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Research Article

Effect of Stone Crusher Pollution on Certain Aspects of Health in and Arround Kabrai, Distt. Mahoba (U.P.) India

Sadhana Chaurasia* and Raj Karan**

* Department of Energy & Environment, MGCGV, Chitrakoot, Satna (MP), India

**Department of Energy &Env. MGCGV, Chitrakoot, Satna (M.P), India

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Abstract: Haze is all one can see beyond 60 meters in Kabrai distt. Mahoba U.P. The visibility reduces to zero when a stone crusher unit starts working. Green trees have greyed and concrete link roads are padded with an inch-deep layer of dust. The process of blasting mountains, blasting rocks, loading & unloading crushed stones of various sizes, crushing of stones in primary and secondary crushers continuously generates huge amount of dust in the atmosphere. The stone dust emissions and depletion of mountains of the region that adversely affect the ambient air quality, human health, ecological balance and fertility of farming lands. The areas around the stone crushing are constantly polluted by dust that spread in the atmosphere, thus causing damages to the environment and the residents lives nearby. The daily average ambient concentrations of TSP and PM_{10} varied from 282-562 $\mu g/m^3$, at the source. The average $PM_{2.5}$ concentration varied from 162-245 $\mu g/m^3$ at the source. Pulmonary function tests performed on workers showed that the average values of pulmonary function in these workers are significantly lower than the average values reported for normal human group. The residents of the area and specifically the labours working are suffering from various diseases such as skin allergy, throat and lungs diseases due to living and inhaling in the polluted air due to stone crushing. This study intends to determine statistical facts about the environmental damages and the health status of the poor workers who are working in stone crushing.

Keyword: - Air pollution, Stone crusher, Health hazard, Lung function.

INTRODUCTION

The chemical composition of the dust tends to be homogenous mixture of oxides of calcium, potassium, aluminium, silica and sodium, which settles into a head mass when it comes in contact with water[1]. In short, dust pollution affects not only human health but also ecological health of a region[2-4]. Stone crusher dust, is extremely harmful to human health as well as surrounding vegetation. The dust impairs visibility the particulate dust falling on leaves may cause foliar injuries, reduction in yield, change in photosynthesis and transpiration etc[1]. The risks of accidents are increased when the crushers are located near the highway. In the absence of proper control devices in these units, the work place can become highly polluted[5].

The work of labourers in these units mainly involves breaking, carrying and loading -unloading stones. The crusher labours work in the open sites without any shelter whether in the hot sun, shivering cold or rains. As they are paid on a piece-rate basis, there are no working hours or timings or assurance of minimum wages. Both rain and sun are a curse to the workers. The tents or so-called shelters are too small for the entire family to take shelter if it rains. Spirometry (meaning the measuring of breath) is the most common of the pulmonary function tests (PFTs), measuring lung function, specifically the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled. Spirometry is an important tool used for generating pneumotachographs, which are helpful in assessing conditions such as asthma, pulmonary fibrosis, cystic fibrosis and COPD.

STUDY AREA

Kabrai is located in Mahoba district of Bundelkh and region (Uttar Pradesh) at 25.42° N 80.02° E on an average altitude of 157 meters. Kabrai is a town where stone crushing is main business. There are more than 100 stone crushers in and around the town. The area of Kabrai is famous for stone production. The market of stone crushing was developed in 1979 with two stone crusher companies Shakti Stone Udyog and Central Stone Udyog. In the year 1982 it was recognized and supported by the government for its development. This initiative by the government helped in increasing the number of stone crushing companies. Continuous quarrying or mining operations in the form of drilling, blasting, loading and hauling including plant process operations are potentially significant sources of emission of dust.

MATERIALS AND METHODS

The sampling locations were selected based on the prevalent wind direction and speed at the site, location of stone crushing units, and their working schedule. Wind speed and direction were monitored continuously for every 1 hour to determine directions for the air quality monitoring program. The dust was collected on Whatman GF/A (size 25.4 cm × 20.32 cm glass fibre filter paper with a pore size of 1 µm using a high volume samplers (Envirotech APM 460 and 430, Envirotech, New Delhi, India), operating at a flow rate of 0.8–1.0 m3 /min. The volumetric flow rate was measured using a calibrated orifice meter (attached part of APM 460 and 430 samplers). All the high volume samplers were calibrated prior to and after each sampling exercise using a field calibration kit consisting of a standard orifice calibrator (APM 421, Envirotech, New Delhi, India). Ambient air quality monitoring (AAQM) was carried out for two seasons; during summer (April–May, 2013) and premonsoon (September–October, 2013) for 30 days continuously on an 8 hours basis (8 a.m.–4 p.m.; 4 p.m.–12 p.m.; 12 p.m.–8 a.m.) and the concentrations were averaged for 24 h to facilitate comparison with the Indian standards. The dust concentration was calculated from the difference in the weight of the filter paper before and after the sample collection.

Health Assessment: Health assessment of workers consists of general clinical examination followed by pulmonary function test. Pulmonary function measurements were performed using a portable data logging spirometer (MIR SPIROBANK Model A23, Italy) according to procedures of the American Thoracic Society (ATS 1991). Pulmonary function assessment was based on values of forced vital capacity (FVC), forced expiratory volume at the end of 1s (FEV1) and peak expiratory flow rate (PEF). All workers underwent an anthropometric assessment, which included height and weight. A nose clip was fixed during the test and the test was performed in a seated position. A complete flow volume loop was obtained from the spirometer. The best values of FVC, FEV1 and PEF from three attempts were taken and used for analysis. Health and medical tests were conducted for 30 days for two seasons.

Pulmonary Function Test: Pulmonary function tests were administered to a total of 25 male and 25 female workers. The spirograms (flow volume loop) were directly downloaded from the instrument and printed and the values were also manually recorded for conducting the statistical analysis. An abnormal spirogram is usually indicative of respiratory impairments that are described as obstructive (abnormal limitation of airflow from the lungs) or restrictive (a decrease in the number of functioning units). The pulmonary function values obtained in this study were compared against the normal values obtained for the control group. Pulmonary Function Testing has been a major step forward in assessing the functional status of the lungs as it relates to:

1. How much air volume can be moved in and out of the lungs
2. How fast the air in the lungs can be moved in and out
3. How stiff are the lungs and chest wall - a question about compliance
4. The diffusion characteristics of the membrane through which the gas moves (determined by special tests)
5. How the lungs respond to chest physical therapy procedures

RESULT & DISCUSSION

Air quality monitoring was carried out simultaneously for sampling stations for 30 days for two seasons. Among the 4 Sampling stations, the average TSP, PM_{10} and $PM_{2.5}$ concentrations were found in the range of 498-721 µg/m^3, 282-562 µg/m^3 and 162-245 µg/m^3. The average maximum TSP, PM_{10} and $PM_{2.5}$ concentration were found 721, 562 and 245 at S1 station while minimum concentration were 498, 282 and 162 µg/m^3 at S4 station. The ratio of PM_{10} /TSP at these 4 sampling station varied in the range of 56.6–79.2 %. The TSP to PM_{10} ratio in these locations varied from 56.5 to 79.2% with an average of 71.15 %. The $PM_{2.5}$ to TSP ratio in these locations varied from 35.5 to 32.5 % with an average of 33.98 %.It was observed that in the daytime during which the crushers were working for 8 h (8 a.m.–4 p.m.) TSP concentrations were about 3–4 times more than that of the following 8 h (4 p.m.–12 p.m.) during which there was no crusher activity but transportation activity was carried out. During the night times (12 p.m.–8 a.m.) there were no crushing and transportation activities, the TSP concentration measured corresponds to background concentration of 40 µg/m^3 and it was found to be 1/7–1/8 of measured concentration for the period of 8 a.m.–4 p.m. The effects of inhaling particulate matter that have been widely studied in humans now include asthma, lung cancer, cardiovascular issues, respiratory diseases, birth defects, and premature death. The size of the particle is a main determinant of where in the respiratory tract the particle will come to rest when inhaled. Because of their small size, particles on the order of ~10 micrometres or less (PM_{10}) can penetrate the deepest part of the lungs such as the bronchioles or alveoli. Similarly, particles smaller than 2.5 micrometres, $PM_{2.5}$, tend to penetrate into the gas exchange regions of the lung, and very small particles (< 100 nanometres) may pass through the lungs to affect other organs. Penetration of particles is not wholly dependent on their size; shape and chemical composition also play a part.

Although all the 50 (male & female) workers appeared normal in the physical examination, more than 1/3 complained of recurrent cough tightness of chest and slight difficulty in breathing.

Table-1: Total Suspended and Respirable Particulate Matter Concentration

S.N.	Sampling location	TSP ($\mu g/m^{3}$)			PM_{10} ($\mu g/m^{3}$)				$PM_{2.5}$ ($\mu g/m^{3}$)			
		Min.	Max	Aver.	Min.	Max	Avg.	PM10/TSP (%)	Min.	Max	Avg.	$PM_{2.5}$/TSP (%)
1.	S1	454	988	721	205	919	562	77.9	172	318	245	33.9
2.	S2	412	941	677	189	874	536	79.2	169	296	233	34.0
3.	S3	384	792	588	156	654	405	68.9	134	283	209	35.5
4.	S4	275	721	498	132	432	282	56.6	112	262	162	32.5

Table-2: Pulmonary Function Test (PFT) of Male

Parameters	Stone Crussing UNIT			
	Contol group		Field workers	
	Mean	Standard Deviation	Mean	Standard Deviation
FVC	3.89	0.67	3.65	0.72
FEV1	3.01	0.61	2.87	0.66
PEF	305	62.00	289	50.94
Age (Years)	31.35	3.10	26.12	7.02

Table-3: Pulmonary Function Test (PFT) of Female

Parameters	Stone Crussing UNIT			
	Contol group		Field workers	
	Mean	Standard Deviation	Mean	Standard Deviation
FVC	3.78	0.69	3.52	0.74
FEV1	2.89	0.64	2.79	0.68
PEF	298	56.62	282	54.22
Age (Years)	31.43	3.13	27.12	7.10

Table-4: Approximate Value of Pulmonary Function Test (PFT) of Male &Female.

Measurement	Approximate Value	
	Male	Female
FVC (L)	4.8	3.7
FEV1 (L)	3.9	3.0
PEF (L/min.)	350	328

CONCLUSION

The dust generated from stone crushing activities contains a significant amount of fine inhalable matter. The TSP and PM_{10} concentration at all 4 stations exceeded the standard of 200 and 100 µg/m^3 recommended by Central Pollution Control Board (CPCB 1998). $PM_{2.5}$ concentrations exceeded the EPA standard of 65 µg/m^3 (24 hour average) at all sampling station. The effect of fine particulate matter can be disproportionately large even though it constitutes only a small fraction of the total suspended particulate matter. The FVC, FEV1 and PEF values observed in mail & female field worker were less than the approximate values. The presence of a high percentage of silica in the dust, respiratory tract deep into the lungs leading to cough and silicosis problem. Chronic exposure to dust due to stone quarrying may increase the risk of respiratory problems and impaired lung function.

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***Corresponding author: SadhanaChaurasia;** Reader, Department of Energy & Environment, MGCGV, Chitrakoot, Satna MP, India