IJASRM

International Journal of Advanced Scientific Research and Management, Special Issue 5, April 2019

www.ijasrm.com

ISSN 2455-6378

Assessment of Stone Crusher Pollution and Its Control Measures

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Abstract

Air pollution is one of the biggest problems of the world. Industrialization is the major cause of air pollution. Stone crusher industries are the major source of industrial pollution. Industrial pollution causes the various human diseases and shows harmful effect on vegetation. This paper assessed ambient air pollution in Bharatkoop town district Chitrakoot. Selected parameters were suspended particulate matter (PM_{10} & $PM_{2.5}$), sulphur oxides (SO_x), nitrogen oxides (NOx). The five sampling stations were selected for sampling during winter and summer, 2016. The concentration of particulate matter was found above the permissible limit in most of the sites while the concentration of gaseous pollutants was found within the permissible limit as per the standards given by Central Pollution Control Board (2009). To improve and manage the ambient air quality of the township there should be a need of proper and regular assessment of air quality. To promote the increased level of cooperation and coordination of among government sectors, non government organizations and the population of this town in reducing and controlling pollution load by using various control measures.

Keywords: *Ambient Air Quality, PM_{10}, $PM_{2.5}$, SO_x, NO_x, Control Measures*

1. Introduction

Pollution is a necessary evil of all development. It is an undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect the life or create a potential health hazard of any living organism and in particular for man. Industrialized countries of the world release in to the atmosphere pesticides, detergents, plastics, solvents, fuels, paints, dyes, food additives etc. are some of the examples. Besides these there are a number of industrial effluents emissions of poisonous gases in the atmosphere. 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. The pollutants in air may be in the form of solids, gases and liquids **(Sharma, 2013).** 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. Stone crushing Industry is an important industrial sector in the country engaged in producing crushed stone of various sizes depending upon the requirement which acts as raw material for various construction activities such as construction of roads, highways, bridges, buildings, canals etc. It is estimated that there are over 12,000 stone crusher units in India. These stone crushers though socio-economically are important sectors yet give rise to substantial quantity of fine fugitive dust emissions which create health hazards to the workers as well as surrounding population by way of causing respiratory diseases **(CPCB, 2010).** The stone crusher is one of such industries that exist in the vicinity of almost all major cities and towns throughout the country in all the states because the construction activities go on throughout the country. Stone crusing units also generate dust as byproduct due to mechanical crushing and screening operations **(CPCB, 1984)**.

Belt conveyor movement is also a source of continuous noise, especially the ill-maintained and cheaper end conveyor system make more noise **(CPCB, 2010).** Suspended particulate matter, sulphur oxide (SOx), nitrogen oxide (NOx) and CO pollution cause a risk for human health **(Gupta and Gupta, 2014)** and exposure of these pollutants also affect vegetation growth due to adsorption of above pollutants on leaf, which prevented the process of respiration and photosynthesis **(Gupta *et.al.*, 2014)**. The dust also adversely affects visibility, growth of vegetation and aesthetics of area. Air borne particles in the atmosphere have serious environmental impacts on the climate **(Broecker, 2000)**, biogeochemical cycling in ecosystems **(Nriagu, 1988),** outside visibility and the health of living beings **(Dockery, 1993)**.

Bharatkoop is a small town of district Chitrakoot (U.P.). It is situated at Jhansi-Allahabad train route. Its geographical location is at latitude 25^0, 21' N and longitude 80^0, 77' E. There are a number of small, medium and big stone crushing industries at and in surrounding of Bharatkoop.

2. Materials And Methods

Five sampling sites of Bharatkoop region were selected for the study. These were Bharatkoop East (BKE), Bharatkoop West (BKW), Bharatkoop Central (BKC), Bharatkoop North (BKN), and Bharatkoop South (BKS). The ambient air sampling was done for 24 hours in winter season and summer season 2016. Fine particulate sampler model APM 550, Envirotech, New Delhi and Gaseous pollutant sampler, model APM 433, Envirotech were used for particulate and gaseous sampling. Whatman glass microfiber and PTFE filters were used for PM_{10} and $PM_{2.5.}$ All parameters were analyzed as per standard methods of National Ambient Air Quality Standard (NAAQS) prescribed by CPCB (Central Pollution Control Board).

3. Results And Discussion

The maximum and minimum concentrations of respirable particulate matter (PM10) were 2074.04 and 324.64 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop North (BKN) during winter, 2016 respectively. The maximum and minimum concentrations of respirable particulate matter (PM2.5) were 768.67 and 202.16 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKS) during winter, 2016 respectively. The maximum and minimum concentrations of SO_x were 14.75 and 7.70 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop West (BKW) during winter, 2016 respectively. The maximum and minimum concentrations of NO_x were 30.41 and 18.06 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKS) during winter 2016 respectively.

The maximum and minimum concentrations of respirable particulate matter (PM10) were 1025.63 and 225.76 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKN) during summer, 2016 respectively. The maximum and minimum concentrations of respirable particulate matter (PM2.5) were 726.10 and 104.17 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKN) during summer, 2016 respectively. The maximum and minimum concentrations of SO_x were 19.56 and 8.01 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKS) during summer, 2016 respectively. The maximum and minimum concentrations of NO_x were 28.49 and 16.87 µg/m^3 in Bharatkoop Central (BKC) and Bharatkoop South (BKS) during summer, 2016 respectively.

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ISSN 2455-6378

Table-1 National Ambient Air Quality Standards, 2009 (CPCB)

Pollutants	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO_2), µg/m^3	Annual 24 Hours	50 80	20 80	Improved West and Gaeke Method
Nitrogen Dioxide (NO_2), µg/m^3	Annual 24 Hours	40 80	30 80	Jacob and Hochheiser modified (NaOH and $NaAsO_2$) Method
Particulate Matter (Size less than 10 µm) or PM_{10}, µg/m^3	Annual 24 Hours	60 100	60 100	Gravimetric Method
Particulate Matter (Size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual 24 Hours	40 60	40 60	Gravimetric Method
Carbon Monoxide (CO), mg/m^3	8 Hours 1 Hours	02 04	02 04	NDIR Method

Table- 2 Concentrations of different air pollutants in ambient air of Bharatkoop (winter, 2016)

S. No.	Sampling sites	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_x (µg/m^3)	NO_x (µg/m^3)
1	BKE	890.64	502.54	10.20	22.43
2	BKW	1561.03	547.74	7.70	25.16
3	BKC	2074.04	768.67	14.75	30.41
4	BKN	324.64	204.40	12.15	25.28
5	BKS	482.76	202.16	8.12	18.06

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Table- 3 Concentrations of different air pollutants in ambient air of Bharatkoop (summer, 2016)

S. No.	Sampling sites	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_x ($\mu g/m^3$)	NO_x ($\mu g/m^3$)
1	BKE	601.18	389.19	11.43	20.03
2	BKW	931.87	436.69	10.23	17.33
3	BKC	1025.63	726.10	19.56	28.49
4	BKN	225.76	104.17	17.11	23.26
5	BKS	341.33	282.71	8.01	16.87

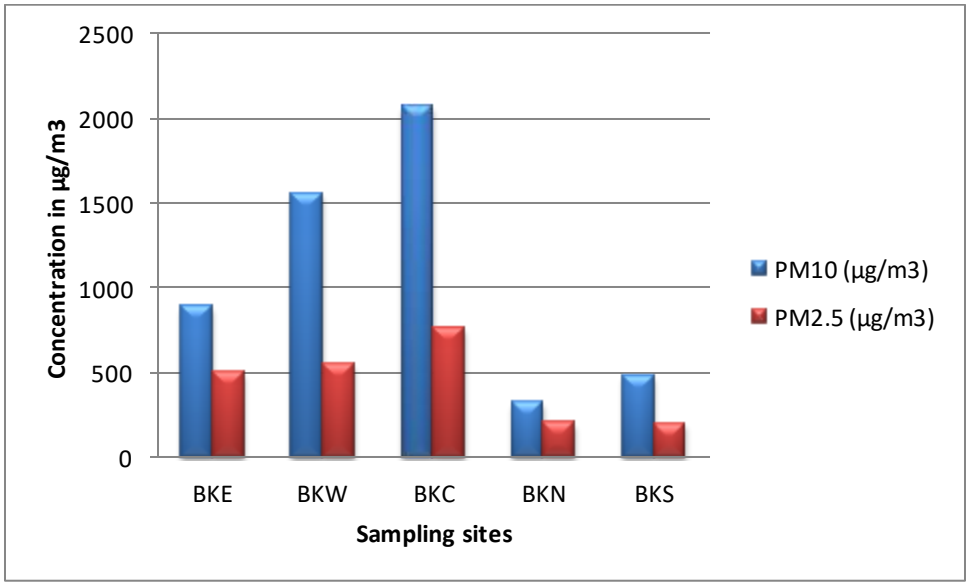

Figure 1: Relation between PM_{10} and $PM_{2.5}$, winter 2016

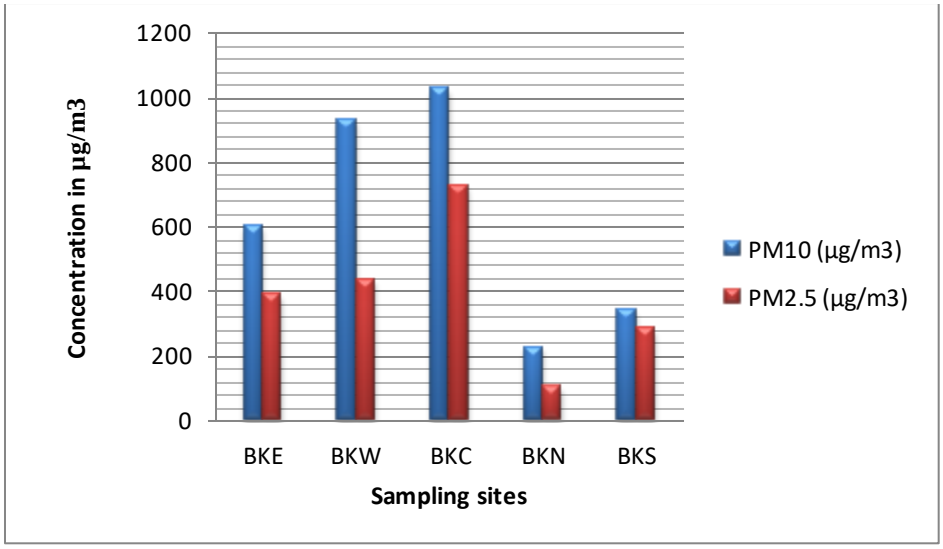

Figure 2: Relation between PM_{10} and $PM_{2.5}$, summer 2016

4. Control Measures

- No stone crusher shall be established/ operated within a radius of 1.5 kms (aerial distance) from abadi area of recorded revenue village as defined under the provisions of Land Revenue Act.
- Refuse to provide permission to start new mines or reject permission to re-open the new crusher plant. Permission should be given only if the required standards prescribed by CPCB should be fulfilled in given area.
- There should be the construction of wind breaking walls, the metalled roads within premises.
- Regular cleaning and wetting of the ground should be within premises.
- Development of green belt should be within and along the boundary wall of adequate height i.e. height should not less than 5 feet.
- For new crushers tall trees like Neem, Pipal, Jamun, Gulmohar etc. shall be deemed to cover 25 m^2 area and Shrubs like Guava, Pomegranate, Jangal jalebi etc. shall be deemed to cover 9 m^2 area of suitable species to be planted to develop a green belt.
- Tree planting programme should be conducted from owner of crushing plants as well as local people.
- All stone crushers should provide the following dust containment equipment/ system:

• Closed metal sheet enclosures at dust emitting points i.e. the crushers including their discharge points, screens, and the transfer points of belt conveyers, with arrangements of a door with opening and closing facility for cleaning and maintenance and flexible covers at entrance and exit of the belt conveyors. All opening provided for ventilation in the enclosures should be covered by canvas bag-filter to arrest the escaping dust.

5. Conclusions

This study reveals that the dust generated from stone crushing activities contains excessive amount of particulate matter in winter season followed by summer which were more than the permissible limits while the concentration of SO_2 and NO_2 were within the permissible limits of National Ambient Air Quality Standard (NAAQS) prescribed by CPCB. The value of particulate matter was found higher at BKC due to more vehicles movement, much handling and transfer of stone boulders as well as stone gravels from cluster of stone crushers. The dust emitted from stone crushers contains high percentage of respirable particulate matter having silica causing serious health problems. The human nostril filter out 99% of inhaled large and medium sized particles. The rest may enter the wind pipe and lungs where some inhalable particles cling to protective mucous and air removed. Some of the particle called respirable particulates may tend to deposited in alveoli (tiny air sacs in the lungs). In lungs particulates slow down the exchange of oxygen with carbon dioxide in the blood causing shortness of breath.

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