The Study Project for Health Hazards Evaluation in Asbestos-Processing Industries in Thailand

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Abstract

This study project was conducted as a major activity of the National Institute for the Improvement of Working Conditions and Environment (NICE) in 1999 through 2001. The objectives are: 1) to determine average airborne asbestos concentrations in various work processes compared to the standards; 2) to identify other occupational safety and health (OSH) problems; and 3) to recommend appropriate preventive and control measures for working environment improvement. Eleven workplaces were selected for this study, categorized into 4 industrial groups. A total of 107 air samplings was conducted to determine levels of asbestos concentration. A Questionnaire survey was also conducted to evaluate workers' health conditions and other OSH issues. From laboratory analyses, 36.45% of the air samples examined exceeded the permissible exposure limit of 5 fibers/cc. Moreover, a significant proportion of workers did not use any, or used inappropriate, protective measures. Recommendations aimed at working environment improvement were formulated for employers, workers, and concerned authorities. Extensive follow-up inspections have been carried out by local labour protection offices. Overall, harmful working environments have been continually eliminated. The outcomes from this study have been used as guidelines for further OSH planning and activities in Thailand.

Introduction

In Thailand, only 2 types of asbestos (chrysotile and amosite) were allowed for industrial use at the time of study. Health hazards associated with asbestos have been widely recognized in the country. Thus, the import and possession of this hazardous substance are strictly under control. The amounts of asbestos imports into the country are shown in Table 1.

Table 1. Asbestos imports in 1998-2001

Types of Asbestos	Amount (Tons)			
	1998	**1999**	**2000**	**2001**
▪ Amosite	1,431.65	8,623.8	7,584.0	7,571.0
▪ Chrysotile	58,032.75	100,160.9	117,491.8	122,319.7
Total	**59,464.4**	**108,784.7**	**125,075.8**	**129,890.7**

Source: The bureau of hazardous substances control

From the year 2002, amosite has been banned and withdrawn from all commercial uses in Thailand.

Despite the large amounts of asbestos imported into Thailand, the number of asbestos-processing industries was contrarily small. There was no case of confirmed asbestosis in the country during recent years; however, some significant numbers of occupational pulmonary diseases were reported by the workmen's compensation funds. Specific study on occupational safety and health in such

industries was needed. Therefore, the National Institute for the Improvement of Working Conditions and Environment (NICE) decided to implement this study project in 1999 through 2001.

Subjects and Method

This study was targeted at all asbestos-processing industries. However, there were difficulties in locating such industries since there were not many present in the country. All registered industries involving asbestos processing were contacted to participate in this study. Almost all of them were in the Bangkok area and nearby provinces.

The survey and environment assessment of health hazards were conducted in 11 workplaces of various processes. The processes were categorized into 4 industrial groups, which are; brake pad, clutch, roof-tile, cement duct and other cement products. All involved the use of asbestos in friable form.

Air samplings were conducted in the breathing zone of each single worker (see figure 1). The equipment consisted of MSA personal sampling pumps (U.S.A.) connected to 25 mm mixed cellulose ester membrane filter with conductive cowl on cassette. Calibrations of air flow were performed using MSA flow meter. The flow rate was set at approx. 1.0-1.5 litres/min. Sampling time was approx. 1 hour for each worker. These workers were selected randomly from all work processes dealing with asbestos exposure. The total number of samples was 107.

Figure 1. Personal air sampling for asbestos

Laboratory analysis was performed in accordance with the NIOSH Manual of Analytical Method – 4th Edition (# 7400). We utilized the computerized asbestos analytical system, equipped with a phase-contrast microscope and software for asbestos counting and sizing assistance (shown in figure 2). The concentration of asbestos in the air from each sample was calculated.

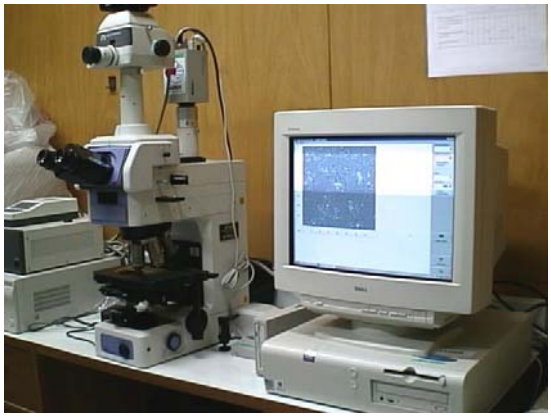

Figure 2. Computerized asbestos analytical system

Questionnaire surveys were conducted to collect data for evaluation of workers' health conditions and other OSH issues. The health hazards were evaluated by comparing the results of air samplings to the OSH standards. The standards used were: 1) local standard: the permissible exposure limit (PEL) for asbestos (5 fibers/cc, time-weighted average for 8 hour work) issued as Thai OSH legislation; and 2) international standard: the threshold limit values (TLV) for asbestos (0.1 fibers/cc, time-weighted average for 8 hour work) recommended by the American Conference of the Governmental Industrial Hygienists (ACGIH), and the U.S. National Institute of Occupational Safety and Health (NIOSH). The results for each work process were also compared to estimated ranges of concentration from similar studies conducted in other countries.

Results

This study revealed that the airborne asbestos concentrations ranged from 0.01 to 43.31 fibers/cc, averaging 5.45 fibers/cc (see tables 2 and 3).

Table 2. Asbestos concentrations, all industries

Industry	No. of samples	Concentration (fiber/cc)			
		Min	Max	Average	S.D.
Brake pad					
▪ Industry # 1	29	0.24	43.31	10.20	10.91
▪ Industry # 2	7	0.91	10.36	4.73	0.38
▪ Industry # 3	12	0.97	13.79	4.44	3.84
▪ Industry # 4	24	1.69	32.77	5.49	6.46
▪ Industry # 5	5	0.66	18.91	7.35	7.08
Clutch					
▪ Industry # 1	6	0.62	2.41	1.61	0.70
▪ Industry # 2	7	0.49	1.69	1.25	0.47
Roof-tile					
▪ Industry # 1	2	0.63	1.66	1.15	0.72
▪ Industry # 2	10	0.01	2.20	0.72	0.77
▪ Industry # 3	1	0.58	0.58	0.58	0.00
Cement products					
▪ Industry # 1	4	0.26	2.10	0.94	0.81
Total	**107**	**0.01**	**43.31**	**5.45**	**7.53**

Table 3. Percentage of samples exceeding standard, by work process

Industrial process	Ave. conc. (fiber/cc)	% Exceeding standard	
		Thai PEL	Intl. TLV
Brake pad	***6.93***	***48.75***	***100.00***
▪ Mixing	10.59	100.00	100.00
▪ Hot molding	3.39	20.83	100.00
▪ Cold molding	9.90	50.00	100.00
▪ Pressing	3.26	25.00	100.00
▪ Cutting/Punching	8.60	59.25	100.00
Clutch	***1.45***	***0.00***	***100.00***
▪ Weaving	1.33	0.00	100.00
▪ Cutting/trimming	1.50	0.00	100.00
Roof-tile & Cement	***0.81***	***0.00***	***76.47***
▪ Preparing	1.00	0.00	87.50
▪ Mixing	0.66	0.00	57.14
▪ Shaping/trimming	0.24	0.00	100.00
Total	5.45	36.45	96.26

Of the 107 measurements, 39 samples (36.45 %) exceeded the TLV (5 fibers/cc) issued by the Thai government. According to ACGIH TLV and NIOSH recommended PEL (0.1 fiber/cc), however, as many as 103 samples (96.26 %) exceeded such standards. The mean concentrations of asbestos in brake industries, clutch industries, and cement products industries, were 6.93, 1.45, and 0.81 fiber/cc, respectively.

In this study, the comparative results of asbestos concentration measurement are described by work process. Among the highest concentrations, most were taken from asbestos-mixing processes, especially in brake industries. Meanwhile, the comparison with estimated concentration levels from similar studies in other countries showed that most values from this study are well below those estimations (see table 4).

Table 4. Comparative study to estimate ranges

Industry	Conc. Range from this study (fiber/cc)		Estimated Conc. Range (fiber/cc)	
	Min.	**Max.**	**Min.**	**Max.**
Brake pad	0.24	43.31	10.5**	37.3**
Clutch	0.62	2.41		
Roof-tile&Cement	0.01	2.2	8.0***	40.0***

** J. William Lloyd, US-NIOSH (1975).
*** Alfred Franzblau, University of Michigan (1998).

For the survey questionnaire, data were collected from the total of 668 workers. This survey focused on the use of engineering control by means of ventilation systems and personal protective equipment, as well as workers' hygiene. A large proportion of them used inappropriate blowing fans which brought about more dispersion of asbestos fibers into the air. Only 10.8 % worked with appropriate local exhaust hoods. The distribution of ventilation systems used at the workplaces is summarized in table 5.

Table 5. Distribution of ventilation systems

Type of Ventilation	Number of Involved Workers
Not used	164 (24.5 %)
Local exhaust ventilation	72 (10.8 %)
Sucking fan	110 (16.5 %)
Blowing fan	288 (43.1 %)
Others	34 (5.1 %)

As for personal control measures used by the workers, the majority (nearly 80 %) used respiratory protective devices (see table 6). However, many of these devices were not the correct type or insufficient for protection. In addition, from observation, some workers did not wear such devices all the time during their work.

Table 6. Use of respiratory protective devices

Type of Respirator	Number of Workers
Not used	138 (20.7 %)
Improper cloth mask	316 (47.3 %)
Dust mask	106 (15.9 %)
Filter-type mask	107 (16.0 %)
No answer	1 (0.1 %)

To minimize contamination by asbestos, workers' personal hygiene was another issue studied. The survey indicated that only about 25 % and 21 % of workers, respectively, change their clothing and take a bath, before leaving their workplaces (see table 7).

Table 7. Workers' personal hygiene

Workers' Practice	Yes	No
Change clothing	172 (25.7 %)	496 (74.3 %)
Take a bath	146 (21.8 %)	522 (78.2 %)

Others relevant minor issues were also included in the survey, e.g. smoking habits, medical history, health conditions, etc. Proper recommendations were given immediately to each particular worker at the time of interview.

Conclusion and Discussion

It can be said that a significant number of workers in asbestos-processing industries in Thailand were employed in hazardous working conditions and environment. A large proportion of air samples yielded results that exceeded permissible exposure limits. Workers in asbestos-mixing processes, especially in brake industries, are among those working under the considerably highest risk. However, in this study, there were possibly extraneous factors affecting the results of air sampling. For instance, abnormal weather conditions such as high humidity and temperature, air flow, work load, etc.

Recommendations were formulated for the employers, workers, and concerned authorities.

For employers:

Obviously, the use of protective and control measures need to be improved. Proper preventive measures need to be employed in each particular workplace, while environmental monitoring needs to be continued. Work processes involving asbestos exposure must be separated from other working areas. Preventive and control measures must emphasize the improvement of working conditions and environment to minimize asbestos contamination. Especially, the application of engineering controls such as installing local exhaust ventilation systems, using wet systems with enclosure at the sources of asbestos release. Employers were encouraged to provide appropriate respiratory protective devices for workers, as well as relevant training to build-up their awareness. Meanwhile, environmental monitoring must be conducted on a regular basis. Good housekeeping was another important issue. To keep workplaces clean, promotional campaigns such as 5s activity should be run actively. Health surveillance should be done by providing involved workers with specific annual examinations; necessary facilities, such as shower rooms, personal lockers, etc. for workers, should also be provided.

For workers:

Safe work practices were emphasized. Workers must follow all workplace regulations, especially the use of appropriate personal protective devices and taking care of their personal hygiene, to avoid asbestos contamination. Penalty measures might be applied. Additionally, workers should play important role in the improvement of their working conditions and environment.

For government:

The use of asbestos for commercial purposes must be under more close supervision by concerned authorities. The intensity level of asbestos control should be stepped-up each year, leading to a ban

on all kinds of asbestos in the future. At the same time, the permissible exposure level for asbestos which is in effect under the Thai OSH legislation also needs to be revised so as to be consistent with the recommended international standards.

However, after close monitoring and stepped-up enforcement by the concerned authorities, the situation has become more positive. The working conditions and environment of asbestos-processing industries has been actively improved. The use of asbestos has also been continually switched to other less hazardous alternative substances. Since 2002, amosite has been banned in Thailand so that there has been only chrysotile in commercial use. Several workplaces included in this study project have stopped using asbestos, while one of them has ceased operation.

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