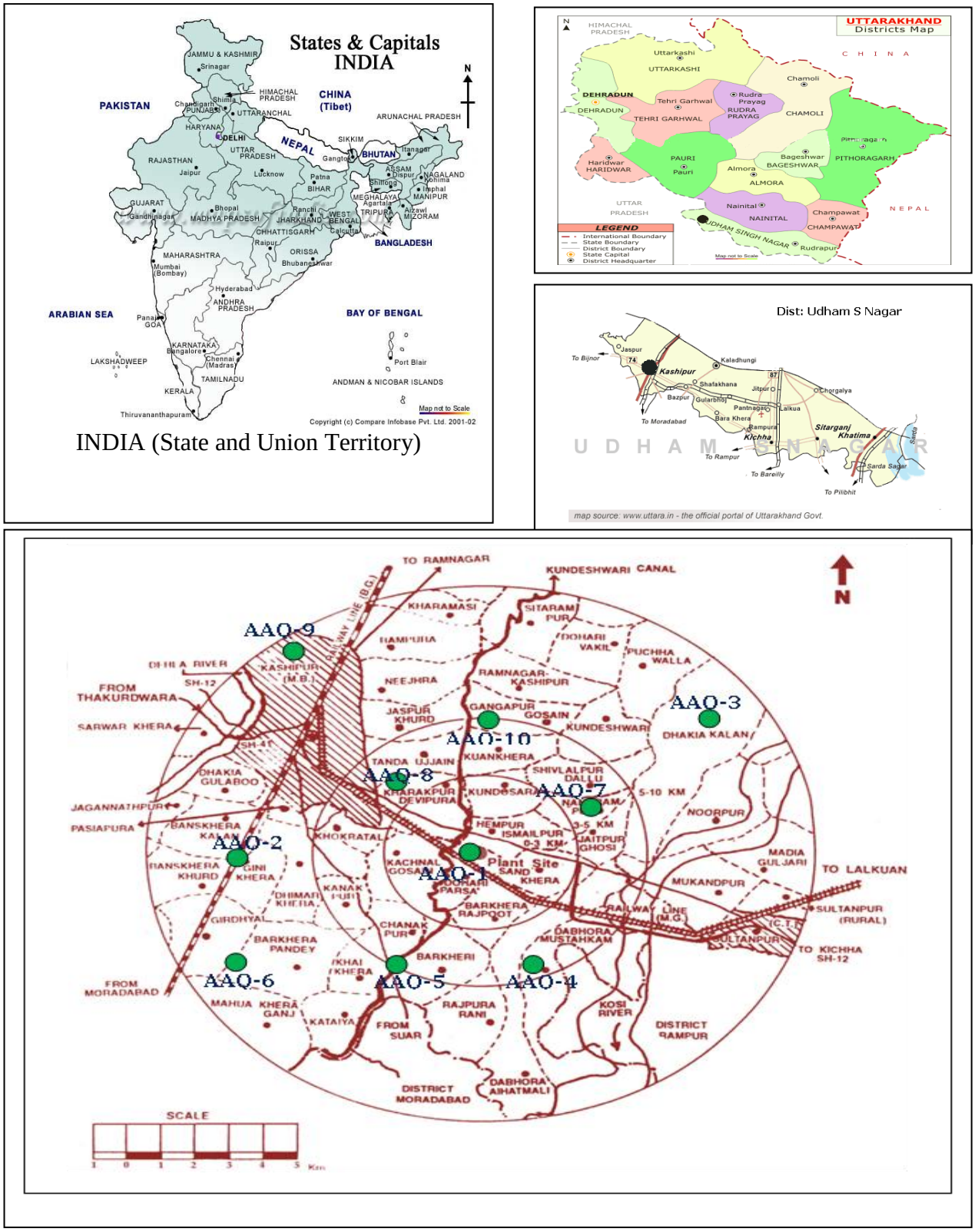
Kashipur station is located in the in telephone exchange building of Kashipur. Uniqueness of this station is that, it will represent the pollution load of local transportation as it is adjacent to highway. The selected study station is considered to be the major traffic intersections area of the city and exhibit intense human activity.

Gangapur gosain is located in aproximaely 6 km north of India Glycols Limited. Uniqueness of this station is that, it will represent the pollution load of ruler activity. The selected study station is considered to be agriculture land and exhibit agri-business.

Table 2 Industrial Activity in Kashipur Area

Industry	Location	Product
India Glycols Limited	Bazpur Road	Chemicals
Goraya Straw Board Mills Pvt Ltd	Bazpur Road	Paper
Multiwal Pulp & Board Mills (P) Ltd.	Bazpur Road	Paper
Prolific Papers (P) Limited	Village Girdhai, Aliganj Road,	Paper
Cheema Papers Ltd	Nainital Road	Paper
Shravanti Energy	Aliganj Road	Electricity (yet to start)
Gama Energy	-	Electricity (yet to start)
Beta Energy	-	Electricity (yet to start)
Naini Paper	Ramnagar Road	Paper
SRF	Ramnagar Road	Chemical
Kashi Vishwanth Steels Ltd	Bazpur Road	Steel, Special Alloys
Jindal Baverages	Bazpur Road	Frozen Foods, Edible Oils

Fig. 1 Map of Industrial Area of Kashipur, showing study area and Air Monitoring Station



Methodology of Air Quality Monitoring (Sampling and Analysis)

Methodology of ambient air monitoring consist of sampling, collection of air samples (following standard procedures) at selected sampling locations using Respirable dust sampler with impinge attachment for gaseous sampling, of Envirotech-make (model APM-451) during summer season in the year 2011. Whereas the concentration Particulate matter 2.5 will be monitored by installing Envirotech made APM 50MFC particulate matter sampler. 24 hourly ambient air samples (separated as day and night) were collected for SPM, PM_{10}, $PM_{2.5}$, SO_2 and NO_x. These samplers were operated at an average flow rate of 1.0-1.2 m^3/min. for sampling/collection of SPM, PM_{10}, and $PM_{2.5}$ levels. They were computed as per standard method after determining the weights of Whatman GF/A filter paper before and after sampling in electronic balance. For SO_2 and NO_x , ambient air samples were collected using Respirable dust samplers of model APM-451 with impinge attachment provided with specific absorbing solutions, which were operated at an average flow rate of 0.2-0.5 l/min. (IS: 5182, part II). The impinge samples (containing SO_2, NOx in specific absorbing solution) were put in iceboxes immediately after sampling and transfer to a refrigerator until analyzed. These were analyzed spectrophotometrically using spectrophotometer. Techniques used for ambient air quality monitoring is given below:

Table 3: Techniques used for ambient air quality monitoring

Parameter	Technique
1. Suspended Particulate Matter	Respirable Dust Sampler (Gravimetric method)
2. PM 10	Respirable Dust Sampler (Gravimetric method)
3. PM 2.5	APM 550 Fine Particle Sampler
4. Sulphur Dioxide	West and Gaeke
5. Oxides of Nitrogen	Jacob and Hochheiser

Results and Discussion

The level of air pollutants were observed at considerably lower level, due to dust suppression and dissolution of gaseous pollutants naturally, by precipitation due to humid atmosphere. Air pollution status and its assessment, is provided below:

Average concentration level of SPM, PM10, PM2.5, SO_2 and NO_X, as observed are presented in Table 4 and Figure 2 & 3 reflecting air quality in the study area.Significant level of SPM can be observed in Kashipur City, Barkheri village and On site at India Glycols Limited. The highest level of SPM can be observed at Kashipur city due to intense human activity and traffc intersections, and second highest SPM observed at Berkheri is mainly due to Chima Paper and unpaved road. Third highest SPM is found on site at India Glycols Limited due to its own activity of storage of coal, movement of coal and biomass fired boiler activity. Still the SPM level of all these are well below the NAAQS.Significant level of RPM (PM10 & PM2.5) can be observed in Kashipur City, Kharagpur Devipura village and On site at India Glycols Limited. The highest level of RPM can be observed at Kashipur city due to intense human activity and traffic intersections consist of heavy earth moving machine movement in highway, and second highest RPM observed at Kharagpur Devipura village is mainly due to agriculture land and exhibit intense agri-business and ruler activity and unpaved road. Agriculture activity will cause emission of fine dust. Third highest RPM is found on site at India Glycols Limited due to its own activity of storage of coal, movement of coal and biomass fired boiler activity. Higher RPM is monitored at two more monitoring station Ginni Khera and Gangapur Gosain and these higher RPM level is due to agriculture land and exhibit intense agri-business and ruler activity and unpaved road. Agriculture activity will cause emission of fine dust. Still the RPM level of all these are well below the NAAQS.Significant level of SO_2 can be observed in Kashipur City and On site at India Glycols Limited. The highest level of SO_2 can be observed at Kashipur city due to intense human

activity and traffc intersections consist of movement of vehicles at highway. Higher SO_2 level is found on site at India Glycols Limited due to its plant activity and coal fired boiler for steam and power generation. Emission of SO_2 due to movement of heavy carriage vehicles carrying raw materials and finished products. Still the SO_2 levels of all these stations are well below the NAAQS.Significant level of NO_X is observed on site at India Glycols Limited and at Kashipur City. The highest level of NO_X observed on site at India Glycols Limited is due to its plant activity mainly coal fired boiler for steam and power generation and oil fired heater for process. Emission due to movement of heavy carriage vehicles for carrying the raw material and finished product also increase the level of NOx in the area. The higher level of NO_X observed at Kashipur city due to intense human activity and traffic intersections consist of movement of vehicles at highway. Still the NO_X levels of all these stations are well below the NAAQS.

Table 4: Average value of pollutants in 2011

Code	Station	SPM	PM_{10}	$PM_{2.5}$	SO_2	NOx
		All value in μ g/m^3				
AAQ-1	On site	249.5	62.4	22.4	21.5	26.6
AAQ-2	Ginni khera	155.2	68.1	19.9	21.3	11.3
AAQ-3	Dhakia kalan	164.3	54.8	21.1	21.2	12.4
AAQ-4	Dhaubora mustakam	149.1	55.3	19.3	20.8	12.7
AAQ-5	Barkheri	264	52.9	20.5	21.2	17.5
AAQ-6	Berkera pandey	150.7	52.4	19.6	21.4	11.4
AAQ-7	Nandrampur	168.4	57.6	20.4	20.6	12.3
AAQ-8	Kharakpur devipura	143.6	63.5	21.2	20.5	11.5
AAQ-9	Kashipur (Kashipur City)	278.5	75.5	22.8	22.1	21.6
AAQ-10	Gangapur gosain	154.7	65.6	20.7	21.5	12.3

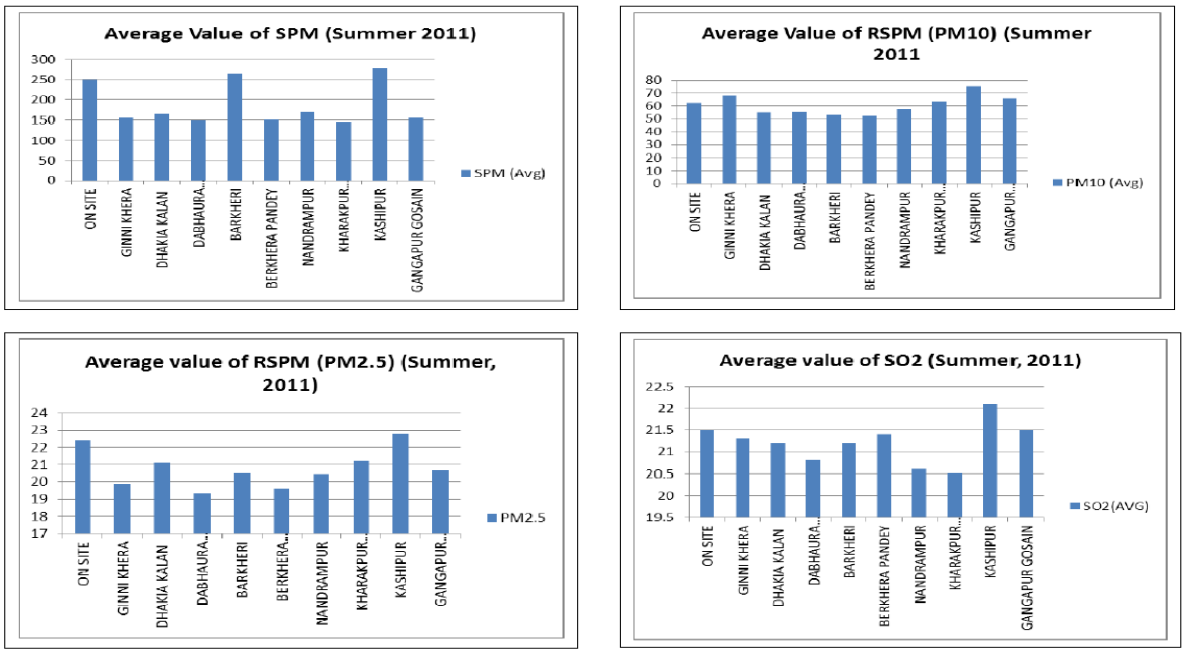


Figure 2 Average Concentration Level of Particulate and Gaseous Air Pollutants in Monitoring Station (Summer, 2011)

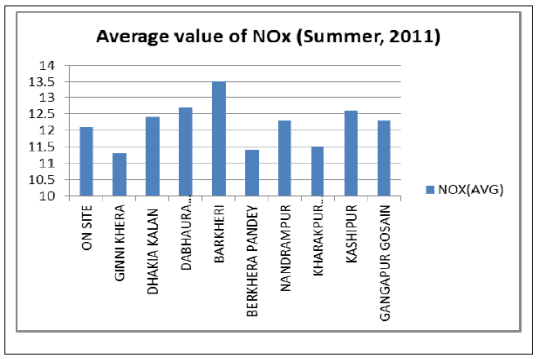


Figure 3 Average Concentration Level of Particulate and Gaseous Air Pollutants in Monitoring Station (Summer, 2011)

Conclusion

This study reveals that ambient air quality of Kashipur industrial area is presently within limit of NAAQS. A detailed study is in progress to observe whether this air quality status is deteriorating or stagnant which will help in developing strategies for control and prevention of air pollution in the area.

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