In Brief

Health Hazard due to dust pollution (especially of women workers) in Stone Quarries and Crushers

D K Das†

Preamble

It is a common belief that the dust emanating from the stone mining industry invariably leads to killer diseases and there is no escape for the workers from it. The main objective of this project is therefore to find out how much the dust affects the health of the workers particularly the women workers and what steps can be taken for amelioration and its prevention. The other objectives of the comprehensive study were designing mechanical dust suppression arrangement at the generation point and also designing cheap, simple, protective facemask as preventive measures which will be user-friendly and affordable to the small/medium stone miners. Generation of awareness amongst the mineworkers and mine owners against dust pollution was also the objective of the project.

Location

The project is located in Md. Bazar PS at a place known as Pachami-Hatgacha in the district of Birbhum in West Bengal. It lies in an area within Lat 24°3′N to 24°6′ N and long 87°34′ E to 87°36′ E. The project covers an area of about 10 sq.kms having 10 mouzas comprising of over 20 villages.

Physiography of the area

The area is an adulatory rocky terrain with scanty vegetation because of thin soil cover. It is a rain fed, midcrop, low yield agricultural zone and sustains a limited number of people. So the villagers were small and scattered with intervening agricultural lands. But presently it has become an epicenter of employment generation attracting thousands of people from outside and the villages have become juxtaposed as big agglomeration.

Geological setting of the area

The project area is predominantly composed of trap rock (basalt) of Rajmahal age overlying uncomfortably over the coal bearing Gondwanas as proved by drilling, both by the State Directorate and the Geological Survey of India and is overlain by clay bearing tertiary rocks capped with laterite and morum beds at many places. The alluvium cover is thicker in the east and south-eastern portion.

Recent	Alluvium
Tertiary	Fine grained sandstone and shales with morum and laterite capping and occasionally with thick band and lenses of Fire clay and Chine clay
Cretaceous	Thick layers of trap rock containing thin intertrappeans as revealed in borehole sections
Gondwana formation	Coal bearing horizon of Indian stratigraphy
Achaean Basement	Not encountered in boreholes drilled in this area

Dust pollution status of the project area

To understand the holistic pattern of the dust pollution status of the project area, the ambient air condition which is normally covered under a

†Director (Rtd), Directorate of Mines & Minerals, Govt of West Bengal, 252/2, N S Road, Howrah 711 101.

canopy of dust for most of the time except during the rains. For such study three suitable clusters on visual observation basis were selected where large numbers of crushers with screens are concentrated. A control area well outside the influence of the project was also selected for study to have a broad idea about the base line situation. Two sets of studies were conducted – one pre-monsoon (April-May) and the other post-monsoon (Oct-Nov). The study revealed that the project area is worst affected in the south-western part, where the SPM exceeds 6/8 times of the prescribed tolerable limit of 600 μ/m^3 or so which justified this study for finding out how far the workers and local inhabitants are affected by the dust pollution.

Health Status of Women workers

In investigating the medical aspects under actual conditions of dust-laden work it is necessary to know the cultural and socio-economic conditions of workers, their genetic and immunological resistance capacity because the inherent traits of ethnic groups at times play a vital role. For the purpose our initial attention was focused on these aspects for which an elaborate questionnaire was drawn. Although it was not possible to get true and dependable answers to all the questions in every case attempts were made to sift the grain from the chaff and developed a fairly dependable device. To avoid too much ethnic variables one single community was chosen, namely the Santal community with similar social custom and heritage, for the study, not that the other ethnic community workers are not affected by dust but for limiting the variables as far as practical.

The different aspects of medical studies were conducted by the authorized medical practitioners at district headquarter at Suri, on

- General health status – height, weight, gate etc
- Chest X-ray by high-resolution X-ray instrument and the interpretation following ILO norm from the authorized ESI hospital at Belur, Howrah.
- Hematological studies e.g. Hb%, pcv% for anemia, eosinophilia, pulmonary tuberculosis etc. HBF%, HbA2%, suckling test were also conducted on 64 subjects by Vivekananda Institution of Medical Research, Kolkata at the initial stage for thalassaemia study.
- Lung function test to assess vitality by Indian Statistical Institute scientists.
- Sputum test for acid fast bacilli
- Normal eye check up including colour blindness, night blindness etc.

The selected subjects were brought to Suri from their villages in batches of 12 to 20 by transport arranged by NISM. Each batch of women was escorted by a Santal interpreter engaged by NISM and a village headman for accompanying the village women and girls.

20 male members from the W.B. Mineral Development & Trading Corporation Ltd, a Govt of West Bengal Undertaking) were also examined for some comparison against gender variation. The subjects were medically checked in all respects for this project. The break up is as follows:

- **From project area** —168 Nos. from villages viz. Hatgacha, Harinsinga, Jetia, Pachami, Nischintapur, Girijhor
- **From control area** — 23 Nos. outskirt of Suri town from Karidhya village
- **Male workers** — 20 Nos. from Pachami project of WBMDTC

The selection of the subjects was made by stratified random sampling method from age groups 15 yrs to 45 yrs dividing them into two categories namely

- Those working below 5 yrs and
- Those working above 5 yrs.

To ascertain the nature of dust, the nature of the parent rock of the project area was studied mineralogical and composition of the dust generated from the rock was also chemically examined. While the mineralogical components were not medically injurious the chemical constituents did not show any injurious heavy metal content above permissible. On the whole, neither the mineralogical components nor chemical constituents appeared to be harmful. If, however, excessively inhaled the dust could cause chest problems like tightness of chest, pneumoconiosis etc. As the trap stone of the project area is a basic volcanic rock, there is no possibility of existence of any free silica, the dust inhaled by the workers therefore cannot cause the dreaded silicosis problem; at the worst cases it may lead to pneumoconiosis. The major problems found, after proper systematic medical examinations, were, however malnutrition, poor knowledge of hygiene,

tuberculosis, anemia, gynecological problems and STDs which far exceeded the cases of dust related lung diseases like pneumoconiosis.

Report of Medical Studies

Health Profile: It has been known for a long time that health is an inherently personal phenomenon, a part and parcel of human beings. Health status can be measured only at the individual level. Aggregating the individual health status of a population, are portrayed as population health status. Most of the elements of human health are not observable. Unobservability of health greatly complicates its measurement, as there is no direct way of assessing its magnitude. Even so, health professionals have made great progress in designing informative indicators of health status at the individual level.

Health indicators can be classified into two broad categories: 1) Indirect measures and 2) Direct measures. Indirect measures include primarily fertility, mortality, morbidity, life expectancy, self reported ailment symptoms etc; direct measures on the other – includes some objective measures of health e.g. body mass index, some measures of cardiovascular fitness – blood pressures, a few blood parameters like hemoglobin level, packed cell volume, lung function measurement and chest roentgenogram.

In the present study, a cross-sectional health investigation performed among the women workers of stone quarries and crushers of Md. Bazar area of Birbhum district of West Bengal (have been designated as 'affected female'). The similar studies were also performed on control group of women who are staying and working well outside the stone quarries and living near Suri town of Birbhum district (have been designated as 'control female'). A small sample of male workers was also investigated in order to see the health effects on male workers (have been designated as 'affected male'). The test protocols for all the individual were similar. The present chapter is devoted to 1) an overview of the technical details and the test batteries adopted in the study, 2) results of subjective and objective health date, and 3) draw reasonable explanations and inferences from the evidences collected as 'results'.

Method Adopted: The report contains details of the methods adopted for the study involving Anthropometric measurements, Blood pressures, Hemoglobin and Packed cell volume, Chest X-ray etc. these studies were made by the scientists of a specialized division of the Indian Statistical Institute.

The medical findings might be summarized below:

- Self-assessment of health is relatively better in the control females compared to affected females. One may have noticed the reasons of bad health of the affected females and that does not seem to be the effect of stone dusts or hardship in the work. The affected females stay in remote areas where qualified physicians are not easily available. Usually the affected females prefer their traditional medicine man and the local quack doctors for treatment of their ailment and the failure in proper treatment leading to dissatisfaction.
- The reported ailments are more among the affected females than control females, apart from the chest and stomach problems, the dust may have some effects on the eye. Because a large number of affected females have reported the problem of reduced vision. A few females have reported reduced hearing which may be caused by the louder sounds of the crushers. The threshold level of bearing the occupational hazards of these people are so high, that they do not bother for small ailments like fever, skin diseases and other kind of ailments.
- A large number of affected females have reported their gynecological problems. It is generally known that unhygienic habits and ignorance in cleanliness may cause these problems. Many of them have symptoms of STD's; unfortunately the confirmation tests were not performed STD's are generally caused by the sexual contacts with infected individuals illegitimate sexual relationships within the community are very common in the population. But this phenomenon has no relationships with the spread of STD's. The STD's are presumably caused by the outside people, especially the truck drivers and their helpers, who employ these poor girls in lieu of cash or kind for their sexual satisfaction. This problem is rather a social problem and needs immediate attention of the local

administration and other higher authorities. Further studies are necessary in these issues and mass eradication programmes of the diseases are necessary in this area as early as possible.

- The anthropometric data including BMI (Body Mass Index) indicates that affected female groups are nutritionally better-off than control females and which is perhaps true in the sense that the affected females have regular and uninterrupted earning sources and this helps them to take regular and better foods. There are no regular income sources of the control females. They depend dominantly on their agricultural land for food and other basic needs, but the land holding is so small that it hardly fulfils their basic need. The case of the affected males is similar as that of affected females.
- The blood and blood pressure data indicates a bad health status of the control females compared to affected females. Getting regularly sufficient food is a dream to the control females; this may be one of the reasons of lower hemoglobin and pcv level. This may have forced them to indulge in smoking and taking other narcotic objects. Smoking habits may have affected to enhance their blood pressure values. Apart from these, the average ages of the control females were more than that of the affected females and it is known fact that blood pressures usually increase with increasing age.
- Lung function parameters show that both affected and control females are more or less similar in most of the lung function parameters, although it was expected that control females would show better results, because they are not exposed to stone dusts. The explanation can be sought out from the smoking habits of the control females and the effect of higher age as well. Besides, most of the households have no separate kitchen and usually the females cook the food items in a corner inside their living rooms and using wood as fuel. The smoke produced from this wood burning has not been taken into account. The male groups are also more affected and that is also for the smoking habit.
- Now regarding chest X-ray results, the comparison between control females and affected females to not show any significant difference and the results corroborates with lung function tests. The X-ray diagnosed pneumoconiosis occurs among both control and affected females, but etiology of the disease was not reported in any of the cases. However, the causes of pneumoconiosis among control females have been discussed earlier. Apart from these the etiology of the disease can be found from their lifestyles and day-to-day activities which were not collected. Most of the males are not affected. Only a few are affected seriously which is mostly due to their smoking habit.

The Broad Conclusions: The broad conclusion from the findings drawn by ISI scientists is as below:

The existence of pneumoconiosis is due to living and working in a dusty (stone dust in the present case) environment, cannot be proved conclusively from the present result. More studies are necessary in this regard with proper study design and rigorous test protocols. In sum, it should be pointed out that the cardiovascular healths of the affected females are not that serious (as expected) as that of their gynecological health. The affected females usually take precaution with their indigenous methods for protecting themselves from stone dusts. But they are not aware, how to protect their gynecological health and what are the long-term effects of the diseases (STD's). It is generally known from medical observation that if any female suffers from STD's chance of conception for childbirth is adversely affected. Most of the young females between age group of 17 to 30 years of affected female are married and without any child and many of their husbands live elsewhere. Therefore, through the husbands of these married females there are chances of STD infection in the surrounding regions. It is apprehended that within near future, there will be much less childbirth in this group of female and the population will be gradually waning leading towards extinction, if precautionary measures are not taken immediately and seriously.

Designing Dust Suppression Device

Considering the holistic pattern of dust pollution in the project area and also as one of the objectives of

this project the task of designing a dust suppression mechanism was undertaken. This project deals with stone mining and crushing units which are highly labour intensive. They mainly belong to the small industry category with very low investments. In order to persuade the small mine owners to work in eco-friendly manner the remedial measures of dust suppression would have to be within their means – any high-tech high cost measures are likely to be ignored. NISM therefore intended to achieve a medium-tech remedy of dust pollution at an affordable cost and which can be effectively handled by the local technical people. NISM therefore did not attempt 100% improvement but kept the target limited to 70%/80% achievement which would be better than ignoring the entire aspect as is the prevalent practice. Instead of trying to define such 70%/80% achievement in technical terms NISM intended to reach this standard by visual observation, which would be easier for the field operation to achieve – in place of dust laden atmosphere it was intended to achieve an apparently clean environment. Such limited achievement would not only be fairly beneficial to the health of the present generation of workers but the work atmosphere under such circumstances would motivate and make the future generation of workers, and even the mine owners, more receptive to eco-friendly work environment. In any case, such partial achievement would be better than 100% exposure to the prevailing dust pollution.

The dust suppression system, which NISM has designed, is operated by dry suction method finally collecting the dust in water filled chamber where dust will settle down ass slurry. The water may be decanted from top and may be used again. The slurry may be disposed intermittently when the chamber gets filled up. The device is user-friendly, affordable and can be fabricated by local mechanics and skilled labourers with locally available materials within the price range of INR 70/75 thousand i.e. around US$1400 / 1500 thousand against the present varieties available in the market costing about INRs 3 to 5 laky i.e. US$6000 to 10000.

Designing User-friendly Mask

The supply of masks to the workers is obligatory to the mine owners, unfortunately the mask supplied to them are not user-friendly and cause discomfort after use for some time. For this discomfort the mask supplied by the mine owners are used only on the occasion of inspection by any regulatory authorities totally defeating the purpose of protection against dust. NISM designed a device based on traditional practice by locals against dust pollution with some modification. The people usually wrap a '*gamcha*' (cheap handloom towel) around their face to avoid dust inhalation but when the *gamcha* gets soaked during heavy sweating for strenuous work that becomes a bit uncomfortable and are usually removed by the user.

NISM increased the breathing space under wrapper by inserting a wired frame. This frame helps to maintain a reasonable gap between the nose and the wrapper even at the time of heavy sweating. Consequently the workers feel comfortable and the mask does not need removal even during heavy sweating fulfilling the purpose of the use of mask. The local labours showed interest in the NISM's device.

After motivational camps quite a good number of labours became conscious about adverse effect of dust and felt the need for the use of facemask against dust pollution for their own interest. In our project, motivation was one of the important focal points without which any amount of compulsive legislation and attempt at enforcement by inspection can be made successful.

Environmental Regeneration

Because of extensive random excavation the area is becoming denuded even of its scanty vegetation and looks environmentally degraded with hanging canopy of dust, but being source of essential raw materials and large employment, the activities cannot be stopped. So it is time that something should be done to improve the environmental condition. It cannot be done merely by introduction of some cut-and-dry legislation. Awareness generation amongst local people should be the main thrust along with compulsive introduction of dust suppression devices to achieve environmental regeneration.

Acknowledgement

The project was sponsored by Science & Technology Dept, Govt of India under S&T "Project for Women" and was operative under Mr. D. K. Das, Principal Investigator of National Institute of

Small Mines, which has the status of Scientific & Industrial Research Organization (SIRO) granted by Govt of India. The project started on 1.11.1998 and ended on 31.3.2002.

References

1. S L Chakravorty — Small Scale Mining in Cluster: A Success Story from India – UN Guidelines for the development of Small/Medium Scale Mining, Harare, 1993.
2. S K Dasgupta and S L Chakravorty — EIA/EMP Guideline for Small/Medium Scale Mining – Case study in Aravalli Region, Gurgaon, Haryana – MERN Research Bulletin, No. 9, 1996. Ed. Prof A Warhurst, University of Bath, UK.
3. Prof. Ajoy K Ghosh — Small/Medium Scale Mining – A Global Perspective, Ed: Proceeding of Global Conference organized by National Insttitute of Small Mines, Calcutta, 1996.
4. Proceeding and Recommendations – Calcutta Consensus and Noamundh Recommendation of Global conference on Small/Medium Scale Mining, Calcutta, Dec 1996.
5. Arati Nandi and S L Chakravorty — India – Changing Socio-Economic Status of Tribal Women engaged in Small and Medium Mines and Mines related activities in India. MERN Research Bulletin No. 13 / 14, 1998, special issues, University of Bath, UK.
6. Arati Nandi and Paramita Aich —Women in Mining – Towards better future?, Women and Work in South Asia: Contemporary Perspective in Labour, Capital and Society, Vol 29, No. 1 & 2, 1996. Pub: McGill University, Montreal, Canada.