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Impacts of Stone Quarrying on Ambient Air Quality

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Abstract

A large number of activities in operation of stone quarrying cause environmental degradation including air pollution. These quarries are usually located in clusters in remote locations of mineral rich areas where living standards is lower and understanding of people towards environmental impact is also poor. These quarrying activities results in disturbance of land surface, altering drainage pattern and land use, besides the pollution problems, which may lead to the environmental problem of water, noise, solid waste pollution and air pollution. Consequently want of suitable solutions to the problem were very much high on demand for eco-friendly quarrying.

Keywords: Impact of Stone Quarrying, Air Pollution, Eco-Degradation.

Introduction

Dhar (1993) has mentioned that, due to lack of proper planning and negligence regulations and appreciable amount of environmental degradation and ecological damage to water, soil, noise and air occur. Mining and quarrying activities have adverse effect on the environment and it is the main cause of environmental degradation (Dutta and Sharma, 2000). These activities of drilling, blasting and transportation increase the suspended particulate matter in the air which is harmful to the health of the workers exposed to the work place environment (Chouhan, 2010).

Mishra and Bhubaneswar (2008) reported that phenomenal growth of construction activity in the country to meet the modern day requirements of civilization has tremendously boosted the demand for building materials. Meeting the domestic commitments as well as fulfilling the export demands has forced the stone quarrying industry to quickly readjust for proven quality, maximum production and profitability. However, along with the accrued benefits, the industry is facing severe crisis due to constraints such as quarrying in proximity of habitation, critical structures etc. there by endangering them through various quarry activities. Main issues are noise pollution, water pollution and air pollution.

Material and Methods

In air, particulate matter occur as solid or liquid, the common solid forms are dust, fumes and smoke while common liquid forms are fog and mist. Particles which are small enough to remain dispersed in air are called aerosols. The particulate matter in air is introduced through natural phenomenon like wind, volcanic emanations, pollen and spores or through human activities like mining and industrial processes. Air borne particles are considered to be a nuisance to industries, mining requiring clean and aseptic atmosphere.

Suspended Particulate Matter (SPM) in ambient at the study site was estimated with the help of air sampler without filter where as Respirable Suspended Particulate Matter (RSPM) was estimated with the help of air sampler with filter.

Observation

The stone quarrying processing units and crushers located in study areas constantly add to stone dust in the soil and air. The stone dust is easily blown in the air causing particulate pollution. It was therefore decided to measure the level of Suspended Particulate Matter (SPM) in ambient air in quarrying sites. Since amount of SPM in air depends on wind velocity hence the study was made every year 2011 to 2013. The results of SPM in ambient air of quarrying sites (Bubani– S1, Srinagar– S2, Sedariya – S3 and DholaBhata – S4) are represented in the table.

Ambient SPM showed significant seasonal variation. SPM in the study sites was varied from527 µg/m3 to 3723 µg/m3. Maximum SPM (3723µg/m3) was observed during the month of May in S1 and minimum SPM (527 µg/m3) was observed during the month of July in S4. Maximum

(Average) value of ambient SPM 3548 ± 177 µg/m^3 was observed in the month of May in summer season and minimum (Average) value of ambient SPM 715 ± 154 µg/m^3 in the month of July in rainy season during study period 2011 to 2013.

Table: Average SPM (µg/M3) In Quarrying Sites (Bubani – S1, Srinagar – S2, Sedariya – S3 And Dholabhata – S4) During Study Period: – 2011 To 2013

Month	Average of S1	Average of S2	Average of S3	Average of S4	Average + S.D. of S1 to S4
January	2623	2533	2473	2223	2463 ± 171
February	2910	2840	2730	2510	2748 ± 175
March	3140	3080	2960	2790	2993 ± 154
April	3403	3343	3223	3063	3258 ± 150
May	3723	3633	3523	3313	3548 ± 177
June	3333	3293	3143	2973	3186 ± 164
July	873	803	657	527	715 ± 154
August	1663	1573	1463	1433	1533 ± 106
September	1877	1767	1657	1577	1720 ± 131
October	2023	1903	1803	1753	1871 ± 119
November	2173	2063	1993	1913	2036 ± 110
December	2323	2243	2173	2093	2208 ± 98

Work place dust concentration (in terms of suspended particulate matter) in different quarrying operations was observed vary from 400µg/m^3 to 3200µg/m^3. Maximum 3200 µg/m^3 dust concentration was found at drilling operation and minimum 400µg/m^3 was observed at the time of blasting operation.

Work place dust concentration (in terms of respirable suspended particulate matter) in different quarrying operations was observed vary from140 µg/m^3 to 2240µg/m^3. Maximum 2240 µg/m^3 dust concentration was found at drilling operation and minimum 140µg/m^3 was observed at the time of blasting operation.

Result and Discussion

Air pollution is a common environmental problem in all mines and quarries especially open cast operations. Dust is one of the most visible, invasive, and potentially irritating impacts associated with quarrying, and its visibility often raises concerns that are not directly proportional to its impact on human health and the environment (Howard and Cameron, 1998). Site conditions that affect the impact of dust generated during extraction of aggregate and dimension stone include rock properties, moisture, ambient air quality, air currents and prevailing winds, the size of the operation, proximity to population centers, and other nearby sources of dust. Dust concentrations, deposition rates, and potential impacts tend to decrease rapidly away from the source (Howard and Cameron, 1998). Open cast quarrying, drilling, screening, blasting, sand transportation, soling preparation and other quarry activities are leading to air pollution. The dust generated by stone quarrying concentrates near the ground level and this leads to breathing problems, which aggravates during windy conditions. (Mishra and Bhubaneswar, 2008).

Environmental Impact Assessment report prepared by National Environmental Engineering Research Institute, Nagpur (Maharashtra) for the mines, average suspended particulate matter concentration at various locations of mining varied between 130µg/m^3 and 1678 µg/m^3. It was revealed in the study that quarrying dust causes air pollution which is particulate in nature. In present study average maximum SPM was observed 3548 ± 177 µg/m^3 in month of May and average minimum SPM was observed 715 ± 154 µg/m^3 in month of July in study period 2011 to 2013. There were seasonal quantitative differences with respect to amount of SPM. Maximum SPM values were recorded for study sites (S1 to S4) in the month of April, May and June (3258 ± 150 µg/ m^3, 3548 ± 177 µg/ m^3 and 3186 ± 164 µg/ m^3 respectively). The results also indicate the fact that amount of SPM showed a regular increase with respect to time. There was a gradual increase in average SPM from 2011 to 2013(2016.91 µg/ m^3, 2506.08 µg/ m^3 and 2547.33 µg/ m^3 respectively). These values were much above than the permissible limits for mining and quarrying area prescribed by WHO. It is bound have adverse health effect on miners and on the people living in the vicinity. Within the same vicinity the residence of the workers in the quarrying units were adversely affected as the particle size of the quarrying dust penetrates the respiratory tract and caused respiratory disorders (Panda and Sinha, 1990).

SPM level was higher at the drilling points for all quarries (Srinivasan and Ilango, 2013). Similarly in the present study, ambient SPM showed significant seasonal variation. SPM in the study sites was varied from 527 µg/m^3 to 3723 µg/m^3. Maximum SPM (3723µg/m^3) was observed during the month of May in S1 and minimum SPM (527 µg/m^3) was observed during the month of July in S4. Maximum (Average) value of ambient SPM was 3548 ± 558 µg/m^3, observed in the month of May in summer season and minimum (Average) value of ambient SPM was 715 ± 28 µg/m^3 in the month of July in rainy season during study period 2011 to 2013. Work place dust concentration in different quarrying operations (in terms of suspended particulate matter) was observed vary from 400µg/m^3 to 3200µg/m^3. Maximum 3200 µg/ m^3 dust concentration was found at drilling operation and minimum 400µg/ m^3 was observed at

the time of blasting operation. Work place dust concentration in different quarrying operations (in terms of respirable suspended particulate matter) was observed vary from140 µg/ $m^3$to 2240µg/ m^3. Maximum 2240 µg/ m^3 dust concentration was found at drilling operation and minimum 140µg/ m^3 was observed at the time of blasting operation. These values were much above than the permissible limits of for mining and quarrying area prescribed by WHO (1980). Among the quarrying operations, the drilling site constitutes dust pollution risk zone within quarries (Enger and Smith, 2002).

Airborne dust exposures (in terms of suspended particulate matter) of workers during different quarrying activities were observed. Drillers were exposed maximum to SPM (1600 µg/m^3 per hour per day) and contractor and blaster were exposed minimum to SPM (400µg/ m^3 per hour per day). Airborne dust exposures (in terms of respirable suspended particulate matter) of workers during quarrying activities were also observed. Maximum RSPM exposure 1120µg/ m^3 per hour per day was showed by driller and minimum RSPM exposure 140µg/ m^3 per hour per day was showed by contractor and blaster. These values were much above the permissible limits for mining and quarrying prescribed by WHO (1983).

During the study it was observed that fine dust inhaled by workers leads to diseases related to lungs and liver. It was found that nearly 25% workers interrogated show dust related diseases, nearly 34% workers felt that the quarrying has caused air pollution affecting their health slowly and 41% mine workers felt that quarrying is the cause of increase in diseases and misery.

The stone quarrying units contributes a lot of air pollution in the form of dust particles. In addition to this various machines like drilling, blasting and crushing are responsible for noise level above permissible limit. Workers in mines and quarries form a high-risk group. They inhale minute dust particles (varying in sizes from 0.1 micron to 150 microns). Inhalation and deposition of silica particles in the lungs result in silicosis, which leads to pulmonary fibrosis and premature death. The average life of a quarry worker is estimated to be between 40 to 50 years. Quarry owners are insensitive to the situation and not keen to provide safety equipment to the workers. Lack of awareness and the poor nutritional status of the labourer's worsen the situation (Madhavan and Raj, 2005).

Conclusion

Present study indicates that quarrying dust generates during processing adversely affects the air quality. The quality of ambient air in the quarrying sites was not within permissible limit and workers inhabiting these places will become prone to occupational diseases. Dusty environment leads to development of different respiratory diseases like cough, bronchitis, breathing problem, phlegm, nasal irritation etc. Work place dust concentration in different quarrying operations was much higher in quarrying sites and dust exposure was also higher than permissible limit. These adverse changes due to quarrying activities will contribute to eco-degradation in central Aravali region.

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