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Figures in parenthesis indicate number of workers.

ENVIRONMENTAL-CUM- MEDICAL SURVEILLANCE IN THE ASBESTOS TEXTILE INDUSTRY

There are two main uses of asbestos, one as a fibrous reinforcement of papers, boards ,pipes or sheets by wet process, and the other in the textile industry which is basically a dry process. Thus, the workers working in asbestos textile industry are exposed more to asbestos dust as compared to the workers working in the asbestos cement sheets and pipes manufacturing industry. Hence, the study was taken up, to assess and evaluate the health hazards due to asbestos in a medium-scale asbestos textile industry at Ahmedabad.

The different Processes in the Industry

The asbestos fibres are initially crushed to small size on a grinding machine. Here the workers are exposed at the time of unpacking as well as grinding of the fibres. Afterwards cotton is thoroughly mixed with asbestos on a mixing machine. Then such material is spinned on a carding machine to manufacture asbestos cotton threads. Such prepared threads are woven on intersieving machine for manufacturing the yarns. After weaving such yarns with each other, ropes are prepared. The black ropes are prepared by applying the paste of graphite and other material. All these processes are dry, involving heavy exposure to cotton and asbestos dusts at all levels. This factory is also manufacturing asbestos mill boards. Here the process is wet and very few workers are involved. This process is more or less similar to the process of manufacturing asbestos cement sheets. Environmental evaluation of the factory and medical examination of the workers were carried out in this study.

MATERIALS AND METHODS

Environmental Study :

General information and data pertaining to hygienic conditions were collected by using standard questionary. The main problem was of dust fibres and dustiness. There were no problems related to heat, noise and illumination, and were not studied.

The environmental study was then taken up in yarn and rope divisions of the factory. The yarn division was inside the factory, and the workers were exposed at the point of unpacking, mixing, spinning and weaving of asbestos and cotton to manufacture yarns. The rope division was inside the compound, but outside the factory itself.

Dust and fibre samplings for determining the atmospheric concentration of dust and fibre were carried out using standard sampling and and analysis techniques as described earlier (Ann. Rept., 1979d). Evaluation of dust and fibre concentration and sizing were made according to standard methods (Ayer et al, 1965). The values of dust and fibre concentrations at the various places of this factory are given in Table-33. It can be seen from the table that the concentrations of total and respirable dust were found variable in the yarn division, being higher at the point of unpacking and comparatively less at the weaving place. The mean values of the fibre concentration were higher at all the sampling points in this division than TLV recommended by American Conferencc of Government Industrial Hygienists (ACGIH, U.S.A., 1964) and British Occupational Hygiene Society (BOHS., U.K., 1968).

In the rope division which was outside the factory, the concentrations of total and respirable dust were less than in yarn division. Here also the mean values of asbestos fibres were less than in yarn division, but much higher than TLV recommended by ACGIH, USA (1964) and BOHS., U.K. (1968).

The high concentration of asbestos and other dusts can be due to dry process and there was no proper machinery which can trap the dust and fibres from the work environment. In earlier studies (Ann.Rept.,

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TABLE-33

Dust and Fibre Concentrations in the Asbestos Textile Factory (Mean and Range)

Site of Sampling		No.of Obs.	Total Dust (mg/m³)	No;of Obs.	Respirable dust (mg/m³)	No.of Obs.	Particles (mppcf)	Fibres/ ml
Yarn Divn.	Unpacking	23	29.09 (3.77-84.40)	14	11.63 (3.62-23.51)	14	57 (37-79)	367 (ND-770)
	Mixing	42	21.10 (8.06-42.47)	20	3.65 (1.08-8.2)	20	45 (11-79)	418 (ND-898)
	Spinning	44	9.73 (0.08-37.72)	20	2.10 (0.064-5.085)	20	86 (27-364)	225 (ND-770)
	Weaving	42	8.18 (0.21-22.19)	20	1.66 (0.08-2.82)	20	47 (25-74)	265 (ND-693)
Rope	Division	28	1.78 (0.34-6.36)	9	0.25 (0.07-0.63)	9	23 (15-59)	216 (ND-449)

ND = Not detected.

1976b; 1979d) in the asbestos cement factories, it has been found that asbestos and other dust concentrations were less than in this factory.

Medical Surveillance :

As this factory is existing since last six years only, the workers were exposed to less duration, but to higher concentration as mentioned above. This factory is registered under E.S.I. and Factory Acts. The housekeeping, dustiness, type of structure and sanitory conditions were very poor. Few of the workers were provided extremely small rooms to stay inside the factory compound and these workers are exposed for more or less for the whole day. There was no ventilation, natural or artificial, in these rooms. The ceiling of these rooms were covered with asbestos cement sheets. In yarn division labour contract system was existing and payment was made on the basis of production.

A total of seventy workers were working in this factory. Out of these, four were having pulmonary tuberculosis and one was uncooperative. So, sixtyfive workers were studied. Detailed medical examination, pulmonany function tests, X-ray of chest and sputum examination, were carried out of all workers. Thirty control subjects of more or less same age and socio-economic status were studied similarly.

RESULTS AND DISCUSSION

Table-34 shows age-wise distribution of exposed and control subjects. It is seen from this table that 63% of the total workers were below 25 years.

TABLE-34

Agewise Distribution of the Exposed and Control Workers

Age Group (Years)	Exposed Workers	Control Workers
Below 20	13 (20.0)	6 (20.0)
21-25	28 (43.0)	12 (40.0)
26-35	13 (20.0)	7 (23.3)
36-45	7 (10.8)	3 (10.0)
Above 45	4 (6.2)	2 (6.6)
Total	65	30

Figures in parenthesis indicate percentages.

Table-35 gives the physical characteristics of control and exposed workers.

It is seen from Table-36 that 60% of total workers were working in the yarn division, where the dust concentration was maximum and 21.5% of the workers were in rope division where the dust concentration was comparatively less due to the open environment. It is also seen that 78.4% of the total workers were exposed for a maximum period of three years.

TABLE-35

Physical Characteristics of Control and Exposed Workers

	Control (30) (Mean ± S.E.M.)	Exposed (65)
Age (Years)	27.27 ± 1.57	27.75 ± 1.2
Height (cm)	161.27 ± 0.61	160.72 ± 0.65
Weight (kg)	45.47 ± 0.72	45.66 ± 0.79
BSA (m^2)	1.45 ± 0.01	1.42 ± 0.19

— Figures in parenthesis indicate the number of subjects.

TABLE-36

Distribution of Workers According to Department and Duration of Exposure

Duration of Exposure (Years)	Department				
	Yarn	Rope	Mill board	Mix	Total
<1	7	6	—	1	14 (21.5)
1-3	26	7	1	3	37 (56.9)
4-5	4	1	—	1	6 (9.2)
>5	2	—	4	2	8 (12.3)
Total	39 (60)	14 (21.5)	5 (7.7)	7 (10.8)	65

Figures in parenthesis indicate percentages.

Table-37 shows the prevalence of respiratory symptoms as reported by the workers. It is seen that 30 workers (46.1%) were having respiratory complaints of chronic nature in one or the other form, while the control subjects were not having any significant respiratory symptoms of chronic nature. Amongst the respiratory symptoms. chronic

TABLE-37

Respiratory Symptoms as Reported by The Exposed Workers

Symptoms	No.of Workers
Chronic cough	8 (12.3)*
Dyspnoea	5 (7.7)
Cough with expectoration	9 (13.8)*
Cough with expectoration and dyspnoea	
Cough, pain in chest and dysponea	3 (4.6)
Cough and dyspnoea	2 (3.1)
Total	30 (46.1)

* $P < 0.05$ compared to controls.
Figures in parenthesis indicate parcentages.
No significant respiratory symptoms of chronic nature were present in the control workers.

cough and chronic cough with expectoration were present in significant number of workers. In earlier studies in asbestos cement factories (Ann. Rept; 1976b; 1979d) respiratory symptoms were present in 21.4% and 19.4% subjects, respectively. In this factory, the workers were young and duration of exposure was less. So, the higher prevalence of respiratory symptoms may be due to high level of asbestos and other dusts in the factory. Banerjee (1968) reported in his study of fiftyone cases that 41% were having dyspnoea and 31% were having cough with expectoration.

Table-38 (A) shows the findings of general examination. The clubbing which has been considered as late and inconsistant feature, was present in 9 (13.8%) subjects, while Banerajee (1968) reported in 7%

TABLE-38

Findings on Clinical Examination of Exposed Workers

(A) Main findings on general examination :

Findings	No.of Workers
Clubbing	9 (13.8)
Anaemia	11 (16.8)
Cheilosis	4 (6.2)
Glossitis	3 (4.6)
Skin disease	3 (4.6)

(B) Main findings of respiratory system examination :

Fine/Coarse crepitation	18 (27.6)**
Bronchial breathing	1 (1.5)
Rhonchii	2 (3.5)

** $P < 0.01$ compared to controls.

Figures in parenthesis indicate percentages.

No major clinical findings were present in control workers.

of the total subjects studied. It is also seen from the table that 11 (16.8%) were anaemic, 4 (6.2%) were having cheilosis and 3 (4.6%) were having glossitis. All these findings can be due to poor nutritional status. The presence of fine or coarse crepitations has been considered as one of the important findings in the workers exposed to asbestos dust and was present in significant number of workers. Eighteen out of 65 (27.9%) had creptiations (Table-38. B). In the two previous studies in asbestos cement factories (Ann. Rept., 1976b;1979d), crepitations were found in 3% and 14.2% subjects respectively. Banerjee (1968) reported crepitations in 19% of the total subjects with a duration of exposure for more than 5 years. In this factory more subjects

having crepitations with less duration of exposure, can be due to the high levels of asbestos exposure due to the prevailing dry process.

Kleinfeld et al (1966) found basal crepitations in 19.6% and clubbing in 14% of the asbestos workers. Wallac and Langlands (1971) compared 50 insulators with 50 controls and found that higher proportion of insulators had basal crepitations, finger clubbing, breathlessness and expectoration. Murphy et al (1971) reported basal crepitations in 14.9% and clubbing in 19.8% of the 101 exposed pipe workers. Berry (1971) reported that 16 out of 290 subjects had basal crepitations.

The International Union against Cancer (UICC) working party recommended (1968) that the recording of crepitations as one of the important findings in morbidity studies of asbestos diseases. They have also recommended that alongwith crepitations, cough, expectoration, dyspnoea, pain in chest, clubbing, smoking and occupational history can help in arriving at exact conclusion. British Occupational Hygiene Society (BOHS, 1968) hae considered basal lung crepitations as one of the important features, since every subject with radiographic changes suggesting asbestosis had basal lung crepitations while some with basal lung crepitations did not have radiographic changes. So, it can be concluded that the presence of basal crepitations in workers exposed to asbestos would be of great diagnostic value for evaluating the exposure risk.

TABLE-39

A Comparison of P.F.T. in Control and Exposed Workers

	Control (30)	Exposed (65)
	(Mean ± S.E.M.)	
VC (lit)	3.47 ± 0.09	2.86 ± 0.08**
$FEV_{1.0}$%	80.88 ± 1.13	82.11 ± 1.26
$FEF_{200-1200}$ ml (lit/sec)	4.51 ± 0.31	4.50 ± 0.25
FEF_{25-75}% (lit/sec)	3.01 ± 0.18	2.92 ± 0.17

** $P < 0.01$ compared to controls.

Figures in parenthesis indicate the number of workers.

A comparison of pulmonary function tests in Table-39 indicates highly significant reduction of VC in exposed workers, without much changes in $FEV_{1\cdot0}$% and the other flow rates, suggesting the presence of restrictive type of lung disease in exposed workers. Busser et al (1971) reported in their study of asbestos textile and asbestos spraying workers, progressive decrease of vital capacity. The studies carried out by Banerjee (1968), Weill et al (1973) indicate a loss in VC of the workers exposed to asbestos. Harries (1973) and Becklake et al (1972) found definite relationship between the exposure to asbestos and the decrease in vital capacity. When the pulmonary function tests were compared according to smoking habits, only VC was seen significantly reduced in both non-smokers and smokers of the exposed group (Table-40).

TABLE-40

Comparison of PFT According to Smoking Habits in Control and Exposed Workers

	Non-Smoker		Smoker	
	Control (20) (Mean ± S.E,M.)	Exposed (32)	Control (10) (Mean ± S.E.M.)	Exposed (33)
VC (lit)	3.46 ± 0.12	2.70 ± 0.10**	3.49 ± 0.13	3.02 ± 0.11*
$FEV_{1\cdot0}$%	81.73 ± 1.45	83.00 ± 2.04	79.15 ± 1.73	81.26 ± 1.45
$FEF_{200-1200}$ ml (lit/sec)	4.87 ± 0.36	4.69 ± 0.35	3.77 ± 0.51	4.26 ± 0.38
FEF_{25-75}% (Lit/sec)	3.03 ± 0.25	3.18 ± 0.28	2.99 ± 0.22	2.68 ± 0.20

*P <0.05; ** P <0.01 compared to respective controls.
Figures in parenthesis indicate the number of workers.

Other functional parameters were not much affected. Since smoking causes loss of ventilatory function, the significant loss of VC in smokers can be attributed to the synergestic affect of asbestos dust and smoking habits, whereas in non-smokers, the loss of VC can be interpreted due to the effect of dust alone. Wallac and Langlands (1971) in their study of the asbestos exposed workers reported a considerable impairment of

lung function, i.e., vital capacity, and the authors concluded that smoking and exposure of asbestos have additive effects in causing impairment of lung function. But the present results indicate that in non-smokers, there was more loss of vital capacity than in smokers. McDonald et al (1974) reported that both VC and $FEV_{1\cdot0}\%$ can decrease to similar extent with increasing dust exposure, but in smokers $FEV_{1\cdot0}\%$ will only be affected. Present studies (Ann. Rept., 1976b : 1979d) have also shown the effect of smoking on lung function.

Table-41 shows the radiological findings in exposed workers. It is seen that 6 (9.2%) of the total subjects were having small regular or

TABLE-41

Findings of Chest X-rays in Exposed Workers

Radiological Abnormalities	No. of Workers
Regular opacities	3 (4.6)
Irregular opacities	1 (1.5)
Regular and irregular opacities	2 (3.1)
Total	6 (9.2)

Figures in parenthesis indicate pcrcentages.

irregular opacities either separately or combined. The small regular opacities suggest the past exposure to some mineral dust or silica. It is interesting to note that all the six subjects were having cough with expectoration, five were exposed to less than five years and all were from yarn division and smokers. On clinical examination they all had crepitations.

On sputum examination 10 subjects showed asbestos bodies which merely suggest the past exposure to asbestos. Banerjee (1968) reported in 16 out of 19 sputum examinations, the presence of asbestos bodies.

SUMMARY

(1) Total and respirable dust and asbestos fibre concentrations in the work environment were found much higher than TLV in this factory.

(2) The affected working population was young and was exposed to high levels of asbestos dust. The working and living conditions of these workers were very poor.

(3) Nearly half of the working population was having respiratory symptoms in one form or another and more than one-fourth were having crepitations.

(4) The signs of nutritional deficiency were present in many subjects.

(5) The reduction in VC in exposed workers suggests the presence of restrictive type of lung disorders.

(6) The reduction in VC was irrespective of smoking habits, but was found more in non-smokers than smokers.

(7) Nine percent of the workers were having small regular or irregular opacities in chest X-rays.

(8) Fifteen percent of the total subjects showed the presence of asbestos bodies in sputum.