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Effective Reduction of Air Pollution Using Strategic Approach

A Review

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1) ABSTRACT

As increase in demand of construction materials there is highly increment in use of coarse and fine aggregates. The coarse and artificial fine aggregates are crushed in stone crushers. Stone crushers creates a lot of noise and emits dust particles in environment. Because of more concentration of dust particles in environment (air), it creates pollution. This pollution creates diseases in humans and animals life like asthama, skin diseases, eye irritation etc. Although it has adverse effects it gives better financial effects as well social development. Although dust control emission control measures are not much significant to recommend, but after a detailed study we have found some of the control measures that are to be implemented so as to reduce the dust and noise pollution caused during use of stone crushers.on site actual photographs have been taken so has to have better understanding. Stone crushers being a small scale industry it is been operated and owned by mostly less educated people and they are scattered all over the country . So as to have better information about the environmental pollution at country level request letters were sent to State Pollution Control Boards (SPCBS) through Central Pollution Control Board (CPCBS). With this help a country level survey was done and some of its results are covered in our topic.

2) Introduction

Stone Crushing Industry 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, Highways, Bridges, Buildings, and Canals etc. It is estimated that there are over 12,000 stone crusher units in India. The number is expected to grow further keeping in view the future plans for development of infrastructure of roads, canals and buildings that are required for overall development of the country. In India, the Stone Crushing Industry sector is estimated to have an annual turnover of Rs. 5000 corer (equivalent to over US$ 1 billion) and is therefore an economically important sector.

The stone crusher is one such industry that exists in the vicinity of almost all major cities/towns throughout the country in all the states because the construction activities go on throughout the country. As transportation of stone over long distances adds to cost of the crushed stone products, the crushers need to be necessarily located nearer to the demand centers such as Cities, Bridges, Canals etc. The crushers are located nearer to the source of raw material such as Stone mines, River Beds etc

3) literature review

Paper detail	Publication detail	Finding
Muhammad Musaa Khan, Rab Nawaz, Nusrat Ehsan, Sajjad Ahmad -**health Hazards and Socioeconomic Effects of Stone Crushing Industry on Its Workers: A Case Study of Sargodha,**	Pakistan-. Journal of Environmental and Agricultural Sciences (ISSN: 2313-8629)	Most Of the workers were aged due to air pollution No provision of any personal equipment to 94 % Hearing problem(82%) skin irritation (75%) respiratory problem (69%)
Assadullah Sheikh, S.V.S. Rana and Amit Pal - **Environmental health assessment of stone crushers in and around Jhansi, U. P**	**India**-J. Ecophysiol. Occup. Hlth. 11 (2011) 107-115	Decline in DO and high value of total hardness in water Problem- respiratory(45.11%) Skin(43.33%) hearing(21.53%) eye(17.8%)

Paper details	Publication details	Findings
Dust pollution in stone crusher units in and around Balasore, Orissa, INDIA R. Amitshreeya and R.B.Panda*	Jr. of Industrial Pollution Control 28(1)(2012) pp 41-44 © EM International Printed in India. All rights reserved	The paper aims to study area is in and around Balasore town where several stone crusher units are running without following CPCB (Central Pollution Control Board, India) norms to feed crushed stone for various health problems
Particulate Matter from Stone Crushing Industry: Size Distribution and Health Effects, Sivacoumar1 ; R. Jayabalou2 ; S. Swarnalatha3 ; and K. Balakrishnan	Journal of Environmental Engineering · March 2006.	it is concluded that 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 South Indian healthy males

4) Study Area:

Description of the Study Area and Selection of Study Stations: The selected area, Southern part of Katraj area Pune is situated at 18°27'13"N 73°51'42"E which is covered by hilly ranges. The Southern Katraj covers Khadi Machine Chouk, Bopdev Ghat, South Yewalewadi and North Yewalewadi. For the analysis and determination of dust, selection of four different study stations is as follows:

1. Khadi Machines Chouk, under Katraj-Kondwa Range, is connecting roads toward Katraj, Kondwa, Yewalewadi and Solapur Road which shows heavy trafic loads. (“Station 1”)

2. North Yewalewadi , is an ideal home for a large number of aggregate industries covers an area of 3 Km2 which is heavily polluted as crushing of naturally occurring rocks take place in entire area. As for instance, over 21 crusher units are found in area of only 3 Km2 at Yewalewadi. (“Station 2”)

3. South Yewalewadi is also affected by large number of aggregate industries and aggregate crushing plants. (“Station 3”)

4. Trinity College of Engineering campus which is located at 3 Km next to Yewalewadi in Bopdev Ghat. It's a developed area of around 108 Acres, which is continuously under the influence of crushing units. ("Station 4")

3.5 Basis/Criteria for evolving the Advanced Designs:

1. The system should be low cost and affordable by stone crushers
2. The system should operate in the dusty condition
3. The system should be easy to install, operate & maintain
4. The system should not affect the product stone quality adversely
5. The system should be indigenously available or fabricated preferably locally

3.6 Dust Monitoring Methods:

In the beginning, EPA was working to get total concentrations of total suspended particulate matter, now recently it approach toward monitoring and regulating total suspended matter in ambient air. Nowadays researchers have great interest to detect smaller particles like PM2.5 & other types & behavior of various organic & inorganic substituent of total suspended matter. Filtration, thermal & electrical precipitation and inertial separators are the available sampling devices and techniques employed to detect suspended particulate matter from ambient air.

3.7 Measurement of dust fall:

The study area is always under the influence of 21 crusher units which emits large amount of dust in to surrounding atmosphere. The amounts of dust fall at different places were measured with the help of glass jar kept at different elevations. The glass jars were cleaned and pre–weighed

(a) Before it placing at location which was under test. The initial time of glass jar placing is recorded. The weight of dust fall along with glass jars

(b) Recorded at the end of test duration. Then the glass jars were cleaned and weighted again for a next test. The weight of dust deposited in the glass jar in one day was calculated. The glass jar mouth area is measured and the dust deposited was expressed as g / m2 day. The total dust fall was calculated as g / m2 day by using following formula

$$PM\ Dust\ fall\ \left(\frac{g}{m^2\ day}\right) = \frac{PM\ mass\ (g)\ x\ 1}{\pi r^2\ x\ n}$$

Where (πr2) is the cross sectional area of the jar mouth in m2 , 1 is one day duration of dust fall testing, n is the actual duration in hours for which glass jar was exposed [1] .

3.8 Wet Type Dust Control System:

A) Dust Containment Enclosures:

1. Enclosure for Crusher Discharge Area
2. Enclosure of Vibratory/Rotary Screen

Upon reviewing the existing Environmental Standards & Guidelines, subsequent Amendments and after reviewing status of dust control systems installed by many stone crushers and reasons for their failure to achieve desired level of dust control & local constraint etc., new improved designs of dust control system have been evolved which would be simple to install, operate and maintain. Various aspects of the designs are discussed in follow.

B) Dust Suppression System:

GOOD	BAD
• Minimum required opening for B/C • All sheets in place • Very little escape of dust • Money spent & useful	• Larger opening for belt conveyor • Some sweets missing/fallen • Substantial escape of dust • Money spent but no use

1) A Closed Water Tank

There should be a water tank closed from all sides with a manhole cover for any maintenance. It is preferable to have a syntax type plastic tank or alternatively a RCC tank with man-hole with cover. This tank should only be used for water spraying purpose and not for any other domestic use. The tank should have a drain valve at the bottom to take out settled dirt or mud periodically.

2) Pump

A pump is required for supplying pressurized water to the nozzles for formation of good desired sprays. The pump should be installed on the tank. In the suction line a foot valve along with a fine mesh filter should be installed. The pump outlet is to be connected to a filter unit. The size of the pump in terms of horse power, suction/delivery diameter and pressure and water flow rate varies depending on size of the Crusher.

3) On-line self-cleaning Type twin micro filter

Even though the water tank is enclosed, some amount of dust/dirt comes along with water and this can eventually choke the small holes in the nozzle affecting the spray formation. It is therefore a fine mesh (about 100 micron) type water filter is necessary. The filter mesh candle should be of stainless steel material.

4) Pressure Gauges

Two numbers of pressure gauges are required to be installed, one at the pump discharge before the filter and other after the filter. The pressure gauge indicates the pressure drop across the filter pointing out excessive choking and also ensures adequate pressure at the pump outlet.

5) Connecting GI Pipelines & Regulating Valves

A network of GI pipeline is required to be laid from pump/filter outlet up to all the nozzle spray locations. The dimension of the pipes of header and branch connection varies depending on the size of the crusher. It is recommended to use PVC pipes to avoid corrosion related problems but such PVC pipes need to be properly protected and supported to avoid damage and breakage to the pipes.

6) Control Panel

A control panel is required to be installed to switch the pump on or off pump as required. The control panel should be permanently installed on a wall at easily accessible location.

3.9 Dust Control System design for various sizes of Stone Crusher:

Sr. No.	Crusher Category	Typical Machinery	Typical Production Capacity	Number of Spray Locations	Optional Spray Locations	Water quantity (max.)
			TPH	Number	Number	Lit/hr
1.	Small	Single Jaw, Single Screen, Manual Feeding & conveying	5-10	2	1	150
2.		Single Jaw, Single Screen, Mech. Feeding & Conveying	10-15	3	--	200
3.		Two Jaws, Single Screen, Mech. Feeding & Conveying	15-25	4	1	250
4.	Medium	One Primary & Two Secondary Jaw, 2 Screens, Mech. Feeding & Conveying	25-60	5	2	300
5.		Two Primary, Two	60-100	6	2	400

		Secondary Jaw, 2 Screen, Mech. Feeding & Conveying				
6.	Large	1 Primary, 2 Secondary, Two Tertiary Jaw, 2 Screens, Mech. Feeding & Conveying	>100	7	3	700

3.10 Dust Suppression Arrangements:

Most of the SCUs were found to have some water spray arrangement, though not satisfactory. The water is generally drawn from nearby bore-well and stored in a water tank. The water tank is generally located at an elevated level where raw material is unloaded. Water is supplied by gravity, through GI pipes, to various locations where dust is generated. Generally, simple holes are made in the pipes through which water is sprinkled. Some Crushers have installed "domestic showers" to get better spray. None of the unit was found to have filtering arrangements to clean the water. In such cases, in the absence of adequate pressure the spray formation is not appropriate and thereby to achieve the same effect as spray by nozzle more quantity of water is required to be sprayed, which again is unacceptable as it may increase moisture in the product excessively affecting quality adversely. Sprays are required to generate large number of fine water droplets which in turn come in contact with large number of fine dust particles, ideally each dust particle should get in contact with each water particle, only then the dust gets suppressed, otherwise suppression effect would only be partial.

a) Typical arrangement adopted for Dust Suppression:

Following arrangements generally exist in stone crushers.

- A bore well as source of water
- A domestic water storage tank, placed at an elevated level.
- GI pipes for water circulation by gravity
- Generally holes are made in the pipes through which water get sprinkled on stone, some units have domestic showers for spraying.
- Some units have additional arrangements such as Water Sprinklers around the plant, along with a pump and G.I. Pipeline network in and around the plant**.**

b) Sprinkler Arrangement

Some stone crusher have installed water sprinklers all around the plant premises which spray water at a height of about 5-7 meters in 360 degrees periodically. Such system consumes a large quantity of water and if operated continuously it can create muddy conditions all over the plant due to accumulation of water in low lying areas. With regard to

effectiveness of dust suppression, as discussed earlier the airborne dust emissions spread to a very large area as it raises and the sprinklers can spray water covering a small percentage of this area and therefore the airborne emissions hardly get suppressed by sprinklers. On the other hand the sprinklers wet the floor area as well as the stock piles and hauling roads and therefore help minimize only the secondary fugitive dust emissions but are ineffective in suppressing/controlling primary process dust emissions which are air borne.

Local Problems in Implementation Of Pollution Control Measures

Discussions were made with number of stone crusher owners to know and learn about the local problems faced by them in controlling dust emissions. A few of the reported problems are highlighted below.

- High investment cost for providing dust containment like G.I. sheet enclosure for Vibratory Screen, Belt Conveyors etc for small size SCU's, for medium and Large size SCU's it is not.
- Huge quantity of water has been used for suppression of dust resulting in poor product quality forcing SCU to abandon it
- Lack of appropriate nozzles for proper spray resulting in excess moisture added to the product and thereby increasing the water consumption
- Lack of knowledge of pollution control measures by SCUs
- Lack of availability of water for dust suppression forcing the SCU's to purchase the same at higher cost
- Financial constraints to implement the pollution control measures for small units

Conclusion

1) The dust generated from stone crushing activities contains a significant amount of fine inhalable matter.
2) The presence of a high percentage of silica in the dust and the particle size distribution further such as that the occupational environment of the workers and surrounding areas may be hazardous the human health.
3) Air quality and health survey conducted at the site indicate that the observed dust may be producing significant damage to respiratory health.
4) It focuses on harmful and controlled emissions of stone crusher units and recommends preventive measures for the same.

10 REFERENCES

1.Addo-Yobo, E.O., Custovic, A., Taggart, S.C., Craven, M., Bonnie, B. and Woodcock, A., 2001. Risk factors for asthma in urban Ghana. Journal of allergy and clinical immunology, 108(3), pp.363-368.

2.Gautam S.P. (2009) Comprehensive Industry Document - Stone Crushers, Central Pollution Control Board"PariveshBhawan" East Arjun Nagar, Shahdara"Delhi Langer, W.H., 2001.

3.Potential environmental impacts of quarrying stone in karst: a literature review. US Department of the Interior, US Geological Survey. Oxman, A.D., Muir, D.C., Shannon, H.S., Stock, S.R., Hnizdo, E. and Lange, H.J., 1993.

4.Occupational dust exposure and chronic obstructive pulmonary disease: American Review of Respiratory Disease, 148(1), pp.38-48. Rao, C.M., 1985.

5.Distribution of suspended particulate matter in the waters of eastern continental margin of India. Indian Journal of Marine Sciences, 14(1519), p.255. Semban, T. and Chandrasekhar, S., 2000. Impact of crusher pollution on workers in Trichy. Environment and People.