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Effect of Occupational Silica Exposure on Stone Crusher Workers

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Abstract The Shankargarh town of Prayagraj district of Uttar Pradesh, India, is well known for its high quality silica sand and large scale surface mining. Evaluation of health of crusher workers was conducted in the stone crushers units of Shankargarh villages to access the silica dust exposure risk on stone crusher workers and nearby residents. These areas are covered with Granite and Silica sand. The various crushing operations involved in stone crushing e.g. blasting, manual cutting, crushing and transportation emit fugitive stone dust. These fine aerosol of stone dust causes health problems among the stone crusher workers. Health survey e.g. general clinical examination, blood sample test, sounds level measurement was carried out to access the extent of the damage caused to the workers.

Keywords: *stone crushing, dust pollution, health effect, ESR, DLC and sound effect*

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1. Introduction

Stone crushing in India is a labour intensive industry engaged in crushing mined stone into gravels of different sizes, which are used as construction of roads, buildings, dames etc. Generally the crushers are located in clusters. Stone crushers need electricity supply, manpower and roads for conveying the product material so that majority of the stone crushing clusters are located along the periphery of cities. Most of these units operate for about 10-14 hours a day and some operate around the clock in shifts. The crushing operation is similar in almost all the unit except the variation in the type of crushers. Processing begins by washing the sand to remove fine particles. Washing is done by spraying the sand with water as it is carried over a vibrating screen. The fine particles are washed off the sand and the coarse particles are carried along the screen by the vibration. An alternative method uses and upflow clarifier, where water and sand flow into a tank. Fine particles overflow the tank while the washed. The flow diagram of crushing process is shown in Figure 1.

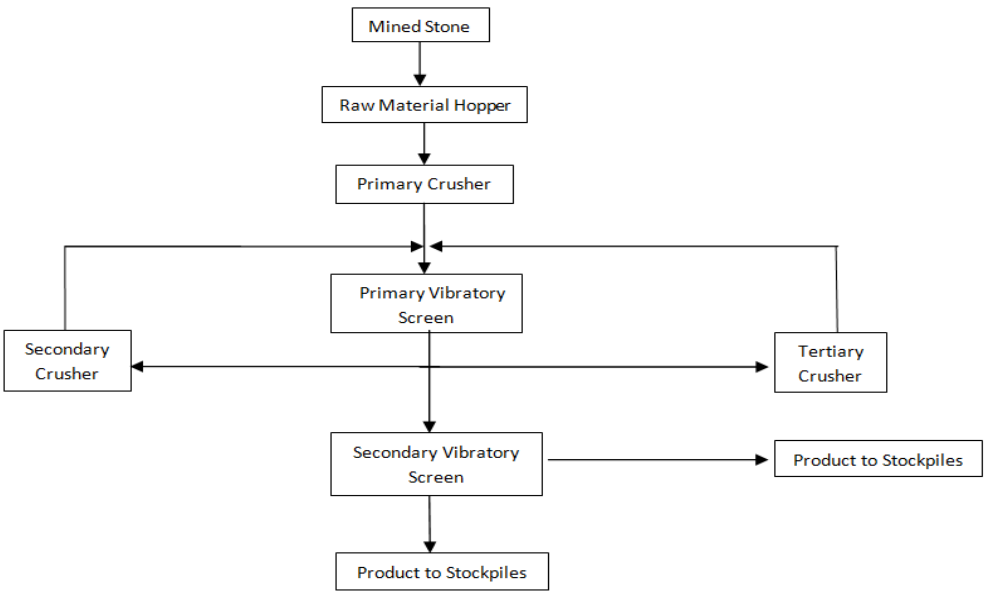

Figure 1. Flow diagram of stone crushing process

Ilas, M and Rasheed, F., have made a study on “Health and environment related issues in stone crushing in Pakistan”. Sivakoumar, R et al., have conducted a study on “Particulate matter from stone crushing industry: size distribution and health effects”. Central Pollution Control Board, (2012) have carried out a study on “Report of the Expert Committee on the Environmental Problems due to Stone Crushers and Related Activities in Sonebhadra District”. Khaleque, A. and Elias, M.S., have carried out a study on “Environmental Pollution and Health Problems of Industrial Workers in Bengaladesh”. These studies represents that these crusher units gives rise to substantial quantity of fine fugitive dust emissions which create health hazards to not only the workers working in stone crushing units but also the people residing nearer to the crushing units.

Shankargarh block of Prayagraj is the biggest supplier of silica sand to the glass industry of the country. The sands in these areas are mainly whitish. Others forms yellow, brown, red are also found. The rocks are exposed from Agartalla, Lakhanpur, Jubai, and Rama. The area where these silica mines are situated is a backward despite the rich mineral resources that it has. Silica sand mines in the region process the sand on-site however processing is done mainly off-site. The various unit operations involved in stone crushing e.g. drilling, blasting, crushing, screening, loading, unloading and transportation emit process and fugitive dust. These substantial fugitive dust emissions pollute the ambient air quality and surrounding environment. The fine silica dust is highly hazardous to human health, agriculture and adversely affects visibility in the nearby areas. The objective of the study was to study the air pollution due to stone crushers and the health effect due to air pollution.

2. Materials and Methods

The study area Shankargarh is present in Bara block of district Prayagraj and located between 25°10'N to 25°20'N latitude and 81°37'E to 81°45'E longitude. The block has about 211 villages. The study site is shown in Figures (Maps) 1 & 2. The region is rich in sand stone mines deposits and structurally the deposits are horizontally layered. These mines are distributed in many villages of Shankargarh.

Figure 2. Shankargarh, India

Figure 3. Shankargarh, Uttar Pradesh, India

Sonbarsa occupies the largest area under mine followed by Chatehara, Ghurehtha, Kohandia, Uthgi-Uparhar, Hinauti Pandey and Geenj. A detailed health impact survey of stone crusher workers and nearby residents at Garha Katra, Geenj, and Hinauti Pandey was conducted on a questionnaire basis. Health survey e.g. General clinical examination, Blood sample test, Hb determination, ESR determination, and Sound level measurement was undertaken. Clinical evaluation was done through a general physical examination followed by drawing blood sample. Blood sample was analyzed for TLC and DLC to estimate the number of granulocytes mainly Eosinophils counts which generally increase with dust exposure. Hb determination was done through Haemoglobinometer. ESR was estimated by Wintrobe tube method. Sound level was studied using Sound meter.

3. Health Impacts

There are many stone crusher sites in Geenj, Hinauti Pandey and Garha Katra, villages of Shankargarh. The main occupation of the local population is mining activity and stone quarrying as the land is not very fertile. An overwhelming majority of these workers belong to the scheduled castes category, namely, jatavs, kumbhis and kols. Most of the workers are illiterate and poor who work as mining labourers in silica mines. Out of 50 mining sites in the study area, one third of the mines are situated in three villages and these villages are at highest threat from environmental point of view. Most of the stone crushers in these areas have inadequate dust control system so that dust emission is substantial which leads to adverse impact on workers health and as well as surrounding environment. The dust exposure level on the workers and resultant health hazard are discussed as –

1. General Clinical Examination: Clinical evaluation was done through physical examination and administration of questionnaire to the stone crusher workers and peoples living around the various crusher plants at, Geenj, Hinauti Pandey and Garha Katra villages of Shankargarh. The survey is presented in Table 1, Table 2 and Table 3.

Table 1. Survey study at Garha Katra (Shankargarh)

Problems/ Diseases	Male	Female	Total
	No. Effective / No. Examined (%)	No. Effective / No. Examined (%)	No. Effective / No. Examined (%)
Respiratory diseases (TB, Asthma, chest pain, etc.)	15/36 (41)	06/14 (43)	21/50 (42)
Breathlessness	11/36 (30)	05/14 (35)	16/50 (32)
Cough	10/36 (27)	03/14 (21)	13/50 (26)
Allergy	15/36 (41)	06/14 (42)	21/50 (42)
Headache/Tiredness	06/36 (16)	05/14 (35)	11/50 (22)
Loss of weight	05/36 (13)	02/14 (14)	07/50 (14)
Eye/Skin irritation	03/36 (08)	02/14 (14)	05/50 (10)

Table 2. Survey study at Hinauti Pandey (Shankargarh)

Problems /Diseases	Male	Female	Total
	No. Effective / No. Examined (%)	No. Effective / No. Examined (%)	No. Effective / No. Examined (%)
Respiratory diseases (TB, Asthma, chest pain, etc.)	08/18 (44)	03/07 (42)	11/25 (44)
Breathlessness	05/18 (27)	02/07 (28)	07/25 (28)
Cough	03/18 (16)	01/07 (14)	04/25 (16)
Allergy	07/18 (38)	04/07 (57)	11/25 (44)
Headache/Tiredness	04/18 (22)	02/07 (28)	06/25 (24)
Loss of weight	04/18 (22)	01/07 (14)	05/25 (20)
Eye/Skin irritation	02/18 (11)	01/07 (14)	03/25 (12)

Table 3. Survey study at Geenj (Shankargarh)

Problems/ Diseases	Male No. Examined / No. Effective (%)	Female No. Examined / No. Effective (%)	Total No. Examined / No. Effective (%)
Respiratory diseases (TB, Asthma, chest pain, etc.)	15/36 (53)	08/14 (50)	23/50 (52)
Breathlessness	13/36 (46)	09/14 (44)	22/50 (46)
Cough	12/36 (43)	05/14 (33)	17/50 (40)
Allergy	22/36 (65)	09/14 (55)	31/50 (62)
Headache/Tiredness	10/36 (37)	07/14 (33)	17/50 (36)
Loss of weight	10/36 (28)	05/14 (22)	15/50 (26)
Eye/Skin irritation	07/36 (18)	04/14 (16)	11/50 (18)

Fifty workers from Garha Katra, fifty workers from Geenj and twenty five from Henauti Pandey villages were selected for test. These workers were grouped into different categories based on their age, duration of exposure. Out of these most of the workers were engaged in crushing and some were moving in and out of the crusher site. Blood samples were drawn from these workers and analyzed for Hb, ESR, and TLC & DLC.

Table 4. TLC of stone crusher workers

Study area	No. of workers	Total leukocyte count (4000-11000 cells/col.)
Geenj	50	Normal (52% are between 4000-9000 cells/col.)
Hinauti Pandey	25	Normal (20% are between 4000-10000 cells/col.)
Garha Katra	50	Normal (65% are between 4000-9000 cells/col.)

Table 5. Haemoglobin determination of workers

Study area	Male No. having < 13 g/dl/ No. having 13.5-17.5 g/dl (%)	Female No. having < 11 g/dl / No. having 11.5-15.5 g/dl (%)	Total No. having less Hb / No. having normal Hb (%)
Geenj	19/36 (52)	08/14 (57)	27/50 (54)
Hinauti Pandey	07/18 (43)	04/07 (57)	11/25 (44)
Garha Katra	23/36 (63)	09/14 (64)	32/50 (64)

Table 6. DLC of stone crusher workers:

Study area	No. of workers	Eosinophils 1-4%	Basophiles 0-1%	Polymorphs 70%	Lymphocytes 20-40%	Monocyts 2-8%
Geenj	50	1-7%	0-1%	60-70%	22-38%	2-8%
Hinauti Pandey	25	1-5%	0-1%	63-72%	20-42%	2-8%
Garha Katra	50	2-8%	0-1%	55-76%	23-35%	3-7%

Table 7. Sound levels at different crusher units

Study area	Locations					
	Near Crushing operation		Near Screening point		Near Collection point	
	Min	Max	Min	Max	Min	Max
Geenj	87	101	89	104	81	92
Hinauti Pandey	83	99	97	100	85	89
Garha Katra	92	103	92	106	83	93

4. Sound Levels at Different Stone Crusher Units

The sound pressure levels as measured in various stone crusher units in different districts are shown in Table 7. This table presents that sound levels at various stone crusher units of three districts are quite high as compared to normal 60 dB. Hearing disorders are mainly complained by the workers involved in the crushing sites.

5. Result and Discussion

Table 1, Table 2 and Table 3 shows that most of the workers of all the three villages complained of allergy, coughing and difficulty in breathing. Blood samples of stone crusher workers of three villages was taken and analyzed as presented in Table 3, Table 4, Table 5 and Table 6. These tables indicate that TLC was normal; Hemoglobin levels were slightly low in both male and female workers. In most of the cases ESR and eosinophils were very high indicating that stone crusher workers are in allergic conditions and in a diseased state. Table 7 indicates that workers working in these crushers units are in excessive exposure of sound which is unsafe condition.

Based on the observations made during the study and discussions it may be concluded that the environmental conditions in stone crusher units in the three villages are not congenial to health. The workers which are engaged for long term in these units encounter with substantial exposure to siliceous dust and noise which may lead to manifestation of various occupational diseases e.g. asthma, tuberculosis, chronic bronchitis, and silicosis etc. So that use of dust respirators, good work practices, health and hygiene conditions, proper medical care and housekeeping etc. are to be improved in stone crusher units.

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