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Effect of Stone Crusher on Ambient Air Quality

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Abstract - *As increase in demand of construction material there is highly increment in use of coarse and fine aggregates. The coarse aggregates and artificial fine aggregates are crushed in stone crusher. Stone crusher creates lot of noise and it emits dust particles in environment. Because of more concentration of dust particles in environment (air), it creates pollution. This pollution creates diseases in human and animal's life like asthma, skin diseases, eye irritation etc. and it effects on vegetation. Measurements of different air quality parameters were carried out at Jaysingpur stone crusher site and analysis was done on the basis of central pollution control board (CPCB).*

Key Words: Stone Crusher, RSPM, TSPM, SOx, control measures, air quality

1. INTRODUCTION

The stone crusher industry in India is basically a labor intensive small scale industry, where most of the operations are performed manually. Above 12000 stone crushers are working now in India (Comprehensive Industry Document Stone Crushers). "The air pollution is defined as the presence in the external atmosphere of one or several substances introduced by man to such extent as to affect health & welfare of human system & life in the atmosphere.

These stone crushers (Fig. 1) are important for local economy but have adverse effect on air quality due to emission of dust particles in surrounding area. This results in respiratory diseases, low visibility in nearby area and reduction in growth of vegetation.

Even though stone crushers are socio-economically important sectors yet they give rise to the quantity of fine dust emission which create health hazard to the workers as well as surrounding population. The dust also adversely affects visibility, growth of vegetation & aesthetic area. The various parameters on considered for the analysis of ambient air quality like Oxides of Sulphur, Oxides of nitrogen, particulate matter 2.5 & particulate matter 10.

Fig -1: Stone Crusher. (Photo: Dattatray Bandi, Engineering Student)

2. MATRIALS AND METHDOLOGY

The work is done in India as well as in abroad is as per following literature's

R. Sivacoumar et al., (2006)[1], had studied "Particulate matter from stone crusher industry : size distribution & health effects." The results presence of a high percentage of silica in the dust and the particle size distribution further suggest that the occupational environment of the workers and surrounding areas may be hazardous to human health. The air quality and the health survey conducted at the site that observes the dust may be producing significant damage to respiratory health. The dust was collected on whatman (size 25.4cm 20.32cm) glass fiber filter paper with a pore size of 1m using high volume samplers (Envirotech APM 460 and 430, Envirotech, New Delhi,India), operating at aflow rate of 0.8-1.4. Ambient air quality monitoring (AAQM) was carried out for two seasons; during summer (April-May) and premonsoon (September-October) for 30 days continuously on an 8 hour basis and the concentration were averaged for 24 hour to facilitate comparison with the Indian standards. the dust concentration was calculated from the difference in weight of the filter paper before and after sample collections. Yashoda Saini et al., (2011)[2], had described the effect of marble dust on plants. Trees species growing in and around area were selected and various morphological characteristics were studied such as leaf area dry weight ratio (LADWR), Dust retaining capacity (DRC) and Chlorophyll content. In the study the effects of marble dust on selected tree species was observed. Particulate matter produced during the marble

crushing is usually of relatively large size. In short dust pollution affects not only human health but also ecological health of region. The dust impairs visibility the particulate falling on leaves may cause foliar injuries, reduction in yield, change in Photosynthesis and transpiration etc. when these particulate matters are deposited on vegetation, the plant growth is adversely effected. Therefore it was necessary to study the effect of dust on plants around the stone crusher area. NAAQS Monitoring & Analysis Guidelines Volume – I (2011)[3], gives Guidelines for sampling and analysis of 1. Sulphur dioxide in ambient air. 2. Nitrogen dioxide in ambient air. 3. PM 2.5 & PM 10 in ambient air. Gajanan N. Supe et al., (2015)[3], The effect of dust pollution on plants is observed in this study as it has reduced the vegetation in study area. The formation of dust layer on plant body damage plant tissue which may reduce rate of photosynthesis. Dust particles emitted from stone crushing activity reduces the pigmentation plant leaves. Deposition of dust particles exerts stresses on plant which reduces productivity of plants. G. S. Gupta & Anjali Gupta (2014)[5], The study represents monitoring of ambient air quality of stone crusher areas. Selected parameters were suspended particulate matter (PM10 & PM 2.5), sulphur oxides (SOx), nitrogen oxides (NOx) and noise. The five sampling stations were selected for sampling during winter. 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 (CPCB, 2009).particulate matter analysis indicated high amount of fine particles and silica content posing serious health problems to the people exposed for longer duration. This study indicates that most of the people whose living around the stone crusher area were suffering from ARI (Acute Respiratory Infection),bronchitis, asthma, skin disease, eye irritations and heart diseases. Pollution of leaf, which is prevented the process of respiration and photosynthesis. The ambient air sampling was done for 24 hours in winter season. Whatman glass microfiber filter paper were used for PM10 & PM2.5. Health survey was done with the help of questionnaire and interviews of local persons and workers. For observing the vegetation growth, plants of common occurrence were selected for chemical analysis within the township. The concentration of PM10 & PM2.5 was higher than the permissible limit at selected area. So the ambient air quality was polluted due to dust of stone crusher industries. On the other hand gases like sulpher oxides (SOx) and nitrogen oxides (NOx) were below than standard limit prescribed by CPCB. M. R. Sinha (2014)[6], studied that "Impact of stone crushing industries on leaf of woody plants." The aim of this study was to evaluate the effect of stone crushing industry on physical damage of leaves due to dust pollution. They also noted that heavy deposition of dust particles on leaf surface. Due to the crushing operation of the stones the suspended particulate matter (SPM), depending on the size and weight of particles, remain in the air for varying length of time, get dispersed and diffused by the wind. Stone dust is primary aerosol and it is released directly from the surfaces. It has detrimental effect on people and environment like changed soil pH and productivity, formation of haze reducing visibility in the surrounding areas, damages of natural resources like valuable vegetation's and wild lives, promotion of spreading many diseases etc. This study investigates the status of particulate and gaseous pollution around stone crusher units and their effects on various foliar parameters of two plants Terminaliaarjuna and Madhucaindica. In this study the SPM was measured from an average distance of 20 meters from the crusher units concerned as per practical solution. It was noted that the SPM was highest in winter and lowest during rainy season. SPM recorded at was done with the help of a leaf area meter. Shashi Bhushan Sharma and Baidyanath Kumar, (2015)[7], have studied the effect of stone crushing dust pollution on the growth performance and yield status of Gram (Cicerarietinum L.).The results indicated that the germination frequency of seeds, shoot length, root length, chlorophyll content, total carbohydrate and protein contents, and grain yield of Gram (Cicerarietinum) were severely affected by stone dust pollution. The plants that grown in control land area were healthy as compared to plants grown in the stone dust treated land areas. The result obtained in the study indicates that root length, shoot length, chlorophyll content, total carbohydrate and protein contents, and grain yield of gram (Cicerarietinum) were severely affected by stone dust pollution. The plants growing in control land area were healthy than the plants growing in the stone dust treated land areas. R. Amitshreeya and R. B. Panda, (2012)[8], They studied that several stone crusher units are running without following CPCB (Central Pollution Control Board, India) norms to feed crushed stone for various health problems. To monitor the dust pollution level 5 monitoring stations were chosen and dust sample inside the unit and 100m away of the unit were monitored. In all the crusher units the concentration of SPM were much more than the permissible standard i.e., 500 µg/m3, whereas 100m away the concentration level fall down and were within the norm. However, a residential zone is 100 m away andthiscause health problem to the residents.The primary objective of this study was to assess the dust concentration and its fallout in and aroundthe workplace. For this purpose an extensive air pollution survey was carried out in the study area. Ambient suspended particulate matter was measured out in each of 5 crusher units at two locations. So it was observed that inall the cases all the computed value were more than prescribed standard i.e., 500 µg/m3 similarly the standard deviation (SD) was calculated as 85.77 µg/m3, 99.67 µg/m3 and 114.25 µg/m3 respectfully inside the crusher unit. Similarly the SPM were measured during the summer season inside crusher unit and 100m away from crusher unit and value of mean and standard deviation (SD) were computed. It was found that all the mean value were well within the standard norms of CPCB which may be due to settling of dust fall after moving away from the crusher unit. The dust generated from crushers during operations contain significant amount of fine inhalable particulate matter. The contribution of individual crushers to

the SPM concentration is not constant. It is also marked that the concentration drastically falls down beyond 100m away from the crusher units. But still the concentration of dust is beyond the permissible limit as people are living around 100m away from the crusher units. Thus it is highly essential to take immediate remedial measures to reduce the dust pollution problem around the stone crusher area. S. Chaurasiya (2009)[9], studied that during the process of crushing stones fine aerosol of stone dust is generated which cause environmental health hazards among the stone crusher workers. Environmental monitoring was carried out at the work place to access the suspended particulate matter, SOx and NOx, effect of SPM on stomata was Also observed and discussed. Stone crusher units creates several environmental problems of pollution by fugitive emission from various sources, which adversely affects the ambient air quality and thereby affect the human health. A substantial percentage of air born emission are carried away by wind current and settles down the surrounding areas and vegetation. Deposition of particulate matter on leaves affects the stomatal opening and the rate of photosynthesis.

3. MATRIALS AND METHDOLOGY

The ambient air sampling was done for 8 hours in High Volume sampler (Fig. 2). Fine particulates sampler APM 860, Envirotech Noida and Whatman glass filter papers were used for Total suspended particulate matter & respirable suspended particulate matter PM10. Sound level meter used for sound level monitoring. The sulphur di-oxides are measured by using hydrogen peroxide method. All parameters are analyzed as per standard method of National Ambient Air Quality Standards (NAAQS). Health survey was done with the help of questionnaires of workers and local persons. The concentration of RSPM & SPM was measured in microgram per meter cube.

Fig -2: High Volume Sampler (Photo: Dattatray Bandi, Engineering Student)

4. RESULT AND DISCUSSION

The suspended particulate matter was measured in stone crusher are as follows. The stone crusher had a significant effect on the growth of vegetation and human health. The 8 hours concentration of various pollutants recorded. Higher concentration of RSPM was observed and it is 1987.64 µg/ m^3 TSPM was observed around 2165 µg/ m^3. The concentration of Sulphur oxide was also measured(Refer Table 1) which is within the limit of CPCB. Whereas the standard limit prescribed by CPCB for RSPM is 100 µg/m3 as shown in Table -2. The noise level monitoring also done and results are within the limit of CPCB (Refer Table -3 and Table -4).

Table -1: Results of Air Pollutants

Sr.no.	TSPM (µg/m^3)	RSPM (µg/m^3)	SO_2 (µg/m^3)
1	471.69	122.64	10.88
2	416.66	324.07	9.86
3	739.27	435.64	8.16
4	694.44	521.24	5.95
5	555.55	243.18	11.56
6	537.05	342.59	14.45
7	1928.10	1663.39	7.82
8	2165.12	1987.65	6.63
9	2152.24	1968	1.03
10	1176.66	943	15.98

Table -2: National Ambient Air Quality Standards

Pollutants	Time weighted average	Concentrated In ambient air for Industrial, Residential, Rural area	Concentrated In ambient air for Ecological, Sensitive area
Sulphur of oxides	Annual 24 Hours	50 80	20 80
Nitrogen of oxides	Annual 24 Hours	40 80	30 80
RSPM	Annual 24 Hours	60 100	60 100
TSPM	Annual 24 Hours	40 100	40 100

Table -3: Measurement of Noise Level at Working Stone Crusher Area.

Sr.No.	Day Time (dB)	Night Time (dB)
1	58	25
2	56	28
3	62	35
4	65	29
5	75	30
6	67	24
7	70	39
8	73	19
9	70	34
10	68	36

Table -4: Ambient Air Quality Standards in Respect of Noise.

Sr. No.	Zones	Day Time (dB)	Night Time (dB)
1	Industrial zone	75	70
2	Commercial zone	65	55
3	Residential zone	55	45
4	Silence zone	50	40

5. IMPACT OF DUST

5.1 Impact of Dust on Human Health:

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 mills are suffering from eye irritation, skin diseases, acute respiratory infection (ARI).

5.2 Impact of Dust on Vegetation:

It was estimated that many plants & trees species growing near stone crusher have become damaged by increasing dust. (Refer figure -3)Dust pollution affected plants in difference way. High dust fall causes visible damage physiological life process affecting growth of productivity of vegetation in that area.

Fig -3: Impact on Vegitation (Photo: Dattatray Bandi, Engineering Student)

6. CONTROL MEASURES

1. Construction of wind breaking walls by using cloth curtains around premises.
2. To reduce the drop height of dusty material.
3. Construction of paved road within the premises.
4. Provide dust masks & ear plugs to the workers.
5. Fine dust powder in the crushing area should be periodically removed.
6. Provide green belt over the premises(Rigorous plantation thought the border of premise).

7. CONCLUSIONS

Due to dust of stone crusher industries, the concentration of respirable suspended particulate matter (PM2.5&PM10) was higher than permissible limit which significantly degraded air quality parameters. It is observed that local people were suffering from allergic problems such as eye and skin irritation. The overall reduction in the growth of trees and plants are found. The various plants and trees are damaged due to high dust fall.

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