Impact Of Stone Crusher On Ambient Air Quality And Human Health Jhansi Region In Bundelkhand U.P

Shree Ganesh, M. M Singh

Abstract-The aim of study,to evaluate the status of ambient air quality and human health in and around stone crusher industry. The main parameters considered for study of ambient air quality included suspended particulate matter (SPM), respirable suspended particulate matter (RSPM), respirable, nitrogen oxides (NOx) and sulfur dioxide (SO_2) and for the assessment of human health used to standard questionnaire during the period of December 2016 to Novrmber 2017. The results indicate, that the particulate matter was found above the NAAQ standard in and around stone crusher industry i.e. RSPM 1803±71.5 to 140.66±40.68 µg/m^3 and SPM 3758±29.8 to 300.33 µg/m^3). But in case of gaseous pollution average annual mean was recorded below the permissible limit in both selected sites stone crusher unit and Lakshamanpura village, SOx (5.58 to 4.91 µg/m^3) and NOx (10.66 to 9.5 µg/m^3) respectively. In the survey, which was based on questionnaire the high prevalence of diseases particularly, respiratory problems 79%, eye irritations 41%, hearing loss 50%, cough 65%, headache 58%, vision defect 52%, wheezing 51%, skin irritation 31%, chest pain 29%, aliment problems 15% and hair loss 9% reported problems among population living in and around the neighborhood of stone crusher industry.

Keywords: Ambient air quality, RSPM, SPM, Stone crusher, Human health.

1 INTRODUCTION

Stone crushing 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, railway sleepers, highways, bridges, buildings, hospitals, shopping complexes and canals etc. The sector is estimated to be providing direct employment to over 500,000 people engaged in various activities such as mining, crushing plant, transportation of mined stones and crushed products etc. Stone Crushers are primarily small scale industries mostly owned and operated by less educated individuals and are scattered all over the country. This sector primarily being an un-organized sector & has only local level (district/region) associations. In the absence of any centralized National or State Level association, the source to get a list of stone crushers in the state was identified as the State Pollution Control Board. Stone dust is a primary aerosol and it is released directly from the source. This primary aerosol has a detrimental effect on people and environment including flora and fauna, for example changed soil pH and productivity, formation of haze reducing visibility in the surrounding areas, destruction of habitat, damage of natural resources like valuable vegetations and wild lives, promotion of spreading many diseases etc[2],[3],[5]. Suspended particulate matter may be affecting more people globally than any other pollutant on a continuous basis[4]. Many studies have shown that there is significant association of SPM with a number of cardiovascular and respiratory health endpoints including mortality, hospital visits, respiratory illness, physiological changes in pulmonary function etc [1] [6],[7],[8]. The present status of stone crusher in around Jhansi reflects the gloomy and lawlessness situation promoting the rapid growth of stone crusher industry though it seems a small investment project but from pollution points of view it is categorized as highly polluting industry by state pollution control board. It poses major threat to adjacent villages and the workers. Mostly there units work as organized sector without any legal compliance and social responsibilities. The village head people will collect money from the stone crusher's management by warning them to close down the stone crushers. By keeping in view the warnings the management pays lump some of money to shut down their mouths. Here the poor and illiterate people are not getting any benefit. But loosing there health because of dust of stone and concrete. Hence the government should and must take appropriate steps for rural people who are residing nearby village.

2 MATERIAL AND METHOD

2.1 STUDY AREA

Jhansi is one of the important districts out of the five districts of Bundelkhand massif of Uttar Pradesh occupies almost 70,000 square kilometers of the central plains in India. The Bundelkhand massif covers about 26000 sq. Km of the total area of the southern Uttar Pradesh and north-eastern Madhya-Pradesh in central India and forms the northern fringes of the Peninsular Indian shield. The district Jhansi lies in southwest portion of Jhansi division of Uttar Pradesh state of India between 25° 30' N and 25° 57' N latitudes and 78° 40' E and 79°

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25' E longitudes. The present study area of the district according to survey of India is covering 5,024 square kilometers. Jhansi falls under a semi arid climate, with two main seasons specially Monsoon and Dry. Mining and rock crushing are the major essential activities that provide the raw material for society. As well, Jhansi is known one of the important granite mining centers in the Bundelkhand region. The study area is located onside road of Jhansi to Allahabad at a distance of 11 km to the east of Jhansi town. The study area enclosed huge number of stone crushers, each with an everyday crushing capacity around 45 tons, operating very close to each other by the side of a quarry. The extent of the area is 2- 4 kilometer square for quarrying and 1 km2 for stone crushing operation. For the air quality monitoring station were selected Sri Mahamaya stone crusher and its neighboring village Lakshamanpura.

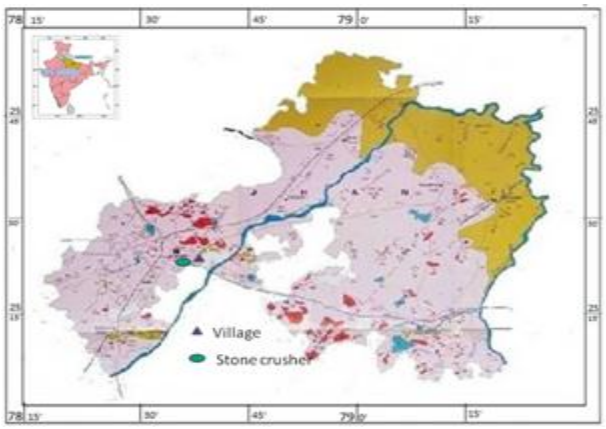

Fig. Map showing study location

2.2 Methodology for air quality monitoring

Respirable Dust Sampler (RDS) APM 460 was used for collecting air samples from different locations of the study area. In the present study, suspended particulate matter (SPM), respirable suspended particulate matter (RSPM), Oxides of nitrogen (NOx) and Oxides of sulphur (SOx) have been monitored by CPCB New Delhi [12].

The assessment of health effects caused by stone crusher workers and the local peoples in the nearby villages was collected with the help of a questionnaire. The total of (27+124) 151 inhabitants in the age group of 15-45 years was randomly selected for health survey. The information was collected regarding the respiratory problems, eye irritations, hearing loss, cough, headache, vision defect, wheezing, skin irritation, chest pain, ailment problems and hair loss respiratory, blood pressure, fatigue, and other signs.

3.2 Methodology for air quality monitoring by respirable dust sampler APM 460.

Particulars	RSPM	SPM	SOx	NOx
Sampling equipment	Respirable Dust Sampler (RDS) APM 460	Respirable Dust Sampler (RDS) APM 460	RDS with gaseous sampling attachment	RDS with gaseous sampling attachment
Collection Media	Glass fibre filter paper	Dust cup	TCM (Tetrachloromercurate)	NaOH plus sodium arsenite
Analytical Method	Gravimetric method	Gravimetric method	Spectrophotometry method (West and Gaeke method)	Spectrophotometery method (Jacobs-Hochheiser)
Time Frequency	8 Hourly	8 Hourly	4 Hourly	4 Hourly
Sampling Duration	continuously for 24 Hours	continuously for 24 Hours	Continuously for 24 Hours	Continuously for 24 Hours

3. Results and Discussion

3.1 RSPM and SPM

One year experimental data shows that during 2016-17 the mean annual value of the RSPM have been recorded at Sri Mahamaya stone crusher and its adjoining village Lakshamanpua monitoring stations ranged from 1468.08±137.27 µg/m^3 to 278.66±28.71 µg/m^3 and SPM the ranged from 3033.85±254.49 µg/m^3 to 491±46.30 µg/m^3 respectively (Table 1-2). The comparison from standard values set by CPCB, Delhi, of RSPM (150 to 100 µg/m^3) as well as SPM (500 to 200 µg/m^3) was found much higher at both study locations.

3.2 Gaseous Pollutants

The annual concentration of the gaseous pollutants SO_2 and NO_2 recorded in both study areas falls between 5.58 to 4.91 µg/m^3 and 10.66 to 9.5 µg/m^3 respectively (Table 1-2). The comparison from national ambient air quality standard value of SO_2 and NO_2 (80µg/m^3) was found under the permissible limit.

Table 1

Air quality status of Sri Mahamaya stone crusher at Lakshamanpura December 2016 to November 2017

Season	2016-17	RSPM	Max-Min	SD	SPM	Max-Min	SD	SO_2	Max-Min	SD	NO_2	Max-Min	SD
Winter	Dec to Feb	1751 ±38.7	1810-1678	67.1	3524 ±46.8	3608-3446	81.16	5.6 ±1.2	8..0-4.0	2.0	13 ±0.57	14.0-12.0	2.0
Summer	March to May	1803 ±71.5	1909-1667	123.8	3758 ±29.8	3812-3709	51.7	4.9 ±0.58	6.0 -4.0	1.0	11.3 ±0.66	12.0-10.0	1.15
Monsoon	Jun to Aug	718 ±138.52	980-509	239.9	1648.3 ±249.7	2103-1242	432.5	3.6 ±0.30	4.0 -3.0	0.52	8 0.57±	9.0-7.0	1.0
Autumn	Sept to Nov	1600 ±50.4	1699-1534	87.3	3204 ±52.6	3280-3103	91.1	5.5 ±0.76	7.0 -4.5	1.32	10.3 ±1.20	12.0-8.0	2.08
Annual Mean		1468.08 ±137.27	1909.0 -509.0	475.53	3033.85 ±254.49	3812-1242	881.58	4.91 ±0.41	8.0-3.0	1.43	10.66 ±0.64	14.0-7.0	2.22

All Value in µg/m^3 (RSPM, SPM, SO_2 & NO_2)

Table 2

Air quality status at Lakshamanpura village December 2016 to November 2017

Season	2016-17	RSPM	Max-Min	SD	SPM	Max-Min	SD	SO_2	Max-Min	SD	NO_2	Max-Min	SD
Winter	Dec to Feb	323.66 ±13.28	347-301	23	553±28.6	601-502	49.56	5.6 ±1.20	8.0-4.0	2.08	10 ±0.57	11.0-9.0	1.0
Summer	March to May	341 ±33.56	408-304	58.12	526 ±70.57	657-415	122.23	5.3 ±0.33	6-5	0.57	9.33 ±0.88	11-8	1.52
Monsoon	Jun to Aug	140.66 ±40.68	222-98	70.46	300.33 ±25.51	342-254	44.18	3.8 ±0.59	10-7.0	1..02	8.0 ±1.0	10.0-7.0	1.73
Autumn	Sept to Nov	309.33 ±47.23	395-232	81.81	518 ±60.30	631-425	104.44	7.46 ±1.07	9.0-5.4	1.85	9.33 ±0.88	11.0-8.0	1.52
Annual Mean		278.66 ±28.71	408.0-98.0	99.46	491 ±46.30	831.0-254.0	160.39	5.58±0.53	9.0-3.0	1.86	9.5 ±0.63	15.0-7.0	2.19

All Value in µg/m^3 (RSPM, SPM, SO_2 & NO_2)

HEALTH ANALYSIS

Stone crushing causes severe air pollution problems in active mining and crushing sites, workers are persistently exposed to large concentrations of dust, gaseous pollutants, high level of noise and accidents which constantly pose a severe threat to workers life and communities in close proximity to operations. The data on various health effects obtained from the current survey among the stone crushing workers and the population inhabiting in and around crusher sites are exhibited by Fig. 2. The activities such as digging, blasting, unloading, crushing, loading release dust particles of variable sizes into immediate atmosphere. The workers are encountered with substantial exposure to dust and noise which may lead to manifestation of various occupational diseases in long term. Most of this dust is made up of silica and workers are facing serious health problems. The most prevalent occupational diseases among the mine and stone crusher workers in Bundelkhand are: respiratory, hearing, eye, skin, fever, silicosis, dyspnea, blood pressure problems and accidents [9]. The dust released during mining and crushing activities not only affect humans but also plant and animals.

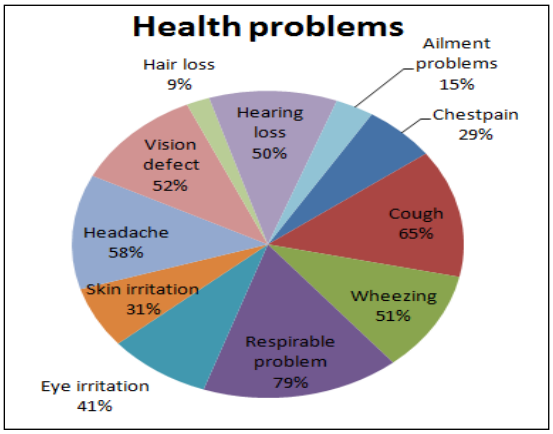

Fig: 2- Status of health problems in and around stone crusher

The overall observations showed that the dust exposure cause serious health problem which accounts respiratory problems 79%, eye irritations 41%, hearing loss 50%, cough 65%, headache 58%, vision defect 52%, wheezing 51%, skin irritation 31%, chest pain 29%, ailment problems 15% and hair loss 9%. The respiratory problems observed in present study were coughing, shortness of breath, chest pain, silicosis, asthma, bronchitis etc.

MANAGEMENT OF DUST EMISSION

Emissions from stone crushing are considered to be fugitive when the sources are not vented to a bag house or contained in an enclosure with a forced air vent or stack [10]. Water sprinkling at dust discharge points wets the dust particles and augments settling. The other control measures for reducing dust emission should include the following good housekeeping practices:

1. All stone crusher units should conform to the design developed and demonstrated by the National Productivity Council of India [11].
2. Covering open operations to prevent dust entrainment by the wind.
3. Construction of wind breaking walls.
4. To reduce the drop height of dusty material.
5. Regular cleaning and wetting of the ground within the premises.
6. Establishment of a green belt along the periphery of the crushing area and roads to arrest the spread of particulate matter arising from vehicular movement inside the area.
7. Construction of reinforce cement concrete road within the premises.
8. Fine dust accumulated in the crushing area should be periodically removed and placed in dumps covered with tarpaulins cloth to arrest the spread of dust.
9. Conveyor chutes should be provided at the discharge points.
10. Fine powder should be collected at the ground level and disposed off immediately.
11. As an occupational safety measure, all the workers should be provided with approved dust masks to prevent dust from entering into the respiratory system.

CONCLUSION

The dust generated from stone crushing activities contains a significant amount of fine inhalable matter. The RSPM and SPM concentration at tow monitoring station exceeded the standard of 200- 100 and 500-150 $\mu g/m^3$ of industrial and residential area recommended by Central Pollution Control Board [12]. RSPM and SPM concentration exceeded the CPCB standard at both site. The health survey was done with the help of questionnaires of workers and local persons. It is observed that people of this area and mostly the workers of stone crusher are suffering from eye irritation, skin diseases, acute respiratory infection etc.

6. REFERENCES

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