

HIGHLIGHTS OF THE WORK DONE

1st April 2006 to 31st March 2007

**National Institute of Occupational Health
and its Regional Centers**

1 Asbestosis among Ship Breaking Workers of Alang

Ship breaking operations expose workers to a wide range of hazards or workplace activities or conditions likely to cause injury or illness. The asbestos used in the hanger liners, mastic under insulation, cloth over insulation, cable, lagging and insulation on pipes and hull, adhesive, gaskets on piping connections, and valve packing, in a ship pose a health hazards during its unsafe removal (Fig.1). As per the directives of the Supreme Court Technical Committee an epidemiological study was planned to find out the magnitude of asbestos related health problems and other disorders among ship breaking workers.

Examination of the medical records supplied by Directorate Industrial Safety and Health (DISH) and medical examination of the asbestos handlers identified by Gujarat Maritime Board (GMB) was carried out. Evaluation of chest X-rays of 81 workers and pulmonary function test results of 66 workers supplied by DISH revealed category 1/1 linear shadows in 13 (16%) cases, category 1/0 (border line) linear shadows in 3 (3.7%) cases and pleural thickening in 3 (3.7%) cases. The medical examination of 44 workers carried out by NIOH revealed that only 35 workers were handling asbestos containing materials. About 65% of the workers have handled asbestos for less than five years and only 3 (8.6%) workers gave history of handling asbestos for more than 10 years. Among these workers 7(20%) workers showed category 1/1 linear shadows on chest radiographs. Thus after adjusting the workers for dual evaluation it was observed that 15 (16 %) of 94 workers occupationally exposed to asbestos showed linear shadows on chest X-rays, and 26 workers (39%) showed restrictive impairment. No correlation was observed between PFT impairment and radiographic changes.



Fig. 1. Source of asbestos exposure during ship breaking

2	Study of Health Hazards / Environmental Hazards Resulting from use of Chrysotile Variety of Asbestos in the Country
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This study was undertaken following a request from Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Govt. of India. Study was necessary to fulfill the requirement of ongoing developments under the Rotterdam Convention to regulate the use of chrysotile variety of asbestos. The objective of the study was to find out the concentrations of asbestos fibers in the workplace environment, in the vicinity of the process area etc. and also to assess the health status of the workers engaged in organized and small-scale industries, the residents of the vicinity as well as the end users of asbestos products.

During the year part of the study was conducted in asbestos cement sheet manufacturing industry of Eastern India. The result of environmental assessment showed that the asbestos fiber level in all the workplaces were below national and international standards. So far as the medical examination of the workers concerned, no complaints related to respiratory system was observed. About 32% of the workers showed impaired lung functions (the major abnormality was restrictive type). Prevalence of restrictive type of PFT impairment was more with employees of higher duration of work experience and in smokers. Some workers had prominent broncho-vascular markings in their radiographs and four workers had radiographs suggestive of interstitial lung fibrosis, which may be due to exposure of asbestos.

3	Assessing Cold Induced Dermal Injuries by Thermographic Technique
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Cold induced dermal injuries are common among workers in occupational groups, like meat and fish processing works, cold storages, forestry work, and in occupations where power operated vibrating machinery and hand tools are used. The occupational group included in this study is the fish processing works, where women expose their hands in ice-cold water for long hours in course of performing fish processing activities. The study explored categorizing the exposure patterns of women, based on hand and finger skin temperatures following cold provocation tests.

The thermographic analysis (Fig.2) of hand and fingers of women following cold provocation tests identified three groups of women viz, group -1 who fast returns to initial task within 10 min, and other delayed groups -2 with average durations of 15 and 29 min. of recovery. The distinctive pattern of changes in finger task signifies relative disruption of peripheral blood circulation with group -3 being severely delayed in response to recover from cold challenge. The study was conclusive to determine the progression of dermal injury among women in fish processing works. The suggested logarithmic relationship of finger task and

recovery duration was useful to predict the women groups in terms of their delaying nature of recovery, and a warning signal of potential problem of cold induced peripheral circulatory function.

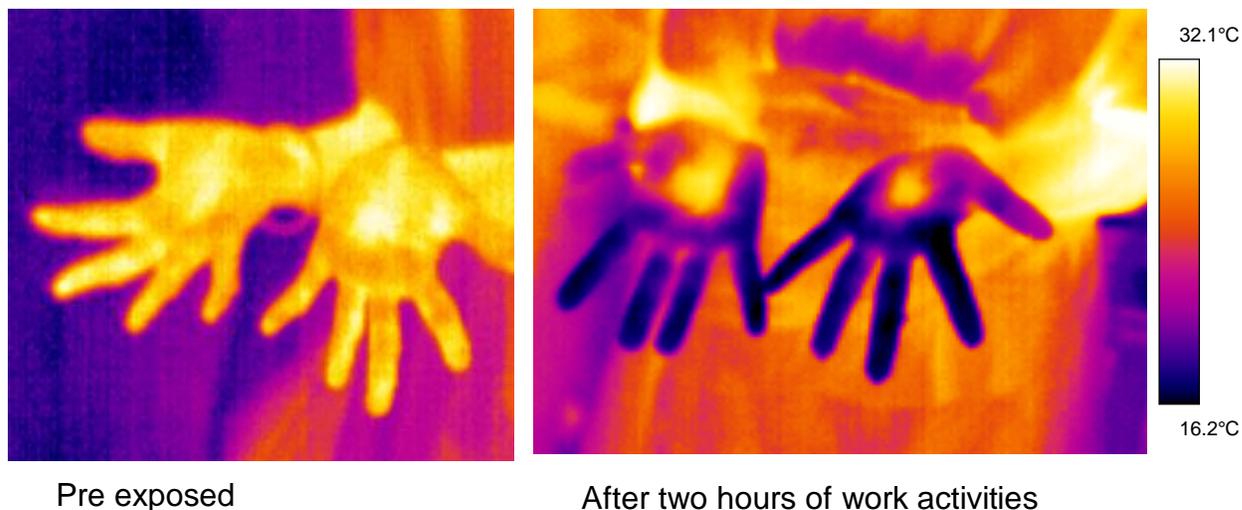


Fig- 2. Thermographic image of hand before and after processing activities

4	Report on Analysis of Pesticide Residues in Sugar Samples
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As per the recommendations of the Joint Parliamentary Committee constituted by the Parliament, the Ministry of Health and Family Welfare (MOHFW) constituted a National Level Expert Committee under the Chairmanship of Prof. N K Ganguly, Director General, ICMR, New Delhi, to advice on fixation of MRL's of various pesticides in carbonated beverages. Twenty-seven sugar samples randomly collected from 27 sugar mills located in Gujarat, Maharashtra, Andhra Pradesh, Tamilnadu, Karnataka, and Uttar Pradesh for the analysis of organophosphorus and organochlorine insecticides.

The analytes analyzed on GC MS/MS were γ -HCH, δ -HCH, ϵ -HCH, θ -HCH, p,p'-DDE, p,p'-DDD, p,p'-DDT, α -Endosulfan, β -Endosulfan, Endosulfan sulfate, and Chloropyrifos. While the analytes of Malathion, Quinalphos, Dimethoate, Metribuzin, Simazine, Atrazine, Alachlor and Carbofuran were analyzed using LC-MS/MS.

The study has shown all the pesticides were below detection limit i.e. 0.1 ppb in 27 sugar samples, except chloropyrifos, which was 0.22 ppb in one-sugar samples. The report has been submitted to the ICMR. Based on this report, ICMR has submitted the guidelines to fix up the MRL in various pesticides to the MOHFW, Govt. of India.

5	Environmental Cum Medical Surveillance Study among Children Residing Near the Rampura Agucha Mine, Bhilwara, Rajasthan
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The Ministry of Environment and Forests (MoEF), Govt. of India directed the management of M/S. Rampura Agucha Mine (Hindustan Zinc Limited. Agucha, Bhilwara (Rajasthan) to estimate blood lead levels of population in the vicinity of mine, particularly among children. The study was carried out to estimate the lead levels in air, water and blood samples along with detailed medical examination and psychological performance of children residing within 2.5 kms (exposed) and more than 10 kms. away (control) from the mines. A total of four hundred fifty two (exposed -298 and comparison -154) school children in the age group of 8-14 years were selected randomly.

Environmental monitoring study suggests that lead levels in air and water samples near the mining areas were within the CPCB prescribed standards (2006). Lead levels in all children residing near the mining (exposed group) and away from the mining (control group) areas were less than 15 µg/dL. It is found that the mean blood lead levels were little higher in exposed group than control group (Table-1).

Table-1: Mean blood lead levels (µg/dL) of children residing in villages near the mine

	Comparison (control)		Exposed	
	Male	Female	Male	Female
No.	78	76	159	139
Mean ± S.D.	6.12 ± 2.68	4.63 ± 3.51	7.70 ± 3.50	8.56 ± 3.49
Range	1.10-14.00	0.84-14.00	1.40-14.0	1.1-14.4

Medical examination of all children did not show any case of lead related health problems. The results of physical growth parameters of boys and girls of exposed and control group were without any significant difference. IQ tests did not reveal any effect on cognitive performance in both the groups. The overall findings revealed that even though the lead exposures do exist in mining areas but its health risk was not observed in children residing near the mines. However intervention strategies needed to control lead exposure in order to safeguard the physical and pschycological growth of growing children.

It is recommended that the periodic medical examination including biological monitoring of the children residing near the mines as well as assessment of community environment (air, water and soil) for lead should be carried out. Health education and awareness programme related to heavy metals exposure and

health effects should be organized for the villagers residing near the mines. Further, engineering control device at the source of the dust exposure should be made more effective to reduce the emission levels of dust.

6	Occupational Health Problems in working children in Brick Manufacturing Industries
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A health study was conducted under ILO-INDO-US project in which the exposed group included 156 children working in different processes of brick manufacturing and 150 school children. Anthropometrics measurements of the working children were comparable with those of control group. The working children group included 88 boys and 68 girls whereas control subjects included 69 boys and 81 girls. About 1.3% of the control children were illiterate as compared to 27.6% of the working children. Further, it was observed that 68% of the child labourers were compelled by their parents for brickwork, whereas 32% of the child workers were working by their own choice. Majority of the working children were deployed for carrying raw material and bricks on the head. The average daily work-duration was 3.94 ± 2.91 hours and average work duration was 9.79 months.

The main complaints of the working children were neck-pain (37.8%), muscle cramps (31.4%), joint pains (26.3%), cough (21.8%) followed by headache (17.9%) and backache (17.9%), fatigue (17.3%) whereas in the control group the common symptoms were headache (14%) and abdominal pain (14%).

Further, medical examination revealed boils in 14.1%, scabies in 14.7%, Bitot's spots in 4.5%, tinea infections in 4.5% and injuries at work in 2.6% of the exposed group subjects, while boils in 3.3%, scabies in 10.7%, Bitot's spots in 2.0%, and tinea infection in 1.3% in the control group.

7	Health Risk Assessment and Development of Intervention Programme in Cottage Industries with High Risk of Silicosis : A Study among Slate Pencil Workers
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Pneumoconiosis constitutes the major proportion of the occupational diseases arising due to the occupations when workers are exposed to silica dust. Such occupation includes sandstone quarry, agate industry, slate pencil cutting industry, ceramic and pottery industry. The problem becomes more severe in the small and cottage type of industry where not only it is occupational health problem but also because of the location of these units in the residential areas it becomes environmental cum community health problem.

Slate pencil workers of Multanpura are a group of unorganized workers exposed to free silica dust. They bring the slate stones from the slate mines, cut it with the help of rotating saw resulting generation of dust. However due to the indigenously developed control device, which includes an exhaust pump at the site of cutting,

this dust is sucked up. This sucked dust is then released into the ambient air thereby exposing the community to silica dust via polluted environment (Fig.-3). Thus the present study was carried out to estimate the prevalence of silicosis and other dust related morbidities among slate pencil workers and the community residing in the vicinity, and compare with the unexposed group. Further environmental and work place dust and silica exposure were estimated.

?? The study suggests that the prevalence of silicosis and silico-tuberculosis were 46.9% among the slate pencil workers and 18.9% in the community residing in the vicinity of these units.

?? Though the workers are using the indigenously developed control device but it is not effective in controlling the dust. Instead it is capturing dust from the workplace and liberating it in the ambient air thereby exposing the community residing in the vicinity.

?? The shifting of these units to some isolated place was recommended.

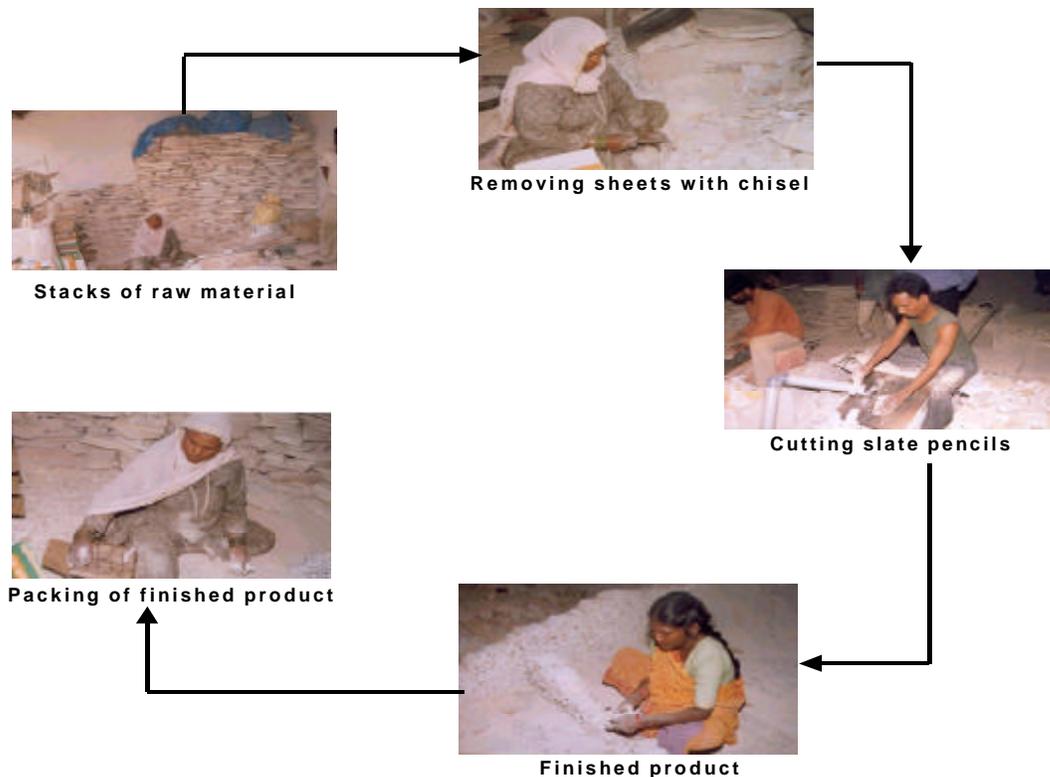


Fig. 3. The work processes in slate pencil-manufacturing unit

8	Occupational Health Problems of Working Children of Footwear Units of Agra
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The Footwear Industry is a significant segment of the leather industry in India. The major production centers in India are Chennai, Mumbai, Kanpur and Agra. Children between 10 and 15 years old are mainly employed in assembling shoes. They mainly work on soling (fixing upper portions of shoes to leather or rubber soles) with glue (Fig. 4). Children are cramped in poorly lit rooms and suffer from continuous skin contact with industrial adhesives and breathing vapors containing solvents that are present in glues.

In the present study the exposed group included 139 child labourers working in the different processes of footwear manufacturing and 160 school children studying in the government schools located in the neighboring areas were studied. Information regarding demographic, occupational, personal and clinical characteristics was recorded in a pre-designed and pre-tested proforma. This was followed by complete clinical examination and administration of neurobehavioral test battery.

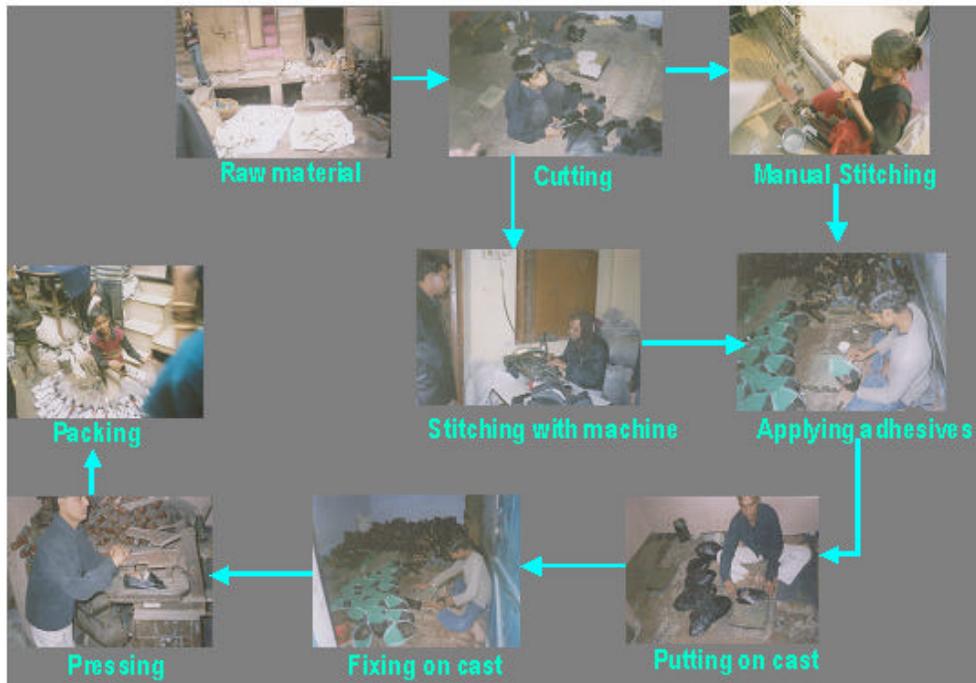


Fig. 4 : The work processes in a footwear-manufacturing unit

It was found that both height and weight of the working children was lower than that of school children. This difference was more remarkable in the younger age groups. In all 70.5% working children were symptomatic while only 65% school

children had symptoms. The common complaints in working children were eyestrain and lacrimation from eyes in 43.9% followed by respiratory symptoms such as cough and frequent common cold in 33.1% subjects and neurological complaints such as headache, tremor, tingling numbness, etc. in 26.6%. The neurobehavioral test performance of working children was poorer than school children. The chemical analysis of the different fluid used in the footwear manufacturing revealed the presence of organic solvents.

9	Occupational Health study among working children in Stone Quarries
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Working children are widespread in the granite and other stone quarries in India. Quarrying involves digging stones out of the earth with hand tools or drilling machines, and cutting rocks or boulders into pieces and is a strenuous work. In the stone quarries, the major sources of dust emission are drilling operations, crushing units, screen units, transfer and loading points. The silica dust levels in the work environment are responsible for the high prevalence of respiratory diseases such as chronic bronchitis, tuberculosis and most dreadful of all, silicosis. The industry operates in the open cast basalt, dolomite, marble and limestone mines located in the Jabalpur and nearby places viz. Katni, Satna and Damoh districts. The stones are mined from the small hills and broken into smaller pieces with the help of hammer. The broken stones are loaded in the trolleys and transported to stone crushing units located nearby. The children are mainly involved in the loading operations. The samples of basalt and dolomite stones were collected for analysis of free silica.

In the present study 147 working children in stone quarries and 146 controls were studied. The working children and control were comparable with regard to age, sex, socioeconomic status, height and weight. The skinfold thickness among the working children was significantly lower than the controls ($p < 0.05$). About 9% of the control children were illiterate as compared to 60% of the working children. About 10% working children were smokers as compared to 0.7% of controls. The main complaints of the working children were cough, breathlessness, backache, muscle cramp, joint pain and injury at work. About 32% boys and 24.2% girls complained of frequent injury at work. The overall work conditions including ventilation, illumination, etc. were found to be satisfactory. However, dustiness due to mining, breaking and loading of stones were potential environmental hazards. The free silica could not be detected in the basalt stone while in dolomite stone it was less than 1%.

10	Auditory and Non – Auditory Effect of Noise in Exposed Workers
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In order to assess the effects of the noise on workers on hearing acuity three types of industries were identified i.e. highly, moderate and less noisy one. For this purpose Engineering units were identified as a highly noisy (>90dB), thermal power as moderate (70-90 dB) and small-scale industries less noisy (<70dB). A total of 100 workers (25-55 years of age) from thermal power station, having duration of employment up to 32 years constituted the exposed group. Fifty workers not exposed to occupational noise, constituted the control group. The workforce was employed on an average of 8 hr. daily. The data of each subject obtained twice i.e. on day 1 at the pre- exposure level (before the work shift) and on the day 3 at the post exposure level at the end of 8 hr. work shifts.

The analysis of data obtained from thermal power units revealed that exposure of 5-14 years did not affect their hearing ability, but exposure from 15-24 years had moderate effect on their hearing ability (Fig.5 & Fig.6). Workers having exposure >25 years had severe deterioration in their hearing ability, while exposure of more than

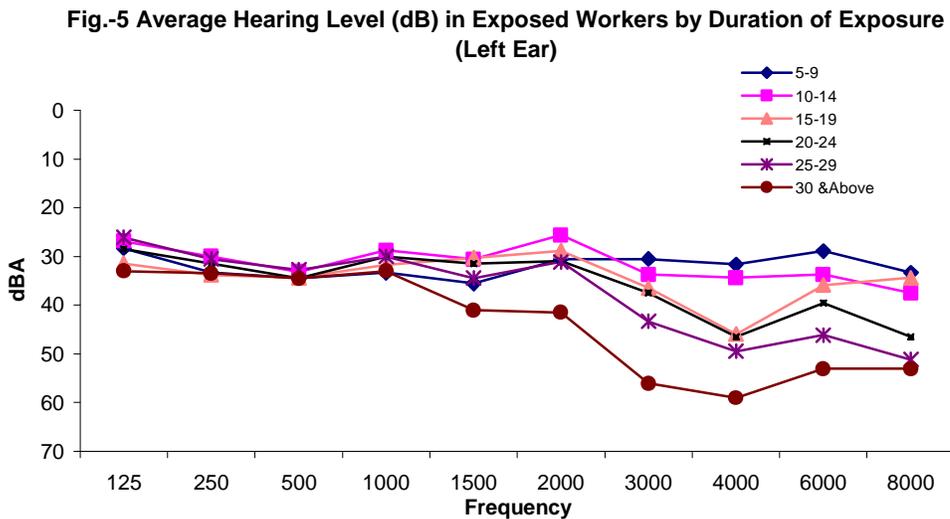
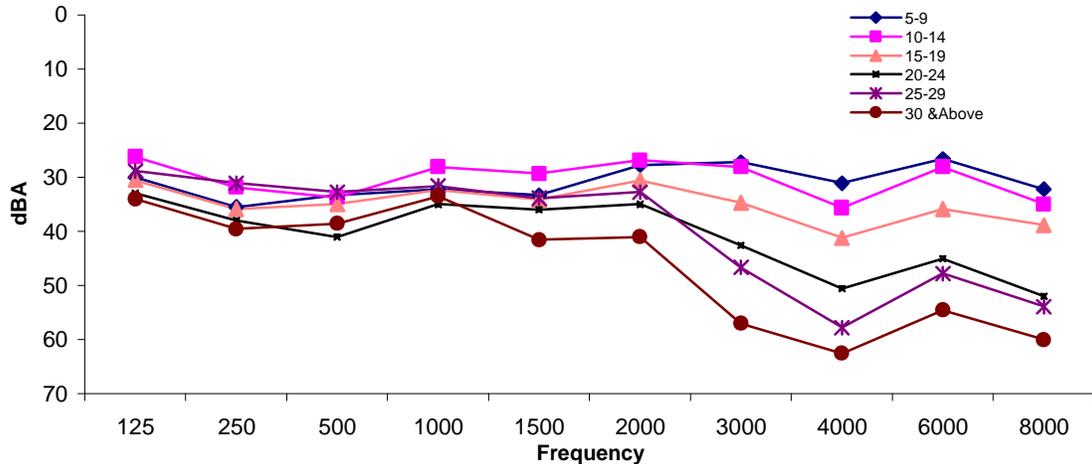


Fig. 6. Average Hearing Level (dB) in Exposed Workers by Duration of Exposure (Right Ear)



reported 'just audible tone' at 60 dB, which is very high. The result indicated that deterioration in hearing ability at the higher frequency (3000-8000) in both the ear associated with the year of exposure. The noise level from 85 to 97 dBA was observed at different work place.

11	Assessment of the Health Status of the Diamond Manufacturing Workers
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Diamond industry is a new age industry with the advent of laser planners, laser saws and assembly line production techniques. A study was conducted to assess the health status of the workers manufacturing diamonds in Surat district. Out of 948 workers up to the age of 30 years, 606 (70%) were up to the age of 24 yrs. higher prevalence of hypertension was noted among these young workers.

Visual inspection and literature search on the work process has identified the following risk factors:

- ?? Carbon nanoparticles
- ?? Heavy meatal's fine particles and nanoparticles
- ?? Ozone
- ?? Solvents
- ?? Limited air circulation buildings

The soot generated by lasers is a mixture of nano-particles, fullerenes and nanotubes. Diamond industries, use purest form of carbon and produce nanoparticles, which are left floating in air. Continuous discharging lasers produce

large quantities of ozone, which may build up in the limited air circulation buildings.

The soot is proposed to be analyzed at the analytical chemistry laboratory at CDRI Lukhnau and at NIOH. The solvent exposure was to be analyzed by Indian Institute of hematology and cytogenetic assay for chromosomal aberrations was to be done by environmental carcinogenesis unit at NIOH. All these parameters are not done yet since the collection of samples one and half years ago.

In accordance with the accepted principles of biomedical research in the field of occupational medicine the following report has been prepared. The first principle to be endorsed by earth summit in 1992 was the principle of precautionary approach and the second principle was of uncertainty based decision making.

These principles state that in the cases when there is uncertainty about the methods of proving an exposure and the statistical modeling of dose-response risk factors should be identified in accordance with the above two stated principles. In accordance WHO also de-emphasizes the role of biochemical tests in its step-wise surveillance program and focusses on established risk factors and behavioral patterns.

Four major occupational groups exist in diamond manufacture.

- ?? Laser planner operators: Coat the diamond with titanium dioxide film and create burn marks on the surface
- ?? Markers: put onk marks on the surface of raw diamond to indicate the plane for cutting or cleaving the diamond
- ?? Laser saw operators: use laser to vaporize dimond along a hexagonal plane
- ?? Grinders: remove the excess rough diamond and polish the surface to perfection on a grinder

This study postulates that myocardium appears to be the target organ for the effects of nanoparticles. The proportion of hypertensive (JNC VIII) workers in the group up to age twenty-four years (23.9%) is very high comparing to the prevalence reported (1.5%) in a cross-sectional study of Indians of the age-group seventeen to twenty-three(Gan et al,2003). In a study of ten industrial populations in India the prevalence of hypertension (stage1 & stage2) was found out to be 12.2% in the age group 20-29 (Reddy et al 2005). The prevalence of hypertension (stage1 & stage2) in diamond workers is 23.9% up to the age of 24 and 25.5% up to the age of 30. The body mass-index of workers across the

occupational groups is comparable and less than 3% of workers have body mass-index over 30. Occupational groups are almost comparable on other measures.

Only significant finding is higher mean total leucocyte count in the occupational group grinders. This is quite possible because the grinders are exposed to different type of nano-particles than other occupational groups. Grinding operations produce predominately carbon nanotubes whereas laser vaporization typically produces fullerenes. Additionally, the workers have both increased and decreased blood counts in the same occupational setting.

The overall work environment for diamond workers appears to be angiotensive with supervening effects of chemicals (solvents), nanoparticles and ozone. The magnitude of exposure to these risk factors is variable but effects may not be variable owing to the fact that for nanoparticles the particle surface area is much more important than absolute mass being released.

The recent consensus about the cardiovascular and carcinogenic effects of particulate matter warrants special concern about the diamond workers. The work environment of the diamond manufacturing industry has all the ingredients of toxic particulate matter viz. carbon nanoparticles, hydrocarbons, ozone, NOx, heavy and transitional metals. They are at higher risk because they work with the technology which exposes them to these elements at just the nano-sized particles which are impropotionally highly toxic. The limited aircirculation buildings cause recirculation and build up of these toxic elements.

12	Biomechanics of Sitting: Influence of Seat Feature and Mode of Sitting
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Seating is integral of our lives and the usefulness of seating lies in (a) the comfort it provides to an individual, (b) stability and balance to body orientation, (c) minimal stress on lower extremities, (d) providing backrest and armrest, (e) better distributing body loads, and (f) demanding less energy. Since the prolonged seating is a potential risk to the spinal, paraspinal and other musculo-skeletal structures, research emphasized on quantifying the postural load at the intervertebral discs. Study examines the orthogonal force components recorded from the ground reaction force, based on force platform signals, and explores the relative sharing of the body force distribution to different components of the seat. The extent of load dissipated by the components of seat would in turn mitigate the compressive and shear stress on the spinal and other paraspinal structures.

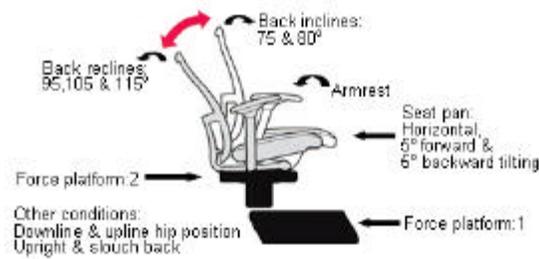


Fig. 7a

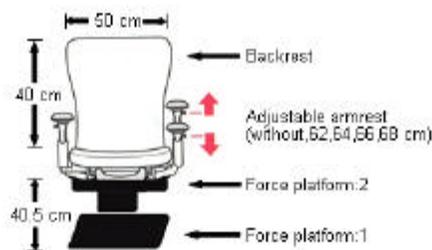


Fig. 7b

The interface analysis of the human body and the seat bears importance to assess the design and functional consequences for persons using the seat. The study analyzed the body force distribution to the seat and feet surface, influenced by the different components of seat. The experimentation included a simulated seat system with two piezoelectric force platform, one placed at the height of a chair seat pan (Fig. 7a) and the other platform placed horizontally on the floor surface (Fig. 7b), served as footrest. The adjustable chair configuration allowed studying the influence of the height and slope of the seat pan, supported and unsupported back, the back curvature, the angle of backrest and the height of the armrest. The results indicated that beyond 95° backrest inclination the load on seat decreased by about 8% at 115°. The height of the armrest adjusted at 68 cm was effective in reducing load by about 7% from the seat. The study reaffirms that the backrest and armrest have conjoint influence in reducing the load at seat, which in turn might help in mitigating the compressive and shear stress on the spinal and other paraspinal structures. While the study on weight distribution is lacking, the similar analysis might be useful to the designers in optimizing chair design features for better distribution of body load to the components of seat.

Grain storage godown workers suffer from respiratory problems due to storage exposure to storage grain dust, a complex mixture of pesticides, fungi, silica, bacteria, spores, storage mites, animal hairs, pollens etc. A total of 304 workers were investigated, out of which a follow up study of 109 workers was again done after one year to see the changes in the workers due to exposure.

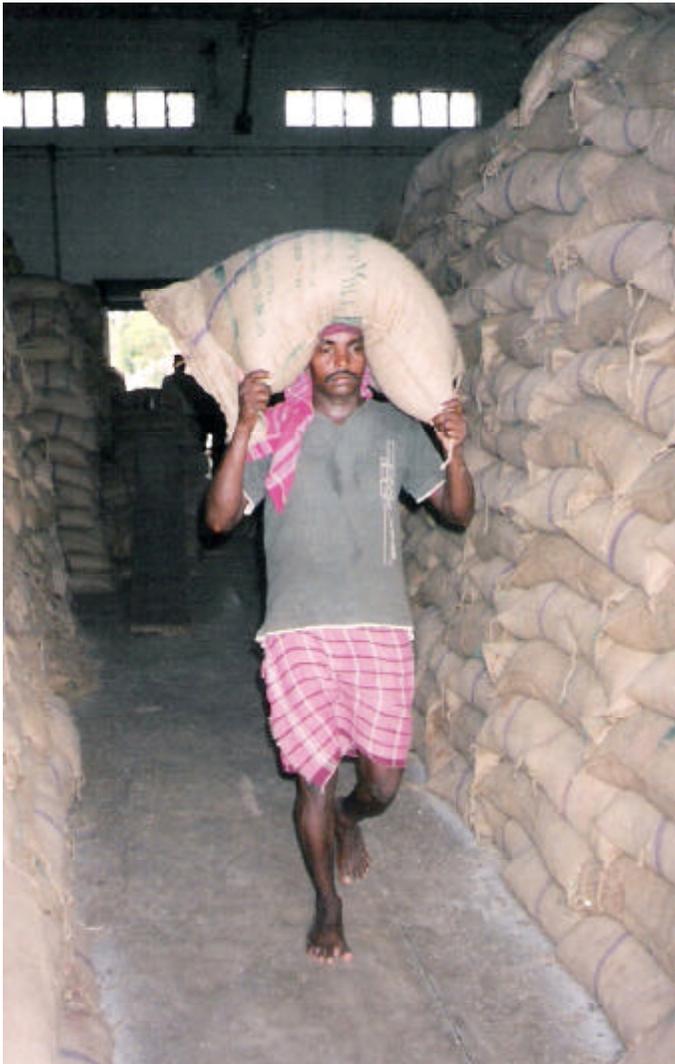


Fig. 8. Worker carrying bag on head in grain storage godown

The results of the environmental study revealed that the mean values of total and respirable dust exposure for loaders have been found above the American Conference of Industrial Hygienists (ACGIH) permissible limit. The higher values of dust concentrations in storage godown air were may be due to heavy loading and unloading activities. Comparatively lower exposures of ancillary group indicate their less activity inside the shed. Indication of thermal stress was observed in case of loaders who undertake heavy job inside the sheds. Different allergic manifestations were found among the workers. The exposure of different concentration of fungal spores might be reasons for the development of the symptoms. The increase prevalence of higher blood pressure observed among all categories of workers showed

an increase with the advancement of age. In load handling workers the mean age is less and the older subjects were more in quality control. These workers showed the highest prevalence of high blood pressure. However the reason of high prevalence of hypertension is not understood. The PFT results showed decrement

of values in higher age groups and among the smokers compared to the non-smokers. The pulmonary function impairment among the workers was restrictive, obstructive and combined one. The bronchodilator aerosol was administered in limited number of subjects; those who have the post shift decrement of PFT values. Some workers satisfy the criteria of positive bronchodilation according to American College of Chest Physicians Committee on Emphysema. According to the duration of work it was found that the decrement of post shift PFT values were more in newly appointed workers. The immunoglobulin E (IgE) level in the blood serum was assessed particularly in those workers who had post shift decrement of PFT values. The IgE level found higher among the grain-handling workers compared to the control subjects. Lower PFT values correlated with high IgE level. The PFT values were also according to the blood eosinophil count. The high eosinophil count was associated with impaired PFT parameters.

The high concentrations of airborne fungal spore in the work environment have been suspected to be causative agent of the respiratory diseases. The fungal components induce the synthesis of the specific immunoglobulins. It has been also noticed that the joint pain and low back pain showed an upward trend with increase of age and work duration. This may be due to the postural changes adopted by the subjects during their work. The load handling workers maximally reported pain and discomfort in back, and head and neck where as the ancillary workers as well as the depot staff workers reported for back and legs. The work related accidents are reported more among the load-handling workers. The accidents occurred mainly due to slipping and tripping of the workers during the movement with the load in congested place. They also get injury by the false hit of hooks. The types of injuries in case of ancillary workers were cut, bruises, prick etc during work. The results of the study may help in formulating plans to control the hazards of the working place as well as to take the preventive measures about the exposure and the occurrence of the diseases of the workers and better utilization of work force.

14	Clinico-Epidemiological Study of Arsenic Exposed Population in West Bengal
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The project work was undertaken in two phases at Katlamari gram panchayat, Murshidabad district, where people are affected by arsenic through drinking water. The arsenic contents of most of the drinking water samples of Katlamari Gram Panchayat 1 were above the permissible limit. The people are exposed to different concentrations of arsenic ranging from $<50\mu\text{g/L}$ to $>150\mu\text{g/L}$. Majority of the samples of urine, hair and nail were found to have arsenic above the prescribed normal range for unexposed population. Multi system involvement by the arsenic exposure is also revealed in the study. In phase-1 study the prevalence rates of weakness, dyspepsia, feeling of cramps, skin pigmentation and keratosis were found to increase with increase of exposure to arsenic. The reporting of joint pain

particularly involving the bigger joints like knee, elbow by the subjects is first of its kind observed due to arsenic exposure. Higher prevalence rates of LBP and neuropathy were observed.

Fig. 9a. Person affected by arsenic in arsenic exposed area



Fig. 9b. A case of severe Keratosis of palm

In phase 2 study similar trend was observed. However, the prevalence rates of weakness, chronic diarrhoea, dyspepsia, cough, sputum, breathlessness, chronic bronchitis, rhonchi, joint pain, LBP, skin pigmentation, keratosis and arsenicosis were more in second phase of the study compared to that of the first phase of the study having similar exposure. Restrictive, obstructive and mixed types of pulmonary function impairments were indicated in phase 1 study whereas restrictive and obstructive types of PFT impairments were seen in phase 2 study group. Restrictive type of PFT impairment was found to increase with increase of Arsenic concentration in drinking water. As a whole PFT impairment was higher in higher exposed group. Some gender discrepancy is also observed in our study where males are more prone to arsenic toxicity than female.

Two awareness camps were undertaken under this study with the help of local NGOs where some measures were taken to educate them how to make arsenic free water and avoid the high concentration of arsenic in drinking water.