IMPLEMENTATION CHALLENGES OF ENVIRONMENTAL GUIDELINES IN THE STONE-CRUSHER INDUSTRY

A CASE STUDY FROM DELHI-NCR

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Contents

1. Why are we discussing stone crushers?

The sources of the continuous increase in air pollution in Delhi-NCR has been a debatable issue. To identify these sources, various source apportionment studies have been conducted. The studies have revealed industrial emissions as one of the major sources to air pollution in the area, along with vehicular, road dust and construction activities.

Consequently, the action plans for non-attainment cities have been incorporated with measures to reduce industrial pollution by means of installation of air pollution control devices and/or change of fuel used for combustion purposes or similar practices. Industrial air pollution includes both stack and fugitive emissions, but the action plans focus only on control measures for stack emissions while entirely overlooking fugitive emissions. Though stack emissions are considered major contributors to industrial air pollution, fugitive emissions also play a crucial role in the ambient air pollution of an area and hence need equal attention.

A Centre for Science and Environment (CSE) 2020 report *Assessment of Industrial Air Pollution in Delhi-NCR* assessed seven regions in Delhi-NCR to identify industrial sectors with high fugitive emissions. Stone crushers were recognized as a sector with high potential for fugitive dust emissions. Although considered small-scale, this sector is infamous for flouting environmental norms by generating air pollution, causing severe discomfort to the residents in their vicinity and degrading the environment. The severity of the emissions from this sector is measured by the fact that the Environment Pollution (Prevention & Control) Authority (EPCA) banned their operation, along with those of brick kilns and hot mix plants, under the implementation of the Graded Response Action Plan (GRAP). The issue has also been reported multiple times in the media and several orders have been passed against the stone crushers by the National Green Tribunal (NGT) (see *Photograph 1*).

Stone Crushers Cause Pollution, Unscientific Mining Degrades Environment: NGT

The bench said: It is well known that stone crushers have potential for huge pollution and unscientific mining for such stone crushers further degrades the environment.

Villagers seek closure of stone-crushers, take out march in Narnaul

Updated At: Apr 13, 2021 01:14 PM (IST)

Tribune News Service

Mahendragarh, April 12

Stone crushers in Delhi-NCR to be closed till November 17 as air quality deteriorates

The Central Pollution Control Board also directed Punjab and Haryana to check stubble burning.

Scroll Staff
Nov 11, 2020 · 06:21 pm

THE TIMES OF INDIA

Nine booked for illegal mining in Aravalis

TNN | Aug 7, 2019, 08.07 AM IST

GURUGRAM: The police and mining department have identified nine people allegedly involved in illegal mining activity in Gairatpur Bas villag which lies in the Aravali hills.

Stone crushers in Mahendragarh under lens

Mahendragarh, December 1

The stone crushers in the district have come under the scanner. A joint committee, comprising officials of the central and state authorities, has started inspecting the units to find out air pollution load and its adverse impact on public health.

The committee led by DC Ajay Kumar and represented by Sunil Dave from the Central Pollution Control Board, Executive Engineer Mohit Mudgil from the Haryana State Pollution Control Board and Harsha Kota, an expert on air pollution from IIT-Delhi, on Wednesday visited Dholera, Bigopur and Bayal villages here to examine the functioning of stone crushers.

Over 50 units shut for norm violation

The committee will inspect all stone crushers to ascertain the units that can operate. There are over 100 units operational in the district while over 50 have already been shut for norm violation. —Official

Right to operate stone crushers not above right to life, says NGT

STAFF REPORTER

NEW DELHI, DECEMBER 06, 2020 20:09 IST
UPDATED: DECEMBER 06, 2020 20:09 IST

Foul Air: Hot mix plants, stone crushers major contributors to air pollution

TNN | Jan 29, 2021, 04.33 AM IST

HYDERABAD: Hot mix plants and stone crushers are turning out to be major contributors to air pollution in the city with many residents raising an alarm over air, soil and water contamination.

"People have been wearing a mask due to Covid-19 now. We have to wear masks every time we step out as the situation is so bad that we find it difficult to even breathe amidst all the dust particles," said Vijay Reddy, a resident of Hyathnagar.

These hot mix plants are spread across Hyderabad, mostly in Shamshabad, Ibrahimpatnam, Patancheruvu, Borabanda and also towards Sangareddy.

NGT imposes Rs 1.17 cr penalty on 21 stone crushers in Andhra Pradesh

The National Green Tribunal has slapped over Rs 1.17 crore penalty on 21 stone crushing and quarrying units for causing pollution and damage to the environment

Topics
National Green Tribunal | air pollution | Andhra Pradesh

Press Trust of India | New Delhi
Last Updated at May 28, 2021 12:42 IST

GURUGRAM NEWS

Environmentalists allege illegal mining continuing in Gurugram Aravallis

A group of environmentalists said they had found evidence of large-scale stone mining in the Aravallis during a ground check near Gurugram

ENVIRONMENT POLLUTION (PREVENTION & CONTROL) AUTHORITY
for the National Capital Region

Dr.Bhure Lal
Chairman

EPCA-R/2019/L-56
November 11, 2019

Dear Sir,

This is further to my urgent direction of November 8, 2019, regarding the measures that needed to be taken to combat the air emergency situation in Delhi-NCR.

The CPCB led task force has reviewed the weather conditions that are likely to prevail over the region and it is their assessment that in spite of winds, AQI has fallen back to 'Very Poor' category. Furthermore, as the direction of the winds is again north-westerly, this has also increased the contribution of stubble burning into the region's airshed. As per IMD, air quality situation is likely to remain under 'Very Poor' to 'Severe' category and improvement is indicated only after November 13, 2019. From November 14, 2019, winds are likely to be stronger resulting in better dispersion of pollutants.

In view of the above, CPCB tasked force has recommended that operation of industries which were restricted earlier may commence from November 14, 2019. CPCB Task Force will also review the meteorological conditions and air quality on November 13, 2019 and further advisory will be issued, if needed.

Given the above situation, EPCA is directing the following:

1. **Hot mix plants, stone crushers to be closed till morning of November 14, 2019 in all NCR districts.**
2. **All coal and other fuel based industries, which have not shifted to natural gas or agro-residue (with exemption to power-plants) to remain closed in Faridabad, Gurugram, Ghaziabad, Noida, Greater Noida, Sonepat, Panipat and Bahadurgarh and Bhiwadi till morning of November 14, 2019. In Delhi industries, which have not yet shifted to PNG to**

Photograph 1: Media reports on operation of stone crushers under the scanner

The sector has also been in the limelight for illegal mining of stone from protected areas. Several reports have described the destruction of the Aravalli Range due to rampant stone-mining activities. The issue turned so extreme that it required intervention from the Supreme Court of India, which subsequently, in 2002, banned stone mining in the Aravalli Range.

There has also been a gradual progression of National Green Tribunal (NGT) orders with regard to the stone-crusher industry. The orders range from acknowledging the illegality and non-compliance by proponents and accounting for misgivings of the state Pollution Control Boards to directing the Pollution Boards to conduct carrying capacity studies and undertake adequate remedial plans for exploited areas. These matters have underlined the negligent attitude of regulators and state administration towards the plight of people living in the vicinity of the non-complying or illegal entities. Compliance by this sector with the regulations has, however, always been a challenge. The issue of environmental damage by stone crushers is not limited to Delhi-NCR but extends all over the country (see *Box: Court cases against stone crushers*). Continued operation of crushers with the current criteria will have deadly consequences.

Fugitive emissions from operation of a stone-crusher unit

To study the causes of pollution from the stoner-crusher industry, CSE conducted an independent study on stone-crusher units operating in Delhi-NCR. With environmental norms strict in Delhi, districts in NCR have emerged as major hubs for industries, and these areas have been selected for the study. The study covers Nuh, Gurugram, Faridabad, Tijara and Alwar (see *Map 1: Regions covered under study*). Mohabtabad Crusher Zone in Pali area of Faridabad is considered Asia's largest crusher zone. Similarly, Manki Crusher Zone in Ramgarh district of Alwar is a hub of stone-crushing plants.

The stone-crushing industry is an industrial sector engaged in producing crushed stone of various sizes and dust which acts as raw material for construction activities. The industry exists in all the states near almost every major city and town. Stone crushers produce substantial quantities of fine fugitive dust emissions that create health hazards for workers as well as the population in the vicinity. The dust also adds to the air pollution of the area and affects visibility. The sector is in the orange category and is required to obtain a Consent to Establish (CTE) and Consent to Operate (CTO) from the State Pollution Control Boards.

Map 1: Areas covered under study

The objective of this study is to understand current practices followed by the stone-crusher units, identify the issues of fugitive emissions, evaluate the effectiveness of sector-specific guidelines on the ground and assess the implementation challenges. Since the sector will always be in demand considering the construction planned in India, the study aims to strengthen the operational practices of this sector such that it is able to work in harmony with the environment. This can be done by reinforcing sector guidelines and incorporating stringent measures to reduce fugitive emissions from the sector.

COURT CASES AGAINST STONE CRUSHERS

Despite state guidelines in place for the stone-crushing sector, various petitions have been recently filed in the National Green Tribunal (NGT) regarding illegal operations, flouting of environmental norms, and complete disregard for siting guidelines by project proponents. Taking note of the pollution from these industries and acknowledging the gravity of the situation, the Green Court also stated, "the right of operating stone crushers cannot get preference over and above the right to life".[1] Some of the NGT cases that highlight the polluting sectors and problematic areas have been discussed below:

1. NGT order regarding closure of unsustainable stone crushers, Haryana, October 26, 2021:[2] A complaint was filed at NGT stating that there are 260 stone crushers in operation in Charkhi Dadri and the environment does not have the capacity to sustain the same resulting in air and water pollution beyond norms. The Committee, constituted by NGT, acknowledged violation of environmental norms in its report and submitted that the carrying capacity of Charki Dadri is negative, i.e. the existing plants are already higher than what can be sustained without any environmental repercussions and health degeneration. The Tribunal thus directed that in view of absence of carrying capacity and unsustainability of the stone crushers, the stone crushers may be liable to be closed to the extent the same are not sustainable. Additionally, an environmental compensation (EC) against 34 units amounting Rs 4.51 crore has been imposed out of which 27 units have deposited EC amounting to Rs 1.83 crore. Likewise, EC for illegal abstraction of groundwater has been calculated for Rs 31.66 crore.

2. NGT order on violation of environmental norms by stone crushers, Uttar Pradesh, June 8, 2021:[2] In compliance with the NGT order, an environmental compensation of Rs 6 crore has been fined on six stone-crusher units operating in district Mahoba of Uttar Pradesh. The units were found violating environmental norms according to the report filed by the joint committee constituted by the NGT. These units were alleged to be operating and violating norms for last ten years as per the petition filed in NGT. NGT also slammed the Pollution Board of Uttar Pradesh; it stated that continuous violation for as long a period as ten years shows the failure of monitoring by the statutory bodies.

3. NGT intervention against violation of siting criteria by stone crusher, Haryana, October 26, 2021:[3] In response to the petition filed against the stone crusher violating siting criteria in Mahindargarh, Haryana, a factual and action taken report has been asked by the NGT from the joint committee of the Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB) and Deputy Commissioner, Mahindergarh. The committee submitted that the said crusher was found to be in violation of siting criteria with regard to distance from educational institutions and thus its consent has been revoked and the unit is not permitted to operate.

4. NGT order regarding dust pollution by stone crushers in district Satna, Madhya, February 21, 2019:[4] It is alleged in the NGT that several stone crushers are operating illegally within the distance of 5–10 metre from the National Highway, which is against the siting policy. A joint committee comprising representatives of CPCB, SPCB and the District Magistrate, Satna, confirmed in their report the operation of five stone crushers within the prohibited distance. The crushers were ordered to close down their operations, including in their captive mines, in violation of the siting criteria. Show cause notices have also been passed against 14 stone crushers for not implementing pollution-control measures that have been set up in the area, including in their captive mines. NGT also said that in spite of illegal operation of crushers, no compensation has been assessed and recovered from the crushers for causing damage to the environment. It directed the state Pollution Control Board (SPCB) to furnish a report with details of compensation cost to be recovered from the crushers.

5. NGT direction to HSPCB regarding distance from educational institutions, May 21, 2019:[5] In response to the petition filed by Sardar Patel Jan Chetna Education Society, NGT ordered the Haryana State Pollution Control Board (HSPCB) to furnish the status report on the compliance of the siting area between the stone crushers and the educational institutes. It is pertinent to mention that Haryana government has included the distance criteria from educational institutes in its notification after the earlier NGT order dated February 19, 2019. The board in its report submitted that 58 stone crushers were found to be non-complying with the distance criteria of a minimum of 0.5 km from educational institutes. The board has taken action against the defaulters and a window of one year has been granted to these units to comply with the siting norms.

6. NGT order regarding closure of crushers operating without consent, Uttar Pradesh February 31, 2020:[6] A petition was filed by the Society for Protection of Environment and Biodiversity in the Green Tribunal claiming that several stone crushers in the four districts of Uttar Pradesh—Hamirpur, Banda, Chitrakoot and Mahoba—were either operating without consent or were alleged to be in its violation. The Uttar Pradesh Pollution Control Board (UPPCB), on being questioned by NGT in the matter, informed the court that 380 stone crushers were running in four districts, and of these, 174 units (46 per cent) were operating without consent. It also informed that closure notices were sent to the defaulter. UPPCB also charged 68 units for environmental compensation. The court ruled that the board shall conduct periodic inspections to ensure that stone crushers without consent are not allowed to commence.

7. NGT order regarding illegal mining and stone-crushing units in Rajmahal Hills, Sahebganj, Jharkhand, September 23, 2020:[7] The matter was related to enforcement of environmental norms in the operation of quarrying and crushing units in the Rajmahal Hills of the Vindhya Mountains, District Sahebganj, Jharkhand. The Tribunal noted that the area is rich in mineral resources and more than 407 stone crushers and 300 stone mines in the area were involved in indiscriminate mining and operation of crushers without due regard to the environmental norms which resulted in destruction of the hills. The court formed a joint committee of CPCB, MoEF&CC and Jharkhand State Pollution Control Board (JSPCB), which in its report submitted rampant violation of environmental norms by the mines and crushers and unscientific and unsystematic mining practised in all the mines during the committee's visit. Haul roads were kuchcha, with inadequate arrangement for water spraying on roads. The roads were full of trucks and the trees in the area were laden with dust. The court stated that the state machinery and the regulatory authorities had allowed a free run to the operation of mines and crusher units, resulting in the present sordid condition. The State Board informed the NGT that a total environmental compensation of Rs 6 crore had been imposed on the defaulters, which NGT found inadequate and not in accordance with the CPCB criteria. The court formed a new four-member committee and directed it to prepare a scientific action plan after in-depth study of the problem with a clear road map. The court also directed the committee to examine the questions of how many stone crushers and mining units could be allowed and subject to what special conditions and to what extent the existing activities needed to be regulated.

2. Stone crushers: Process and air pollution

Depending on geographical location, type of demand for crushed products, type of raw material, local availability of plant and machinery etc., there are great variations in the kinds of stone crushers in the country. The industry can be divided in three categories—small, medium and large. While small crushers usually have a production capacity of 3–25 tonne per hour (TPH), the production capacity of medium-sized crushers is in the range of 25–100 TPH. The production capacity of large crushers is more than 100 TPH; they are generally owned by companies with their own or leased stone mines.

The major process in stone crusher units remains the same, with variations in the number of crushing and screening steps depending on the size of the unit and the requirement of the final product. The products from these units generally include fine dust and stones of size 6 mm, 10 mm, 20 mm and 40 mm. A different size of stone can also be produced as per the demand by changing only the size of the screen mesh.

Process of stone crushing

A. **Mining of stone:** The first step in the process is availability of raw material. Various types of raw material—such as granite, riverbed pebbles, semi-grade stone, soft rock etc.—are used in stone-crushing units as per the local demand requirements in different geographical locations. The supply zones for the various types of raw materials range from local hillocks, open-cast mines, riverbeds, cliffs and other miscellaneous sources. Mostly small-sized stone crushers source their raw materials from local hillocks, riverbeds or from mine owners in the vicinity while medium- and large-sized units source their raw material from leased or owned open-cast mines.

B. **Transportation of raw material:** Mined stone from various sources are transported to stone-crushing units via trucks, trailers or automatic dumpers. Most of the transportation vehicles have hydraulically operated tilting arrangement for easy and faster unloading of stones at the crusher sites.

Unloading point for raw material (deep pit feeder)

Jaw crusher with elevated feed hopper

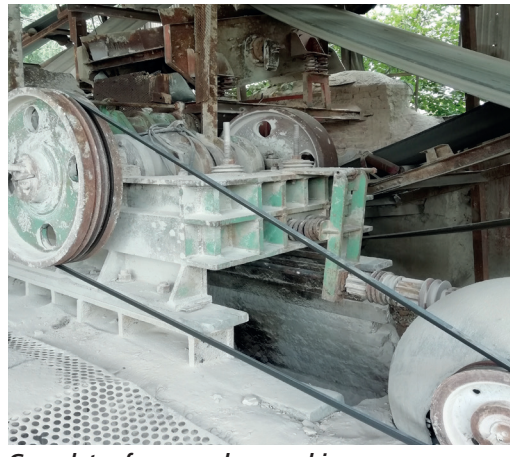
Raw material unloading in feed hopper

Raw material fed to jaw crusher from feeder

Photograph 2: Primary crushing unit

C. **Primary crushing:** Transported mined stones are fed directly to the primary crusher via stone wells or feeders. Two types of feeders are used at the units, one with the deep pit—also called *haudi*—and the other an elevated feed hopper. The feeders are connected to the primary crusher. Jaw crushers are widely used as primary crushers in these units. The primary crusher crushes the large stones and boulders into stones of size 100–140 mm. Crushed stones are conveyed to stock piles to further transfer them to a secondary crusher (see *Photograph 2*).

D. **Secondary crushing:** Crushed stones from stockpiles are fed to secondary crushers via conveyor belts. In this step, stones are further crushed to sizes ranging from as large as 40–60 mm to 10 mm or even smaller. Stone-crushing units use different types of crushers for secondary crushing. The granulator is most commonly used in non-engineered units (with basic design) while engineered units use a cone crusher for this step (see *Photograph 3*).



Granulator for secondary crushing

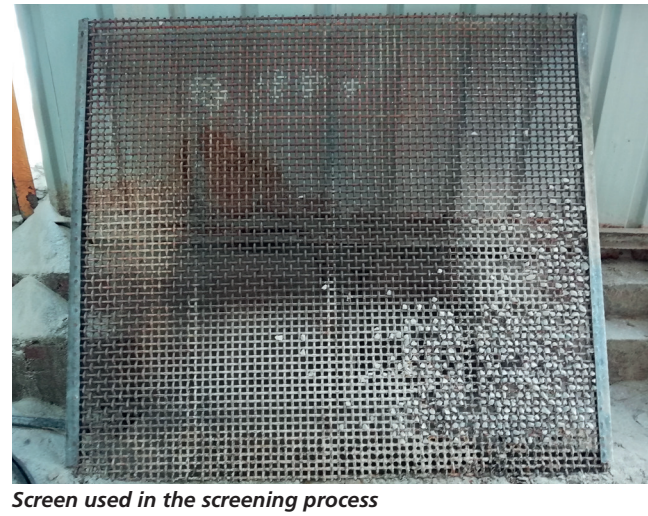
Cone crusher for secondary crushing

Photographs 3: Secondary crushing units

E. **Screening:** Crushed stone from the secondary crusher is transferred for screening via a conveyor belt. Screening is the process of separating groups of product of various sizes. Several screens of different mesh size are aligned one below the other and each screen is connected to a separate conveyor belt to discharge product of different sizes. The size of the screen mesh depends on the size of final product required. For example, for a final product of stone size 10 mm, a screen of mesh size of 12 mm is used. The mass that remains on the screen is called oversize and the material that passes through the screen is called undersize. The oversize is returned to secondary crushers for further crushing and then again to the screen. The undersize is discharged through a chute on to a conveyor belt (see *Photograph 4*). The screened product of

Typical screening unit

Screening in progress



Screen used in the screening process

Photograph 4: Screening of crushed material

various sizes gets conveyed to stockpiles by belt conveyors. Different types of screens—grizzly-type screen, vibrating screen and rotary screen—are used. Vibrating screens are used most often.

F. Tertiary crushing: Tertiary crushing is performed in units that produce dust as their primary product. Dust, generally a byproduct of the stone-crushing process, is of low quality and has a low market price. Units that produce dust as their main product install a separate machine, usually roller crushers. Stones of 10–20 mm size are sent to the crushers to be ground into fine dust (see *Photograph 5*). To separate dust from oversize, the output from roller crushers is conveyed for screening. A separate screen may be installed by the units for this step or the primary screen may be used.

Photograph 5: Tertiary screening unit

G. **Product storage and loading:** After crushing and screening, the final product is transferred to a conveyor belt that delivers the product into different stockpiles, depending on the size of product. The conveyors belts have chutes attached at the delivering position in order to streamline the fall of product and reduce emissions. Many units, however, provide chutes only for dust, and not for other products. Wind-breaking walls between stockpiles of product are also required to prevent dispersion of product during high winds.

Loading of the final product into trucks and trolleys is practised in two ways. An additional conveyor belt is installed at the base of the stockpile and the belt transfers the product directly into the carrying vehicle. But as this process requires more area, the units have the product transferred through JCBs (see *Photograph 6*).

Chute for release of final product to stockpile

Product release without chute

Wind-breaking wall

Product loading through conveyor belt

Photograph 6: Product storage and loading

H. Conveyance system: Conveyor belts are the primary means of transferring raw material and product from one end to another through the entire process. As they continuously carry one or another form of product, they are potential source of high fugitive dust emissions during the process. To substantiate the dust, water sprinklers are provided on each belt and are required to be operated during the process. To reduce emissions further, some units cover conveyor belts either with sheets or thick cloth. The coverings are easily removable during maintenance of belts (see *Photograph 7*).

Conveyor belt system in a stone-crushing unit

Water sprinklers provided on conveyor belts

Halfhearted attempted in covering conveyor belt

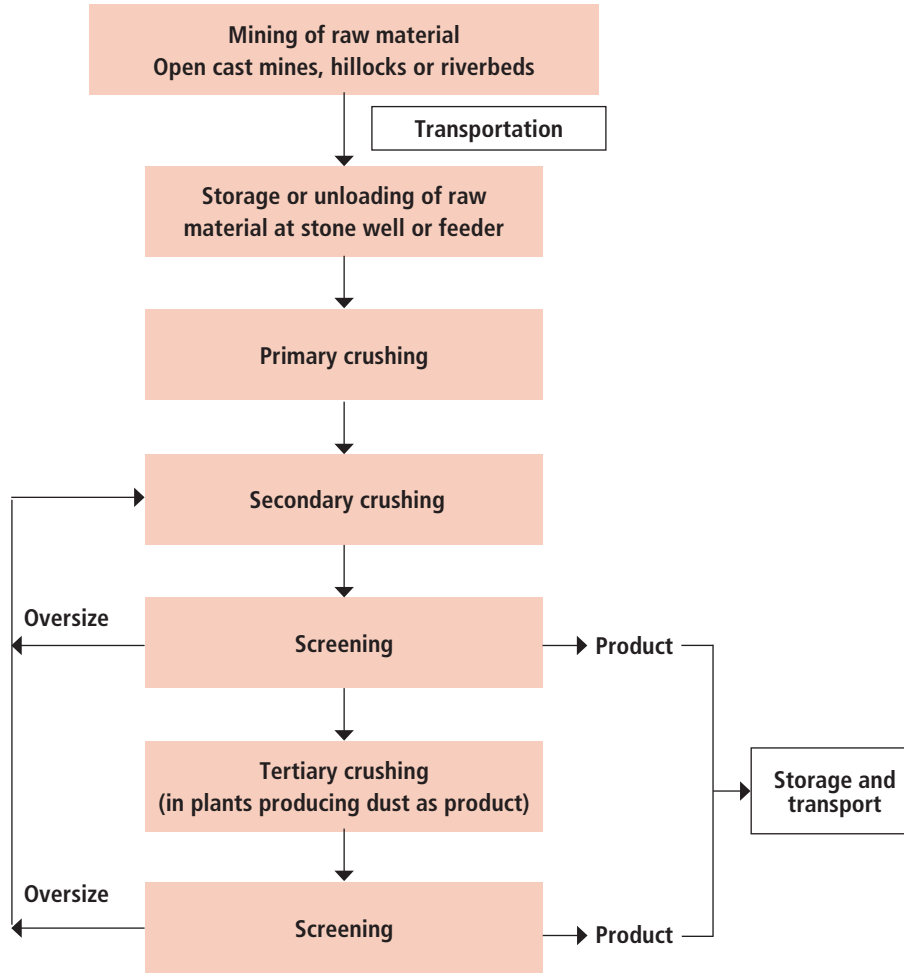
Complete covered conveyor belt

Photograph 7: Conveyance system in the stone crusher units

Sources of emission

The complete process of stone crushing involves generation of fugitive dust emissions (see *Figure 1: Flow diagram of stone-crushing process*). The only difference lies in the quantum of dust generated from each step, which increases as the process proceeds towards finer crushing. To control these emissions from being airborne, the guidelines notified by the states directs the use of covered sheds at the machines for dust containment and water sprinkling for dust suppression. The guidelines already had minimum requirements; however, the crusher units fail to fulfill these bare minimum measures, thus leading to huge amounts of fugitive emissions. A few units, however, have attempted to provide good infrastructure in

Figure 1: Flow diagram of stone-crushing process



terms of dust containment at various stages. The emissions at different stages and the control measures taken by the unit (partial or complete) are discussed further in the next section.

A. Primary crushing: As this step crushes large boulders into comparatively smaller sizes, the crushing process along with unloading of stones involves generation of substantial amount of fugitive dust (see *Photograph 8*). The mechanism for water sprinkling is provided at this step to reduce fugitive dust but they were observed as non-operational during site visits. At some sites, the primary crushing area is partially or completely covered under shed as a measure to contain the fugitive dust, though partial covering does not seem to provide much of a benefit (see *Photographs 9*).

Photograph 8: Emissions from primary crushing

Partially covered shed

Fully covered shed with door

Photograph 9: Practices to contain emissions from primary crushing

B. Secondary crushing: Fugitive dust generated from this step is much higher than in primary crushing (see *Photograph 10*). Units provide sheds for this part of the process but they are usually partially covered and dust escapes into the atmosphere (see *Photograph 11*).

Photograph 10: Fugitive emissions from secondary crushing

Partially covered sheds

Completely covered sheds for granulators

Photograph 11: Practices to control emissions from secondary crushing

Photograph 12: Fugitive dust from screening process

C. Screening: The screening process is the source of highest fugitive dust emissions. As the material from secondary crushers is conveyed to the screens, the screen vibrates and thus separates the material into different categories. This vibratory action causes large amounts of fugitive dust accompanied by a high degree of noise (see *Photograph 12*). Shed and water sprinklers are made available to combat dust but sprinklers are not operated frequently. A few units have adopted the practice of complete shed coverage for the process, with doors provided for the purpose of maintenance (see *Photograph 13*).

D. Tertiary crushing: As this step involves grinding stones into fine dust, large quantities of fugitive emissions are generated. The emissions can be observed

Partial covering of screens

Fully covered shed with doors for maintenance

Photograph 13: Covered sheds for screening process

Photograph 14: Fugitive dust from tertiary process

in the shed and even escaping into the environment if the machine is partially covered (see *Photograph 14*).

E. Product release and storage: Fugitive emissions transferred through chutes are lower than direct disposal of product onto the stockpile, which generates high amounts of fugitive emissions (see *Photograph 15*). These emissions are higher at dust stockpiles than at stone piles of 10–20 mm size.

Photograph 15: Dust emissions during product release at stockpile

3. Regulatory framework

State-specific guidelines for stone crushers

Many states have developed guidelines for stone crushers units, which include siting criteria and pollution control measure to reduce fugitive emissions from these units. In the case of Delhi-NCR, Haryana has defined guidelines in place for these units, with suitable siting rules. The state guidelines have also notified crushing zones for the establishment of such units. Rajasthan also has guidelines notified for such units; the guidelines, however, are very general and do not direct much of control measures.

The following discusses state-wise guidelines:

A. Haryana

The Haryana government's 2016 notification stated that stone crusher units are required to practise the following pollution-control measures:

a. Pollution-control measures

- Dust containment-cum-suppressing systems for equipment in the form of covered sheds and sprinklers.
- Construction of approved wind-breaking wall of length of at least 50 metre and height of at least 16 feet, along with provision of telescopic chute to ensure that the crushed material from the nod is released from a point which is at least 2 feet below the height of the wind-breaking wall.
- Construction and maintenance of metalled roads for vehicular movement within the premises of the crushing units or within the zone housing the stone-crushing units. The metalled roads to be provided either individually within the premises or jointly by the crushers in the approved crusher zones will be as determined by the Haryana State Pollution Control Board (HSPCB). HSPCB has the authority to cancel continued

operation of stone crushers in a zone or isolated sites within zones where such metalled roads are not satisfactorily constructed or maintained. Regular cleaning and wetting of the ground within premises and the remaining enclosure of crushing units and zones where stone-crushing units are situated is required.

- All stone-crushing units shall provide a green belt of two rows along the periphery. Till plantation within the premises is fully developed, the project proponent shall erect a barrier along the periphery to contain dust emissions. The barricade should completely enclose the premises from all sides and may be a boundary wall or made of flexible cloth (tarpaulin etc.) or a combination of the two. The height of the barricade shall not be less than the height of the highest tip of the conveyor belts.
- The stone-crushing units shall provide at least 50 sprinklers along with a water-storage facility of capacity of at least 10 kilolitre. Further, they must sprinkle at least 10 kilolitre of water per day for a stone-crushing capacity of 100 tonne per day and pro rata accordingly for higher capacity crushing units.
- In order to ensure regular operation of sprinklers system, the stone-crushing units will provide an interlocking system along with a separate energy meter with load survey and demand features.
- The stone-crushing units shall obtain raw material only from legal sources and will have exclusive contract with the legitimate mining lease holders and will submit complete data relating to the sources and quantity of raw material utilized by the stone-crushing units.
- A green belt along any approved notified zone will be for a depth of at least 100 metre or along the periphery of the crusher zone with at least 10 rows of such trees. The responsibility for planting and maintaining the green belt shall be with all the stone-crushing units operating at that time. In case any stone crushing unit does not comply with this direction, the Board shall get it done at the expense of the defaulting stone crushing unit.
- No stone crusher will be allowed to be set up in a stream or riverbed within their flood protection embankments.

b. Siting norms

The 2016 notification of the Haryana government dedicated various crusher zones in the districts of Faridabad, Panchkula, Yamuna Nagar, Gurugram, Mewat and Bhiwani. Stone-crusher units that did not fall in these notified zones were required to follow the siting guidelines as stated in the following table.

S. no.	Criteria	Distance (km)
1	Minimum distance required from the nearest national and state highway	1.0
2	Minimum distance required from the nearest outer limit of major district roads and other roads	0.1
3	Minimum distance required from the limits of National Capital Territory of Delhi	5.0
4	Minimum distance required from the limits of nearest municipal corporation	3.0
5	Minimum distance required from the nearest town, city or municipal limits	1.5
6	Minimum distance required from the nearest village phirni. If there is no phirni, the distance will be measured from the village Lal Dora	1.0
7	Minimum distance required from any land recorded as forest in government records (revenue or forest department) except strip forests, plantation along roads, canals, railway lines and bunds	0.5
8	Minimum distance required from any strip forests or plantation along roads, canals, railway lines and bunds etc. recorded as forest in government records	0.1
9	Minimum distance required from approved water supply scheme open to sky of 20 kilolitre capacity	1.5
10	Minimum distance required from any indoor health treatment unit catering to 25 or more bed for catering indoor patients	1.0
11	Minimum distance required from national parks, wildlife sanctuary and conservation reserves	2.0

These siting criteria are only applicable to stone-crushing units to be established in the area outside the existing notified, approved crusher zones or their extension. All stone-crushing units (existing or new) that do not meet the siting criteria are required to shift to a site meeting the siting parameters or to the identified crusher zone depending on the availability of vacant sites in the zone. The notification provided a window of three years for re-siting of stone crushers with a further extendable period of one year provided that the crusher has procured the land meeting the siting the criteria.

The Haryana government has implemented a good initiative of notifying crusher zones for operation of stone crushers. This will be helpful in managing crusher units, provided there is regular monitoring of these units. The guidelines, however, are lenient in terms of pollution control measures. It mandates dust containment system in the form of covered sheds; it does not, however, specify the technicalities. For example, it does not specify the height of the shed or whether it is to be covered from all sides. This ambiguity has resulted in a situation where the units have provided partially covered sheds (on three sides and top), leaving one side open. Since these units were found to be operating during the survey, this seems to be a sorry state for the pollution board.

Conveyor belts carrying crushed material from one step to another are an important source of fugitive emissions. As the belts travel across units, they are a concern with regard to emissions. The guidelines, however, mention neither any measures for covering conveyor belts nor the provision of flexible openings for the passage of the belts in sheds. As a result, even units that are completely covered have open conveyor belts and even open passage for these belts and thereby release dust from the belt as well as sheds. Dust is required to be contained from all probable sources of generation; the focus of the guidelines, however, is only on the sheds.

Provision of closed storage of the final product has not been discussed in the guidelines. The final product is in its finest form—most often dust—and is thus most susceptible to being airborne. Storing this fine product in the open creates a lot of nuisance; the guidelines, however, have limited the provision only to the wind-breaking wall, which alone does not suffice. The number of water sprinklers in the guidelines is given as 50, but the location where it needs to be installed is not specified. The purpose of installing this number of sprinklers if they are not positioned correctly is not clear. The guidelines need to be strengthened technically with regard to pollution-control measures in order to minimize fugitive emissions from this sector.

B. Rajasthan

The Rajasthan government vide its notification of 2018 released the guidelines for abatement and control of pollution in the stone-crusher industry. This notification superseded the 2011 guidelines which were in place for the regulation of this sector. The new guidelines are general in nature and do not direct much of the provisions for pollution control.

The following requirements are mentioned in the guidelines as measures for pollution control.

a. Pollution-control measures

- Dust containment-cum-suppression system for the equipment. Construction of wind breaking walls;
- Regular cleaning and wetting of the ground with in the premises;
- A green belt along the periphery;
- To control fugitive emissions from the premises of stone-crusher units, a water-sprinkler system shall be installed at all strategic locations, i.e. into the feed hopper, at the inlet and outlet of primary and secondary crushers, at the outlet of the vibrating screen, with all material conveyors and drop point of dust conveyors etc.;

- After construction of boundary wall of sufficient height (at least as high as the drop point of the chute at the conveyor) to act as a wind barrier around crusher premises, there is no need to construct separate wind-breaking walls along material conveyors;
- Up to 33 per cent of the area shall be utilized for plantation within the crusher unit;
- All existing stone-crusher units not having plantation up to prescribed norms shall submit a time-bound action plan (not more than one year) along with bank guarantee of Rs 15,000;
- Groundwater shall not be abstracted without a prior no objection certificate (NOC) from the Central Ground Water Authority (CGWA);
- A signboard showing the name, address and capacity of the stone-crusher industry should be displayed at the entrance of the site;
- The crusher area shall be clearly demarcated by providing boundary walls at all sides:
- Raw material should be obtained from legal sources only. If at any stage raw material procured from an illegal source is found to be used, the sole responsibility will be of the project proponent.

The 2018 guidelines are claimed to be developed with the intent to control pollution from stone crushing units. They have, however, been diluted to the bare minimum criteria. The guidelines mandated general conditions for the crusher units to comply with. As evident from the comparison table (see *Box: Stone crusher guidelines 2011–18: Rajasthan government takes a step back*), the 2011 guidelines discussed provision of a dust extraction system for screening and crushing areas to remove dust contained in the sheds. This is an effective measure to control dust as wet suppression does not suffice. The current guidelines, however, are limited to just a dust containment-cum-suppression system. The guidelines have not mentioned provision of flexible opening for conveyors; which was a mandated provision in the 2011 guidelines.

The 2011 guidelines mandate the covering of final product of size less than 5 mm and wetting of product of size more than 5 mm. It is a logical and required measure to combat emissions from stored products. The current guidelines, however, fail to incorporate this effective measure and are restricted to regular cleaning and wetting of ground. The previous guidelines also required covering of trucks carrying crushed product and washing of truck tyres while leaving the premises.
The guidelines has additionally defined the siting criteria for stone crushers from various places. These, however, have been removed from the current guidelines. Before setting up a stone crusher, an NOC is required from the State

STONE CRUSHER GUIDELINES 2011–18: RAJASTHAN GOVERNMENT TAKES A STEP BACK

The Guidelines for Abatement of Pollution in Stone Crusher Industry, the stone crusher guidelines notified by the government in 2011, were detailed and comprehensive while taking into account socioeconomic, technical and environmental aspects associated with the sector. The guideline has well-defined siting criteria and has provided detailed measures for control of fugitive emissions from the operation of the stone crushers, many of which are removed from the current guidelines.

A comparison of the guidelines on these measures are given below:

Pollution-control measures	2011 guidelines	2018 guidelines
The outlet of all primary crushers and both inlet and outlet of all secondary and tertiary stone crushers, if not installed inside a reasonably dust tight housing, shall be enclosed and ducted to a dust extraction and collection system such as fabric filter.	√	X
Water sprayers shall be installed and operated in strategic locations at the feeding inlet of stone crushers.	√	√
Stone crusher enclosures shall be rigid and be fitted with self-closing doors and close-fitting entrances and exits.	√	X
Where conveyors pass through the crusher enclosures, flexible covers should be installed at entries and exits of the conveyors to the enclosure.	√	X
The vibratory screens shall be totally enclosed in housing. Screen housing shall be rigid and reasonably dust tight. Where conveyors pass through the screen house, flexible covers should be installed at entries and exist of the conveyors to the housing.	√	X
Where containment of dust within the screen house structure is not successful then a dust extraction and collection system should be provided.	√	X
Except for those transfer points which are placed within a totally enclosed structure such as screen house, all transfer points to and from conveyors should be enclosed.	√	X
Openings for any enclosed structure for the passage of conveyors should be fitted with flexible seals.	√	X
All open stockpiles for aggregates of size in excess of 5 mm must be kept sufficiently wet by water spraying.	√	X
The stockpiles of aggregates 5 mm in size or less must be suitably covered to ensure that the same is not carried away (or whipped out) by the wind.	√	X
Wheel cleaning facilities should be provided for delivery trucks leaving the works for the removal of mud.	√	X
Trucks carrying crushed and screened products must have their loads covered with tarpaulin sheets before leaving the premises.	√	X
Wetting agents should preferably be added in the water used is the spraying systems so that water consumption is reduced.	√	X
The dust extraction and collection system must be regularly inspected and maintained in good condition and shall be used as required.	√	X

SITING CRITERIA

The minimum aerial distance of the land on which stone crusher is established from various places as mentioned in the guideline are provided as under:

- Abadi area of any revenue village, 1.5 km;
- State or national highway,100 m;
- Other road, 50 m;
- National park or sanctuary, 500 m;
- Reserve protected forest, 100 m;
- Prominent public sensitive place, 500 m place of worship, school, hospital, community park, notified archaeological monument; and
- Waterbody located downstream, 1,500 m.

The above siting criteria was not applicable for the stone crushers established (with valid consent) prior to issuance of these guidelines.

Pollution Control Board (SPCB) for the siting clearance; this power has now been transferred to the Revenue Department. The Revenue Department gives siting clearance for establishing the crusher; on the basis of this the SPCB grants consent for the crusher. How the Revenue Department will consider environmental factors while granting NOC for site is a point to be deliberated on.

The 2011 guidelines seem to have been developed after rigorous thinking and with the actual objective of controlling pollution. The current guidelines, in contrast, seem to have been developed to ease the operation of crusher units rather than combating pollution.

E-RAWAANA SYSTEM TO CURB ILLEGAL MINING

The states of Haryana and Rajasthan have initiated a system of e-transit pass (e-Rawaana) to monitor the movement of raw material from mining sites and products from stone crushers and screening plants. The system is developed to help regulators in controlling illegal mining as well as overloading.

Previously, mining lease-holders, screening plant owners and stone-crusher owners needed to issue manual bills to their buyers for transporting material or processed mineral. This is now replaced by electronically generated e-transit passes.

In this system, mining leaseholders, screening-plant owners and stone-crusher licensees of the state are required to be registered on the Mines and Geology Department portal. Only persons and firms registered on the portal will get permission to generate and issue electronically generated e-transit passes to their buyers. Similarly, all vehicle owners intending to transport any mineral are also required to register their vehicles on the department portal. Vehicle owners who are not registered at the portal and are found transporting minerals without e-Rawaana will be considered illegal.

Previously, mining leaseholders issued one-time royalty slips to vehicles transporting mining material and products. But transporters allegedly misused the slip by using it multiple times. After implementation of the e-Rawaana system, vehicles will be allowed to transport minerals or products only once on one pass as loading and unloading details can easily be verified. It is claimed that after the implementation of e-Rawaana, if the Mining Department carries out stock verification on screening plants and stone crushers regularly, the quantity of total raw material can be assessed correctly and illegal mining can be stopped.

4. Survey card

Implementation of state guidelines

The CSE team visited several stone-crusher units in Faridabad, Gurugram, Nuh, Tijara and Alwar to determine the implementation of state-specific guidelines for stone crushers. The survey was also intended to understand the effectiveness of these guidelines in controlling fugitive dust emissions from stone-crusher units. Although the sample size of the survey is small as several plants denied entry to their premises, it is sufficient to present an insight about the current implementation status, feasibility of measures directed in the guidelines and additional practices that can be incorporated. The selection of stone crushers in different district was random and some were arranged by the respective State Pollution Control Boards.

According to the 2016 notification of the Haryana government, Mohabtabad in Village Pali in Faridabad, Raisina in Gurugram and Indri Rewasan in Nuh are the notified stone-crusher zones. The first attempt to visit Nuh was incomplete as due to poor road conditions, the units were not approachable. The area was visited a second time for the survey, during which the units were not operational due to the implementation of GRAP in Delhi-NCR. In total, 12 stone crushers were surveyed in Haryana, four from Faridabad, two from Gurugram and six from Nuh (see *Table 1: Compliance of state guidelines by stone crusher units in Haryana*).

Table 1: Compliance of state guidelines by stone-crusher units in Haryana

Points under guidelines	Faridabad (Pali)				Gurugram (Raisina)		Nuh (Indri Rewasan					
Unit number	1	2	3	4	5	6	7	8	9	10	11	12
Dust containment-cum-suppressing system for equipment in the form of covered sheds	Fully covered	Partially covered*	Fully covered	Fully covered sheds with provision of gates for movement	Partially covered		No sheds		Partially covered			Partially covered
Dust containment-cum-suppressing system for equipment in the form of sprinklers	Sprinklers installed at various points; they were not, however, operational at time of visit											

Table 1: Compliance of state guidelines by stone-crusher units in Haryana

Points under guidelines	Faridabad (Pali)				Gurugram (Raisina)		Nuh (Indri Rewasan					
Unit number	1	2	3	4	5	6	7	8	9	10	11	12
Construction of wind-breaking wall at least 50 metre long and 16 feet high	Wind-breaking wall present; height not as per guidelines			Wall provided as per the guidelines	Not available	Wind-breaking wall present; not as per the guidelines	No wind-breaking wall					
Provision of telescopic chute to ensure crushed material from the nod is released from a point	No chute provided	The unit was producing only dust and has provided chute for it.		Has provided chute for all products	Chute provided only for dust; not for other products		No chute provided				Chute provided only for dust; not for other products	No chute provided
The release point of chute should be at least 2 feet below the height of wind-breaking wall.	No chute; height of wind breaking wall not adequate	Chute present as required			No wind-breaking wall	Chute release point above wind breaking wall	No wind-breaking wall					
Construction and maintenance of metalled roads within the premises of the crushing units	Not present			Well-laid ground surface, but covered with dust	Not present							
Construction and maintenance of metalled roads within the zone housing the stone crushing units	Poor road conditions				Abject road condition							
Regular cleaning and wetting of ground within premises	Not observed during visit											Wetting of ground observed during visit
Green belt along the periphery	Not on all sides		Present	Not on all sides	Present	Not on all sides	No green belt					
Barricade or boundary wall along the periphery until green belt is fully developed	Boundary wall on all sides						No boundary wall		Boundary wall on three sides			
The height of the barricade shall not be less than the height of the highest tip of the conveyor belts	Wall height not as per the guidelines						No boundary wall	Wall height not as per guidelines				

Partially covered: The shed is not covered from all sides, is not provided for all equipment or is damaged at various places;
Fully covered: The shed is covered from all sides and is provided for all equipment

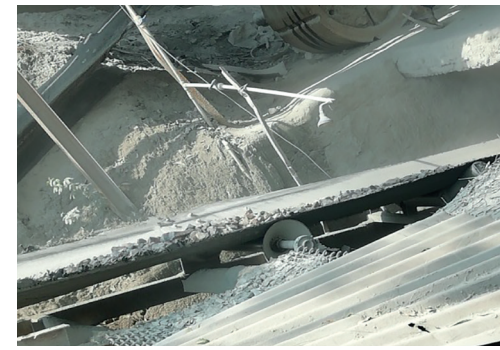
Full compliance | Partial compliance | Non-compliance

Analysis of Table 1 highlights the following:

Inappropriate sheds: Sheds are one of the most important requirements in a stone crusher for dust containment to ensure the emissions do not leave their source of generation. They can be seen as the first line of defense against dust movement. However, out of all the units surveyed in Haryana, more than half have poor condition of sheds. The sheds were either damaged from various places or covered from three sides, leaving one side completely open (see *Photograph 16*). The sheds do not serve any purpose and seem to be installed only to convey compliance of the guidelines. The condition of sheds at stone crushers in Faridabad were better than those in Gurugram and Nuh.

Photographs 16: Partially covered or damaged sheds for dust containment

Non-use of water sprinklers: Another important aspect is water sprinklers. All the units surveyed had sprinklers installed and thus seem to be complying with the guidelines. Operation of these sprinklers, however, was the biggest concern during the visits. Most of the units surveyed were operating the plant without using the installed sprinklers despite visibly high fugitive emissions (see *Photograph 17*). Going by the amount of dust near the sprinkler in the photograph, it seems that the sprinklers had not operated in a long time. Although the guidelines specify the number of sprinklers to be installed by the stone crusher as 50, the



Photograph 17: Non-operational sprinklers

survey clarifies that it is not the number but the operation of water sprinklers that needs to be ensured.

Inadequate wind-breaking wall and chute: The purpose of the chute is to reduce dispersion of the crushed product while releasing it from the discharge point and allowing linear fall. The purpose of the wind-breaking wall is to prevent dispersion of stored product during high winds. These two aspects together, when provided as per the guidelines, can be beneficial in controlling the dust emissions. However, the implementation of this combined aspect is poor in all units except in one which has provided the wind-breaking wall and chute as per the guidelines. With regard to provision of wind-breaking wall, out of 12 surveyed units in Haryana, only five units have a wind-breaking wall; the height of the wall, however, was not adequate as per the guidelines.

Inadequate height of wind-breaking wall

A similar scenario was observed with regard to provision of a chute for discharge of the final product. Fifty per cent of the units had not provided a chute. Three units that were producing different products had provided a chute only for dust (see *Photograph 18*). Even though the other products were not as fine as dust, they generate substantial amounts of dust when they fall from a height. Only one unit out of twelve was found with provision for a chute for all products. Additionally,

Inadequate boundary wall height

Chute provided only for dust

Photograph 18: Inadequate wind-breaking wall, chute and boundary wall

the release point of the chute is required to be two feet below the wind-breaking wall as per the guidelines; this was followed by only three units. In the other units, either there was no wind-breaking wall or the release point of the chute was above the wind-breaking wall. In both case, the purpose was not fulfilled.

Stone crushers, as per the guidelines, are also required to provide a boundary wall whose height should not be less than the highest tip of the conveyor belt. However, the surveyor observed that no unit met this criterion. Even in units which have boundary walls, the height is not as per the guidelines.

Poor road infrastructure: The road infrastructure plays an important role in curbing fugitive dust emissions. Dust emissions from unpaved roads are significant in comparison to dust emissions from good metalled road. According to the guidelines, road infrastructure is required both within the premises of stone crusher units as well as within zones where the crushers are installed. Except at one unit, road infrastructure within the premises was not observed in any units. The road in the one unit also was covered with dust which highlights the magnitude of fugitive dust emissions generated in a stone crusher.

With regard to road infrastructure within the crusher zone, the condition in Pali was questionable and worse in Raisina and Indri Rewasan. The latter two did not have any road infrastructure due to which huge quantities of dust could be seen on the road during movement of vehicles (see *Photograph 19*). This is in spite of the state guidelines providing for cancelling operation of stone crushers by the Haryana State Pollution Control Board (HSPCB) subject to unsatisfactory construction and maintenance of metalled roads within the premises or crusher zone. The ground implementation of the clause doesn't seem to in practice.

Condition of road in Indri Rewasan Stone Crusher Zone, Nuh

Road emissions in Raisina Stone Crusher Zone, Gurugram

Roads in Mohabtabad Crusher Zone, Pali

Photograph 19: Poor road infrastructure in different zones of Haryana

In the case of Rajasthan, the state does not have any notified crusher zones or siting guidelines, which means crushers can be located anywhere in the state. The survey was conducted in the Manki area of Alwar, the biggest hub of stone-crusher units. Also visited were stone crushers at Kishangarhbas, Hasanpur Mafi, Neemli and few crushers located in mining lease in Ulaheri village of Alwar. In total, twelve units were surveyed in two districts of Rajasthan (see *Table 2: Compliance of state guidelines by stone crusher units in Rajasthan*).

As discussed in Chapter 3, the guidelines for Rajasthan are lenient and do not demand strict measures for controlling fugitive emissions from stone-crusher units. Close analysis of Table 2 shows, further, complete failure by stone-crusher units in implementing these minimal guidelines.

Inefficient dust containment-cum-suppression system: The units, as in Haryana, have provided partially covered sheds for equipment. The sheds were completely futile—during the survey huge amounts of fugitive emissions were seen to be emanating from the sheds. Out of all the units visited, only one unit had fully covered sheds for all the processes along with the provision of doors for

Table 2: Compliance of state guidelines by stone crusher units in Rajasthan

Points under guidelines	Bhiwadi			Alwar								
	Hasanpur Mafi		Neemli	Manki			Kishangarhbas		Ulaheri			
Unit number	Uniwt 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
Dust containment-cum-suppression system for equipment	Partially covered						Fully covered sheds with gates for movement	Partially covered				
Crusher area shall be clearly demarcated by providing boundary walls at all sides	Presence of boundary wall								No boundary wall		No boundary wall	
Boundary wall should be at least up to the height of drop point of chute at conveyor to act as wind barrier	Height of boundary wall not as per guidelines						Boundary wall as per the guidelines	Height of boundary wall not as per guidelines				
If height of boundary wall not sufficient, construction of wind-breaking wall	Inadequate height of wind-breaking wall						No wind-breaking wall as height of boundary wall sufficient	Inadequate height of wind- breaking wall	No wind-breaking-wall	Inadequate height of wind-breaking wall		
Construction of metalled roads within the premises	No metalled roads											
Regular cleaning and wetting of the ground within the premises	Not observed during the visit											
Water sprinkler system shall be installed at all strategic locations	Sprinklers installed at various points; they were not operational at the time of visit											
33 per cent of the area should be green belt	There was a green belt, but it didn't seem to be 33 per cent		Random plantation	Random plantation	Sufficient green belt on the periphery of plant	Random plantation	There was a green belt but it didn't seems to be 33 per cent	Random plantation				

**Partially covered: The shed is not covered from all sides, is not provided for all equipment or is damaged at various places;*
Fully covered: The sheds is covered from all sides and provided for all equipment

Full compliance Partial compliance Non-compliance

the purpose of maintenance. The unit has even provided closed sheds for primary crushing (jaw crusher), a provision not observed in any unit surveyed in Haryana or Rajasthan. The remaining units either had not provided sheds on all sides or had damaged sheds (see *Photograph 20*). An additional practice of covering conveyor belts with thick cloth or a sheet was observed during the visit only at crushers in Manki area.

Partially covered sheds

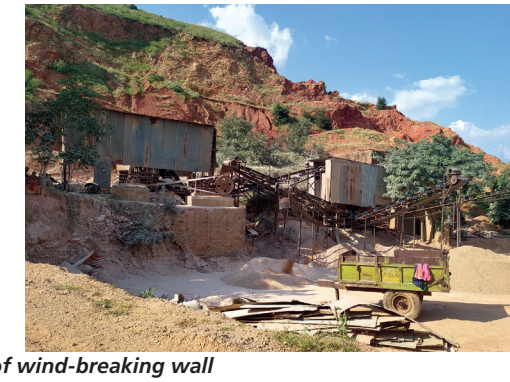
Conveyor belt covered with thick cloth

Working but inefficient water sprinkler

Photograph 20: Provisions for dust containment

The suppression system with regard to water sprinkling was as inoperative as in Haryana. Sprinklers installed at various locations were not in operation during the visit. One of the plants operated the sprinkler for the surveyor's observation, but the quantity of spray was found to be insufficient to suppress dust.

Inadequate boundary wall: The guidelines state that if the units provide a boundary wall as high as the drop point of the chute, they are not required to construct separate wind-breaking walls. With respect to implementation of this criterion, most of the units had a boundary wall but the height was less than stipulated by the guidelines. These units had a wind-breaking wall but they seem to be built only as separators between the product (see *Photograph 21*).



Inadequate height of wind-breaking wall

Inadequate height of boundary wall at stone-crushing units

Photograph 21: Inadequate height of walls

The overall observation from the units in Rajasthan was that the boundary wall served the purpose of site demarcation and wind-breaking walls as separators for products. The walls seem to have been built only to show implementation of the guidelines. In the absence of proper inspection, measures implemented by crusher owners will not help control the dust emissions.

Green belt: The guidelines mandate that 33 per cent of the land of crusher units be developed into green belts. Although it was difficult to ascertain the percentage of green cover in the crusher units during the visits, most of the units did not seem to have a one-third of the area of their plots under green cover. Only one unit out of 12 units surveyed in Rajasthan had adequate plantation. Three others units seemed to have good plantation but less than one-third of the plant area. Some of the crusher owners said that their sites were not suitable for plantation and thus they were not able to provide the green cover. The guidelines specify that in such a scenario the crusher owner has to provide a green belt in land other than their own land. A green belt serves as a natural barrier to dust; what purpose trees planted at another site will serve is unclear.

BLATANT VIOLATION BY STONE CRUSHERS: AN EXPERIENCE DURING THE VISIT

The CSE team during their visit found a stone-crusher unit to be violating the environmental norms. The crusher, situated near the team's hotel, was operating at midnight. Heavy and loud noise of truck movement and boulder unloading was clearly heard at that time. The operation was clearly identified with loud noise of equipment accompanied by a thick plume of dust covering the nearby area. On enquiry, the hotel staff said that the crusher had been long creating a nuisance and was impacting them severely. The crusher would start its operation at approximately 5.30 a.m. and continue till late night.

Several complaints were sent to the Pollution Board but no action has been taken against the crusher so far. Crushers operating near habitation either need to do so professionally or they should be shifted to other locations.

Environmental infrastructure at stone-crusher units

Despite the state guidelines being in place, serious issues associated with fugitive dust emissions were observed during the survey from the stone-crusher units. Since the guidelines are fairly general for the complete process, CSE has bifurcated the guidelines further for each step of the process to assess the compliance and evaluate the environmental performance of the crushers. The parameters decided for the assessment are based on observations during the survey. Each parameter is categorized as open (O), partially covered (PC) or fully covered (FC) and is assessed accordingly. The parameter for chute availability, however, is assessed if a chute is provided for all products, a few products, or is completely missing. The effectiveness of these parameters is eventually estimated in terms of fugitive emissions observed during the survey (see *Table 3: Environmental management practices for the process*).

Table 3: Environmental management practices for the process

State	District	Area	Unit	Unloading of raw material (O/PC/FC)	Primary crushing (O/FC/PC)	Secondary crushing (O/FC/PC)	Screening (O/FC/PC)	Tertiary crushing (O/FC/PC)	Chute for all final products (Yes/No/P)	Storage of final product (O/FC/PC)	Conveyor belts (O/FC/PC)	Water sprinkling (yes/no)	Observation in terms of fugitive emissions
Haryana	Faridabad	Pali	Unit 1	O	O	FC	FC	FC	No	O	O	No	
			Unit 2	O	O	PC	PC	PC	Yes	O	O	No	
			Unit 3	O	O	FC	FC	FC	Yes	O	O	No	
			Unit 4	O	O	FC	FC	FC	Yes	O	O	No	
	Gurugram	Raisina	Unit 5	O	O	PC	PC	PC	P	O	O	No	
			Unit 6	O	O	PC	PC	PC	P	O	O	No	
	Nuh	Indri Rewasan	Unit 7	O	O	O	O	O	No	O	O	No	Cannot be assessed as the plants were not operational during the visit
			Unit 8	O	O	O	O	O	No	O	O	No	
			Unit 9	O	O	O	PC	NA	No	O	O	No	
			Unit 10	O	O	O	PC	O	No	O	O	No	
			Unit 11	O	O	PC	PC	PC	P	O	O	No	
			Unit 12	O	O	PC	PC	NA	No	O	O	Yes	
	Bhiwadi	Hasanpur Mafi	Unit 1	O	O	PC	PC	PC	P	O	O	No	
			Unit 2	O	O	PC	PC	PC	No	O	O	No	
		Neemli	Unit 3	O	PC	PC	PC	PC	P	O	O	No	
Rajasthan	Alwar	Manki	Unit 4	O	PC	PC	PC	PC	Yes	O	PC	No	
			Unit 5	O	PC	PC	PC	PC	Yes	O	FC	No	
			Unit 6	O	PC	PC	PC	PC	Yes	O	FC	No	
		Kishangarhbas	Unit 7	O	FC	FC	FC	FC	Yes	O	FC	No	
			Unit 8	O	O	O	PC	PC	P	O	O	No	
		Ulaheri	Unit 9	O	PC	PC	PC	PC	N	O	O	No	
			Unit 10	O	PC	PC	PC	PC	N	O	O	No	
			Unit 11	O	PC	PC	PC	PC	N	O	O	No	
			Unit 12	O	PC	PC	PC	PC	N	O	O	No	

O: Open; PC: Partially covered; FC: Fully covered

High emissions Medium emissions

The survey found that 66 per cent of the units had high fugitive emissions, and the remaining units had medium emissions. No unit was found with low degree of emissions.

The reasons for high fugitive emissions were assessed as follows:

- **Open unloading:** As apparent from Table 3, unloading points at all the crushers are open. This is the point where big boulders along with loose soil fall from the dumpers into the hopper of primary crusher and generate huge amounts of fugitive emissions. Water sprinklers have been installed at some of the units as a measure to reduce the dust emissions at these points; however, since they were not operational, it was futile. No provision of any shed or covering was observed at any of the units. Since huge amounts of dust are generated during this process, it is important to provide a dust-containment system at this point also. The system can be provided with some flexible opening mechanism to ease the unloading process.

- **Uncovered conveyor belts:** Conveyor belts are very significant part of the stone-crusher process as these belts carry the raw material and crushed

products from one part of machinery to another and thus are a definite source of dust generation. However, they have been completely ignored both by crusher owners and regulators since all units except three have open conveyor belts. The practice of covering belts was observed only in units in Manki, in Alwar district. The conveyor belt can be left open if it is placed within a completely enclosed structure; if, however, a separate dust-containment system is provided for different equipment, the conveyors needs to be fully covered. Additionally, the openings of any enclosed structure for the passage of conveyors should be provided with flexible seals.

- **Open storage of products:** Another important aspect is open storage of the final product. None of the units has a facility for closed storage of the final products. Even units that have covered facilities for all other steps have stored their products in the open. As a result these units fall under the category of medium emissions even though they have good infrastructure for other equipment. The reason is simple. During the survey, huge amounts of fugitive emissions were observed from products, especially from stored dust, with slight vehicular movement or wind. The state guidelines, both in Haryana and Rajasthan, do not have any provision for covering of stored products. They only require providing a chute for release of the final product. However, it was assessed that even dust falling from chutes has high fugitive emissions (see *Photograph 22*), and thus closed storage should be provided to minimize impact.

Emissions from crushed stone

Emissions from chute

Photograph 22: Emissions during product discharge

- **Non-performing water sprinklers:** The most popular method for controlling dust emissions is water sprinkling. Combating dust emissions involves two steps: dust containment and wet suppression. While covered sheds fulfill the first step, the second step is performed by sprinkling water on the contained dust to suppress at the emissions at the source.

  Appropriate location of water sprinklers and right timing of its operation can help in decreasing fugitive emission in stone-crusher units. However, while the units have water sprinklers installed at various locations, their operation was hardly observed during the survey (see *Tables 1 and 2*).

  On enquiry about the reason for this, owners and workers claimed that excess water usage resulted in jamming of conveyor bearings and other parts, thus necessitating frequent maintenance. Another reason cited was the impact on the product quality. The addition of water results in dust lingering to stone or grit which decreases the market price. Similarly, wet dust is considered of inferior quality and has less demand. For these reasons, crusher units avoid using water sprinklers and thus the dust generated is not suppressed and becomes airborne. Since the system of wet suppression increases maintenance cost and is likely to reduce the product cost, it is very hard to get it implemented.

- **Inefficient dust-containment system:** As discussed in previous section, implementation of the dust-containment system is very poor in both states. Table 3 shows that many of the units providing partially covered sheds fall in the high emissions category. The reason lies in the definition of partially covered sheds. Any shed that is not completely covered from all four sides and from the roof or is damaged from anywhere is considered partially covered by the surveyor.

  The basis for this is clear; any opening in the shed will lead to release of dust emissions into the environment and thus become akin to an open system. Thus only three units out of 24 units surveyed, which provide fully covered sheds, are categorized under medium emissions. Photograph 23 shows instances of emission from partially covered sheds during the survey—their effectiveness in dust containment can easily be gauged.


Photograph 23: Dust emissions from partially covered sheds

Environmental performance rating of stone crushers

Tables 1, 2 and 3 present a qualitative description of how stone crushers performed with regard to implementation of the guidelines and environment infrastructure to control fugitive dust emissions. To give it a quantitative score, a rating has been performed to evaluate the environmental performance of each stone crusher on various parameters such as environmental guidelines prescribed by respective State Pollution Control Boards (SPCBs) and basic infrastructure to control fugitive dust emission. The ranking has been done separately for stone crushers in the state of Haryana and Rajasthan as measures to be undertaken by these units vary significantly in both states under state-specific guidelines (see *Table 4: Performance rating of stone crushers and Annexure 1 for a detailed rating sheet*).

Table 4: Performance rating of stone crushers

Rank	Crushers in Haryana	Score (%)	Rank	Crushers in Rajasthan	Score (%)
1	Unit 4, Pali	43	1	Unit 7, Kishangarbhas	58
2	Unit 3, Pali	37	2	Unit 5, Manki	21
3	Unit 1, Pali	27	3	Unit 6, Manki	14
4	Unit 2, Pali	13	4	Unit 4, Manki	11
5	Unit 5, Gurugram	7	5	Unit 1, Hasanpur Mafi	7
5	Unit 12, Nuh	7	6	Unit 2, Hasanpur Mafi	4
6	Unit 6, Gurugram	0	6	Unit 3, Neemli	4
6	Unit 7, Nuh	0	6	Unit 8, Kishangarbhas	4
6	Unit 8, Nuh	0	7	Unit 9, Ulaheri	0
6	Unit 9, Nuh	0	7	Unit 10, Ulaheri	0
6	Unit 10, Nuh	0	7	Unit 11, Ulaheri	0
6	Unit 11, Nuh	0	7	Unit 12, Ulaheri	0

Table 4 clearly shows blatant violation of the state PCB guidelines with no consideration to basic environmental infrastructure for controlling fugitive dust. The environmental performance of stone-crushing units in the Pali area of Haryana is better than that of stone-crushing units surveyed in other parts of Haryana.

The highest score obtained by a stone-crushing unit in Haryana is 43 per cent, which is of a unit at Pali. The crusher had a boundary wall but not of adequate height as per the guidelines. However, the unit has a wind-breaking wall along with a chute at the appropriate height. The unit has well laid-out roads within the premises but it was laden with dust, showing poor housekeeping and inadequate water sprinkling. The unit has also provided fully covered sheds for secondary and tertiary crusher and at the screen. The sheds were provided with gates for movement and maintenance.

In Rajasthan, Unit 7 in Kishangarbhas scored 58 per cent and tops the chart among the surveyed stone crushers in the state. The reason for the high score is the provision of fully covered sheds for major steps such as primary, secondary and tertiary crushing and screening. The conveyor belts were fully covered and a chute was provided for all the products. The unit has also provided boundary walls of sufficient height on all four sides. Although the crusher has plantation, the surveyor felt that it does not meet the criteria of 33 per cent of the total area as mentioned in the RSPCB guidelines. The unit ranked 2 in Rajasthan, scored 21 per cent, 37 per cent less than the unit ranked 1. This clearly indicates poor implementation of the guidelines by other units.

The stone crushers in Nuh and Gurugram areas of Haryana and Hasanpur Mafi, Neemli and Ulaheri areas of Rajasthan performed poorly. Five out of six surveyed crushers in Nuh and all surveyed crushers in Ulaheri could not get any score on any parameter. The one crusher in the Nuh area, Unit 12, could score only because ground wetting was observed during the survey. The condition of roads in Nuh, Gurugram and Ulaheri was questionable, with huge fugitive dust emissions due to vehicular movement.

The rating highlights that laxity in ground implementation is the cause of uncontrolled fugitive emissions from stone-crusher units. Stringent steps need to be taken both at the crusher level and the region and/or zone level to control fugitive dust from the sector.

5. Conclusion and recommendations

The survey clearly highlights that stone crushers operating with poor implementation of environmental guidelines cause high levels of fugitive emissions. But the degree of its impact on ambient air and inhabitants in the vicinity go unaccounted for. Since this industry does not have stack emissions, no air monitoring is required to be done by unit operators. Further, the Pollution Control Boards also do not perform air monitoring around such units frequently. The Central Pollution Control Board (CPCB) provides emission standards for suspended particulate matter; however, no monitoring data is available in the public domain to assess whether these industries are meeting the standards. Only a few independent studies have been conducted that account for impact of stone crushers on the ambient air.

CPCB EMISSION STANDARDS

For stone crushers, CPCB has standardized the concentration of suspended particulate matter (SPM) at a distance of 3–10 metre from an isolated as well as from a unit located in a cluster to 600 $\mu g/m^3$. Beyond this distance, the concentrations are compared with the ambient air standards as given in the table below.

Parameter	CPCB standard for ambient air
PM 10	100 $\mu g/m^3$
PM 2.5	60 $\mu g/m^3$
RSPM (old)	100 $\mu g/m^3$
TSPM (old)	200 $\mu g/m^3$

Before 2009, pollutants in ambient air were measured as total suspended particulate matter (TSPM) and respirable suspended particulate matter (RSPM). Thus some of the studies mentioned in the following section have considered these pollutants instead of PM10 and PM2.5 for assessment of ambient air.

Impact on ambient air

A 2007 report *Assessment of Dust Emissions from Stone Crushing Industry in Trisoolam Area, Tamil Nadu,* published by the National Environmental Engineering Research Institute (NEERI) for the Tamil Nadu Pollution Control Board, covered 10 crushing units for source sampling and seven locations for ambient air quality monitoring. The study area had a total of 72 crushing units operating at a capacity of 60 tonne per day. The study was conducted both while all crushers were operating and also when no crusher was operating to account for background emissions of total suspended particulate matter (TSPM) and respirable suspended particulate matter (RSPM). The results of the study are tabulated in *Table 5: Impact on ambient air—Summary of NEERI report.*

Table 5: Impact on ambient air—Summary of NEERI report

When all crushers operating			When no crushers operating		
Source monitoring parameter	**Concentration (µg/m^3)**	**Standard (µg/m^3)**	**Source monitoring parameter**	**Concentration (µg/m^3)**	**Standard (µg/m^3)**
TSPM	1,268–4,108	600	TSPM	509–1266	600
RSPM	274–654	100	RSPM	-	100
Ambient air monitoring parameters			**Ambient air monitoring parameters**		
TSPM	64–417	200	TSPM	44–106	200
RSPM	274–654	100	RSPM	73	100

The table clearly highlights that during the operation of all crushers, both TSPM and RSPM average concentrations greatly exceeded the standards in the source monitoring results, while in ambient air RSPM exceeded standards at all places and TSPM at a few locations.

During no crushing activity, in contrast, both TSPM and RSPM values in the ambient air were found well within the limits. The TSPM concentration at source, however, exceeded the standard at a few locations. The comparison highlights the contribution of crushers in the ambient air pollution—six times for RSPM and double for TSPM.

An independent study[8] conducted in Bundelkhand region of Jhansi in UP selected one stone crusher and monitored ambient air pollution both inside the crusher and at an adjoining village for one year to understand the impact on the area. The results showed that the concentration for SPM levels were 1,648–3,758 µg/m^3. As is evident,

the values exceed the standard of 600 μg/m^3 (SPM) irrespective of the season. The ambient air results from the nearby village also found to exceed the standards, with RSPM levels 140–341 μg/m^3 and TSPM levels 300–553 μg/m^3. The lowest value for pollutants in ambient air was observed in the monsoon season, but they still exceeded the standard limit of 200 μg/m^3 for TSPM and 100 μg/m^3 for RSPM.

The National Council for Cement and Building Materials (NCCBM) also conducted a study[9] to evaluate the impact of stone crushers on ambient air. The study covered four zones of India—Tamil Nadu, Goa, Haryana and Jharkhand—and assessed three crushers in each zone. To understand the difference in impact on ambient air, if any, it studied isolated units in Tamil Nadu and Goa and stone-crusher clusters in Haryana and Jharkhand (see *Table 6: NCCBM's study findings*).

Table 6: NCCBM's study findings

Location of unit	Measures	SPM, μg/m^3				PM2.5, μg/m^3 (ambient)				PM10, μg/m^3 (ambient)			
		Min	Max	Avg	Std	Min	Max	Avg	Std	Min	Max	Avg	Std
Isolated	With dust-control measures	121	893	507	600	19	58	38	60	40	137	89	100
	With partial dust-control measures	200	2136	1,168		55	129	92		81	410	246	
Cluster	With partial dust-control measures	1,041	9,956	5,500		164	649	407		329	2,431	1,380	

The average SPM concentration was found to be way beyond the standards, irrespective of isolated or clustered units. The same scenario was observed for ambient air parameters, where the average concentration of PM10 and PM2.5 exceeded the limits in case of partial dust-control measures. In contrast, the average values of all parameters were found to be within limits while using dust-control measures, which clearly shows the significance of using adequate control measures in this industry. The maximum value for SPM and PM10 exceeding the limits, however, questions the adequacy of the measures being used.

The Maharashtra Pollution Control Board (MPCB) along with CPCB conducted an assessment study[10] in compliance with the NGT order dated September 26, 2016 in Wagholi, Bhavadi, Lonikand and Perne near Pune, with 56 stone crushers. To draw an inference with respect to the cumulative impact of the crushers, 24-hourly monitoring was performed on stone-crushing activity in the area on both working days and non-working days.

All 56 stone crushers monitored during the study were found to be non-complying with the notified emission standard of 600 µg/m^3. The monitored concentration of SPM varied from 770 (minimum) to 56,617 (maximum) µg/m^3. The effect of these high emissions was also observed in the ambient air quality results. Concentrations of PM10 and PM2.5 were found to be exceeding the 24-hourly standard limit at all five locations in both the rounds of monitoring (see *Table 7: MPCB assessment study results*). Even during the non-working day, when crushers were not operational and only material was transported by trucks, the ambient air quality remained poor. This clearly shows that the contribution of pollution to ambient air is not temporary but has long-lasting impacts.

Table 7: MPCB assessment study results

Location	Working day		Non-working day	
	PM 10 (µg/m^3)	PM 2.5 (µg/m^3)	PM 10 (µg/m^3)	PM 2.5 (µg/m^3)
Location 1	227	65	178	131
Location 2	225	212	324	77
Location 3	213	403	153	126
Location 4	136	133	115	108
Location 5	220	112	222	74
Standard (µg/m^3)	100	60	100	60

What needs to be done to reduce dust emissions from stone crushers?

The aforementioned case studies show the impact of stone crushers on the ambient air quality of an area. With such high impacts, this industry cannot be allowed to operate in the current fashion under the pretext of being a small-scale sector. In order to operate in an environmentally sustainable manner, this sector requires stringent guidelines along with strict on-ground implementation. This should be accompanied by regular monitoring of the crushers and nearby areas by the State Pollution Boards. These together will help in operation of this industry in harmony with the environment and allow its growth. Thus, with the objective of improving environmental practices in the stone-crushing industry, CSE recommends the following:

1. **Shift from wet suppression to dry extraction system for dust control:** Without good environmental management practices in place, this industry will not be sustainable. The guidelines provide a few measures but they are

insufficient and ineffective; additional measures are required to combat pollution. One of the measures is to shift from wet suppression to dry extraction system for dust control. The current practice for controlling dust as recommended in the guidelines is containment through sheds and suppression through water sprinkling. However, as discussed, implementation of the water-sprinkling system is very poor in these units. The explanation for the non-implementation is also legitimate as it deteriorates the quality of the final product and also causes jamming of machine parts, thereby necessitating frequent maintenance. Thus, an alternative is the use of dry extraction system as practised in the mineral-grinding sector.

This system will require hooding arrangements for extraction of dust, arrangement of cyclone or settling chamber to collect the coarser portion of the dust and a bag-filter house to capture the finer portions of emissions not captured by the cyclone or settling chamber. All the enclosed structures (primary, secondary, tertiary crushers, screen and discharge points) should be provided with hooding arrangements and the dust will be extracted via duct network. This system will also present the possibility of using collected dust, which otherwise would have lost. The Rajasthan State Pollution Control Board (RSPCB) in its 2011 guidelines mandates the provision of dust extraction system, but it has been dropped from the current guidelines. In order to make this sector work in an environmentally sustainable manner, it is time to switch to dry extraction system and the same should be incorporated in the guidelines.

2. **Proper infrastructure to arrest fugitive dust:** Storage of the final product is not discussed in the guidelines. No provision for storage of final product was observed during the survey at the site. As discussed in Chapter 4, only provision of a chute is not sufficient to prevent emissions during discharge of the final product. It should be accompanied with a closed storage yard to contain emissions generated. Provision of closed storage for final product, especially dust, should be mandated in the guidelines. Storage yards should be covered from all sides, along with a flexible opening on one side for movement of trucks. An opening for the chute should be provided on the roof. The option of storing dust in silos rather than in the open should also be explored.

   It is prudent to mention here that the cost involved for the provision of environmental management practices is meagre as compared to the overall cost of setting up a stone-crusher unit (see *Table 8: Cost comparison of stone crusher plant and environmental provisions*).

Table 8: Cost comparison of stone crusher plant and environmental provisions

Cost of machinery in stone crusher unit (100 TPH)			
With conventional technology (Rs)		**With engineered technology (Rs)**	
Primary crushing (jaw crusher of 36 x 44 feet)	20 lakh	Primary crusher (jaw of 36 x 44 feet)	20 lakh
Screen (20 x 6 feet)	15 lakh	Screen (20 x 6 feet)	15 lakh
Secondary crushing (granulator of 12 x 48 feet)	20 lakh	Cone crusher (100 TPH)	1 crore
Tertiary crushing (roller crusher: 30 x 48 feet)	30 lakh	Tertiary crusher (roller: 30 x 48 feet)	30 lakh
Total	**85 lakh**	**Total**	**1.75 crore**
Cost of environmental management provisions (Rs)			
Water sprinklers		2 lakh	
Dry extraction system (100 TPH stone crusher capacity)		20 lakh	
Sheds • Cost of shed = Rs 150–200/sq. ft • Area of stone crusher = 1 acre (minimum area required by stone crusher as mandated by government) • Considering, 40 per cent area used under process		17,424 sq. ft x 150 = 26 lakh	
Total		**48 lakh**	

Source: In consultation with various sector experts

Table 8 shows the price of machinery as approximately Rs 85 lakh if the unit is set in the conventional manner whereas the cost is up to Rs 2 crore for an engineered setup. The crusher setup also involves cost of conveyor belts, motors and other auxiliary parts, which are not included in the table. The current environmental management practice, which involves water sprinklers, costs approximately Rs 2 lakh. Although the cost of the shed varies depending upon the area of the unit, an approximate cost is calculated after consultation with various experts and is considered as Rs 150–200 per sq. ft. Accordingly, the cost of the shed as calculated works out to Rs 26 lakh. The proposed dry extraction system will cost an additional amount of Rs 20 lakh, taking the total cost of environmental management to approximately Rs 50 lakh. The cost does not seem to be high for a unit that is investing more than Rs 1 crore in setting up the plant. Hence, non-compliance of environmental practices on the pretext of high costs is clearly unjustified. Additionally, it is time to decide the functioning of these units in a sustainable manner and on the number of units allowed to operate without compromising the carrying capacity of the ambient air in a particular area.

3. **Declaration of crusher zones and relocating all units to these zones:** Stone crushing is a dusty operation and operation of stone crushers near habitation or educational and/or sensitive sites creates a nuisance for inhabitants in the vicinity, causing them to lodge complaints against the crushers. With the

rapid increase in population and habitation spreading in all directions of the states, operation of stone crushers near newly developed habitation become troublesome and the crusher may be asked to close down its operation. To address this situation, the states should identify specific zones for crushers and no individual or standalone crushers should be permitted outside these zones. This should be made applicable for both new and existing crushers while providing a specific timeframe for existing crushers to shift to permitted zones. Operation of crushers in specific notified zones will also help Pollution Boards in better monitoring of compliance and ensuring implementation of environmental practices by these units.

4. **Installation of ambient air monitoring stations near crusher zones:** Shifting crushers to zones does not mean unguided and unmonitored operation of the crushers. The units should follow strict environmental management practices and regular monitoring must be carried out to assess their performance in terms of air pollution. For this, continuous ambient air monitoring station should be installed at crusher zones to keep track of the air quality in the zones. Additionally, source emission monitoring should be carried out periodically at the crushers to identify polluting or non-complying units.

5. **Provision for noise management:** The guidelines have mandated various provisions for controlling air emission during the crushing process. However, even though unloading of heavy boulders into hoppers is noisy, noise management has not been discussed anywhere in the guidelines. It becomes disturbing for inhabitants, especially in the early morning and night, when crushers are operating near habitation. The solution to this issue also emphasizes on shifting of crushers to dedicated zones and as long as the crushers are not shifted to these crusher zones, strict timings should be mentioned for their operation, with complete restrictions on night operations.

6. **Strengthening of state guidelines:** The guidelines for Haryana and Rajasthan are general and provide only broad measures to control dust emissions, resulting in poor environmental performance of the crushers. To improve the performance of this sector, the guidelines needs to be process-specific, with control measures for each step clearly mentioned, starting from unloading of raw material to storage of final product. For example, the guidelines states provision of a dust-containment system but have not clarified the technicalities of this system. The guidelines should clearly state that all the steps (primary crushing, secondary crushing and screening) should be carried out within sheds that are fully covered on all sides and the roof. The height of the shed should

be from the platform of the machine to its highest point. The crushers can either provide one shed for the whole unit or separate sheds for each step. The openings, provided for any movement, in both cases should have flexible covers. In the case of separate sheds, conveyors belts should be fully covered with thick cloth or sheet. The openings for conveyor belts in sheds should also be provided with flexible sheets. As sheds are the first line of defense for dust emissions, strengthening this step will help minimize emissions significantly. The guidelines for both Haryana and Rajasthan do not address unloading operations. Provisions should be made to ensure no dust emission during unloading.

7. **Public access to e-Rawaana to stop illegal stone mining:** Both Haryana and Rajasthan have initiated an online e-Rawaana system. The system is claimed to be incorporated to stop illegal mining of stone in both states. The destruction of the Aravallis and other hills in both states, however, clearly indicate continued illegal mining in the states. Further, it highlights the failure of regulators in preventing illegal mining. In order to make this online system effective, the general public should be involved in the system. Provision should be made by which the public can enter a truck/dumper number carrying raw material in the e-Rawaana system and get details of its source and/or destination. Absence of details of the truck on the system implies illegal transport of raw material. Provision should be made to lodge an immediate complaint on the portal itself. Illegal mining is not only destroying the environment but is also allowing illegal crushers to flourish. Putting an end to this will save the environment and regulate illegal crushers.

8. **Display of consent information on gate:** The guidelines for Rajasthan mandate that crushers provide a signboard displaying the name, address and capacity of the crusher. The Haryana government has, however, omitted to take this point into account; it does not require any such information from the crushers. It is vital to have these details of crushers displayed on the board in order to identify illegal crushers. The board should also display consent information to show whether the crusher is operating with valid consent.

9. **Exposure visits and training programmes for stone-crusher owners:** Regular training programmes and exposure visits for owners and employees of stone crushers should be conducted. Exposure visits to showcase best practices in the sector will enhance the understanding of crusher owners on feasibility and profitability by installing good practices at the units. These visits accompanied by training programmes will help in knowledge-building of unit owners and workers.

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Annexure: Rating criteria for stone crushers

Table 1: Environmental performance rating for stone crushers—Haryana

S. no.	Parameter	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
A.	State guideline												
1	**Water sprinkler**	ww											
1.1	Present (1) Absent (0)	1	1	1	1	1	1	1	1	1	1	1	1
1.2	Operational (1) Non-operational (0)	0	0	0	0	0	0	0	0	0	0	0	0
	Score (1.1 x 1.2)	0	0	0	0	0	0	0	0	0	0	0	0
2	**Construction of wind-breaking wall at least 50-metre long and 16 feet high** *Present (1)* *Absent (0)*	0	0	0	1	0	0	0	0	0	0	0	0
3.1	**Provision of telescopic chute to ensure crushed material from the nod is released from a point** *Present for all products (1)* *Present for a few products (0.5) Absent (0)*	0	1	1	1	0.5	0.5	0	0	0	0	0.5	0
3.2	**The release point of chute should be at least 2 feet below the height of wind-breaking wall** *Present as per guidelines (1)* *Not as per guidelines (0)*	0	1	1	1	0	0	0	0	0	0	0	0
	Score (3.1 x 3.2)	0	1	1	1	0	0	0	0	0	0	0	0
4	**Construction and maintenance of metalled roads within the premises of the crushing units** *Present (1)* *Present but not maintained (0.5)* *Absent (0)*	0	0	0	0.5	0	0	0	0	0	0	0	0

5	**Construction and maintenance of metalled roads within the zone housing the stone crushing units** *Present (1)* *Present but not maintained (0.5)* *Absent (0)*	0.5	0.5	0.5	0.5	0	0	0	0	0	0	0	0
6	**Regular cleaning and wetting of the ground within the premises** *Present (1)* *Absent (0)*	0	0	0	0	0	0	0	0	0	0	0	1
7	**Green belt along the periphery** *Adequate (1)* *Partial (0.5)* *Absent (0)*	0.5	0.5	1	0.5	1	0.5	0	0	0	0	0	0
8.1	**Barricade/boundary wall along the periphery until green belt fully developed** *All sides (1)* *Three sides (0.75)* *Absent (0)*	1	1	1	1	1	1	0	0	0	0.75	0.75	0.75
8.2	**The height of the barricade shall not be less than the height of the highest tip of the conveyor belts** *Height as per guidelines (1)* *Not as per guidelines (0)*	0	0	0	0	0	0	0	0	0	0	0	0
	Score (8.1 x 8.2)	0	0	0	0	0	0	0	0	0	0	0	0
	Total score (A)	**1**	**2**	**2.5**	**3.5**	**1**	**0.5**	**0**	**0**	**0**	**0**	**0**	**1**
	Maximum score	8	8	8	8	8	8	8	8	8	8	8	8
	Percentage	13	25	31	44	13	6	0	0	0	0	0	13
B	**Environmental infrastructure**												
	Fully covered (1) *Partially or uncovered (0)*												
1	**Unloading of raw material**	0	0	0	0	0	0	0	0	0	0	0	0
2	**Primary crusher**	0	0	0	0	0	0	0	0	0	0	0	0
3	**Secondary crusher**	1	0	1	1	0	0	0	0	0	0	0	0
4	**Screening**	1	0	1	1	0	0	0	0	0	0	0	0
5	**Tertiary crusher**	1	0	1	1	0	0	0	0	NA*	0	0	NA
6	**Storage of final product**	0	0	0	0	0	0	0	0	0	0	0	0
7	**Conveyor belts**	0	0	0	0	0	0	0	0	0	0	0	0
	Total score (B)	**3**	**0**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Maximum score	7	7	7	7	7	7	7	7	6	7	7	6

	Percentage	43	0	43	43	0	0	0	0	0	0	0	0
	Overall score (A+B)	4	2	5.5	6.5	1	0.5	0	0	0	0	0	1
	Maximum score	15	15	15	15	15	15	15	15	14	15	15	14
	Percentage	**27**	**13**	**37**	**43**	**7**	**3**	**0**	**0**	**0**	**0**	**0**	**7**

NA: Unit does not have tertiary crusher

Table 2: Environmental performance rating for stone crushers—Rajasthan

S. no.	Parameter	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
A	State guideline												
1.1	**Crusher area shall be clearly demarcated by providing boundary walls at all sides** *Present (1)* *Absent (0)*	1	1	1	1	1	1	1	1	0	0	1	1
1.2	**Boundary wall should be at least as high as drop point of chute at conveyor to act as wind barrier** *Height as per guidelines (1)* *Height not as per guidelines (0)*	0	0	0	0	0	0	1	0	0	0	0	0
	Score (1.1 x 1.2)	0	0	0	0	0	0	1	0	0	0	0	0
2	**If height of boundary wall not sufficient, construction of wind-breaking wall** *Wind-breaking wall* *Present (1)* *Absent (0)*	0	0	0	0	0	0	NA*	0	0	0	0	0
3	**Construction of metalled roads within the premises** *Present (1)* *Absent (0)*	0	0	0	0	0	0	0	0	0	0	0	0
4	**Regular cleaning and wetting of the ground with in the premises** *Present (1)* *Absent (0)*	0	0	0	0	0	0	0	0	0	0	0	0
5.1	**Water sprinkler system shall be installed at all strategic locations** *Present (1)* *Absent (0)*	1	1	1	1	1	1	1	1	1	1	1	1
5.2	**Water sprinkler** *Operational (1)* *Non-operational (0)*	0	0	0	0	0	0	0	0	0	0	0	0
	Score (5.1 x 5.2)	0	0	0	0	0	0	0	0	0	0	0	0
6	**33 per cent of the area green belt** *Adequate (1)* *Partial (0.5)* *Absent (0)*	0.5	0.5	0	0	1	0	0.5	0	0	0	0	0

** NA (units has adequate boundary wall)*

	Total score (A)	**0.5**	**0.5**	**0**	**0**	**1**	**0**	**1.5**	**0**	**0**	**0**	**0**	**0**
	Maximum score	6	6	6	6	6	6	6	6	6	6	6	6
	Percentage	8	8	0	0	17	0	25	0	0	0	0	0
B	**Environmental protection infrastructure**												
	Fully covered (1)/partially or uncovered (0)												
1	**Unloading of raw material**	0	0	0	0	0	0	0	0	0	0	0	0
2	**Primary crusher**	0	0	0	0	0	0	1	0	0	0	0	0
3	**Secondary crusher**	0	0	0	0	0	0	1	0	0	0	0	0
4	**Screening**	0	0	0	0	0	0	1	0	0	0	0	0
5	**Tertiary crusher**	0	0	0	0	0	0	1	0	0	0	0	0
6	**Storage of final product**	0	0	0	0	0	0	0	0	0	0	0	0
7	**Conveyor belts**	0	0	0	0.5	1	1	1	0	0	0	0	0
8	**Availability of chute** *Present for all products (1)/ Present for a few products (0.5)/ Absent (0)*	0.5	0	0.5	1	1	1	1	0.5	0	0	0	0
	Total score (B)	**0.5**	**0**	**0.5**	**1.5**	**2**	**2**	**6**	**0.5**	**0**	**0**	**0**	**0**
	Maximum score	8	8	8	8	8	8	8	8	8	8	8	8
	Percentage	6	0	6	19	25	25	75	6	0	0	0	0
	Overall score (A+B)	**1**	**0.5**	**0.5**	**1.5**	**3**	**2**	**7.5**	**0.5**	**0**	**0**	**0**	**0**
	Maximum score	14	14	14	14	14	14	13	14	14	14	14	14
	Percentage	**7**	**4**	**4**	**11**	**21**	**14**	**58**	**4**	**0**	**0**	**0**	**0**

Although fugitive emissions contribute substantially to air pollution, they are overlooked in the preparation of measures to combat air pollution. A CSE study identified the stone-crushing sector as one with high potential for fugitive dust emissions. The sector is also infamous for flouting environmental norms by generating air pollution and degrading the environment. It has also been in the spotlight for illegal stone-mining from protected areas and has various cases filed against it at the National Green Tribunal (NGT) and the Supreme Court.

This study identifies current practices followed by the sector and evaluates on-ground implementation of sector-specific guidelines. Conducted in various regions of Rajasthan and Haryana, it found that both weak state guidelines and poor implementation have resulted in high levels of dust emissions during the operation of crushers. The report recommends various measures that need to be strictly implemented so that this sector can operate in an environmentally sustainable manner.

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