ASSESSMENT REPORT

ASSESSMENT OF ASBESTOS FIBERS IN AMBIENT ENVIRONMENT IN SELECTED INDOORS HOUSES IN RURAL FELDA SETTLEMENT AREAS

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RESEARCH TITLE:

ASSESSMENT OF ASBESTOS FIBERS IN AMBIENT ENVIRONMENT IN SELECTED INDOORS HOUSES IN RURAL FELDA SETTLEMENT AREAS

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EXECUTIVE SUMMARY

This study aims to assess the concentration of asbestos fibre in air in houses in FELDA Sungai Tengi, Selangor within the west coast of Peninsular Malaysia. Ten houses with asbestos roofing were selected for assessment. One of the house covered the asbestos roofing with ceiling. Of the ten houses, nine assessment was conducted indoor and one assessment was conducted outdoor. The assessment method was adapted from the NIOSH NMAM 7400. Air sampling pump was used to assess air concentration of asbestos for eight hours in each house. The sampling rate chosen was 2L/min for 240 minutes (4 hours). Therefore, for each location, two cassettes were used for 8 hours measurement from morning to late afternoon to ensure the quality of data. Analysis of asbestos fibers was performed in the National Institute of Occupational Health (NIOSH) in Bangi, Selangor. PCM was used to analyse the number of fibre drawn onto a cassette with a filter of 0.45 to 1.2 μm mixed cellulose ester membrane, 25 mm diameter, 50 mm conductive cowl by microscopy at 400x to 500x magnification. Findings from observation indicated that the environment of the FELDA settlement was clean with no nearby activities related to dust such as quarries or manufacturing processes. The condition of asbestos roofing in all houses was good with no detectable friable asbestos materials. Results of laboratory analyses showed that the level of asbestos fibre was non-detectable indicating that the concentration of asbestos sampled was very low which could not be detected by the assessment and definitely lower than the permissible exposure limit proposed by US NIOSH and UK OSHA.

1.0 INTRODUCTION

In Malaysia, data on asbestos-related diseases are very limited. The first attempt to identify the health effect of asbestos on factory workers examined medical surveillance data on 1000 Asbestos Cement workers from 1995 to 1997 (Lim et. al., 2002). Only two cases of asbestosis and one case of bronchial cancer were found. Levels in ambient environments in Malaysia have not been characterized in detail and there has never been any report of established levels that the public may have been exposed to thus far.

Lack of data may lead to misleading estimation of the risk of asbestosis-related diseases in Malaysia. As such, there is a need to conduct a representative study on public exposures to asbestos. This is the first ever exposure assessment study conducted in Malaysia to measure asbestos in ambient air. Data obtained contribute to the huge gap in knowledge in terms of ambient asbestos level that is currently present. It is hoped that the outcome of this study will assist health officials in estimating the level of exposure that the public are currently being exposed to. The outcome of this study can be used by other parties to fulfill the need for further deliberation on the legislation needs in Malaysia.

The use of asbestos in Malaysia is highest and widespread among the population of FELDA settlers (Abdullah and Mat Derus, 2015). It has been reported that the use of chrysotile asbestos among the FELDA settlers were for roofing purposes as the product is cheap and durable. As such, measurements performed in the selected homes located in FELDA settler area represents close general exposures (if any) of asbestos to the public.

2.0 OBJECTIVE OF THE STUDY

This study aims to measure airborne asbestos fibers and identify the type of asbestos fibers in selected areas (namely homes and indoor spaces where general public is present) where asbestos material is used to represent the exposure faced by the indoor inhabitants in these spaces.

3.0 SITE VISIT TO FELDA SUNGAI TENGI

Figure 3 presents the map area of Malaysia detailing the location of FELDA Sungai Tengi. A site visit was performed on 30th March 2019 to identify the distribution of homes and public areas in which asbestos roofing is still used. From the visit, the public congregation areas such as mosques, community hall, multi-purpose hall and schools were new buildings and did not use asbestos roofing material. Only houses that still using the asbestos roofing materials were included in this study. From the site visit and at the specific cross-sectional time line, no visible work such as installation of asbestos roofing was actively being performed in the FELDA area. As such, the measurements performed only represent a resident’s exposure to asbestos. The air of the environment was clean.

4.0 RESEARCH METHOD

4.1 Sampling Location

The sampling location selected for this was FELDA (Federal Land Development Authority) settlement within the west coast of Peninsular Malaysia. The selected FELDA was FELDA Sungai Tenggi, one of the the oldest FELDA settlement in Malaysia. It is located closely to Kuala Lumpur (within 84 km).

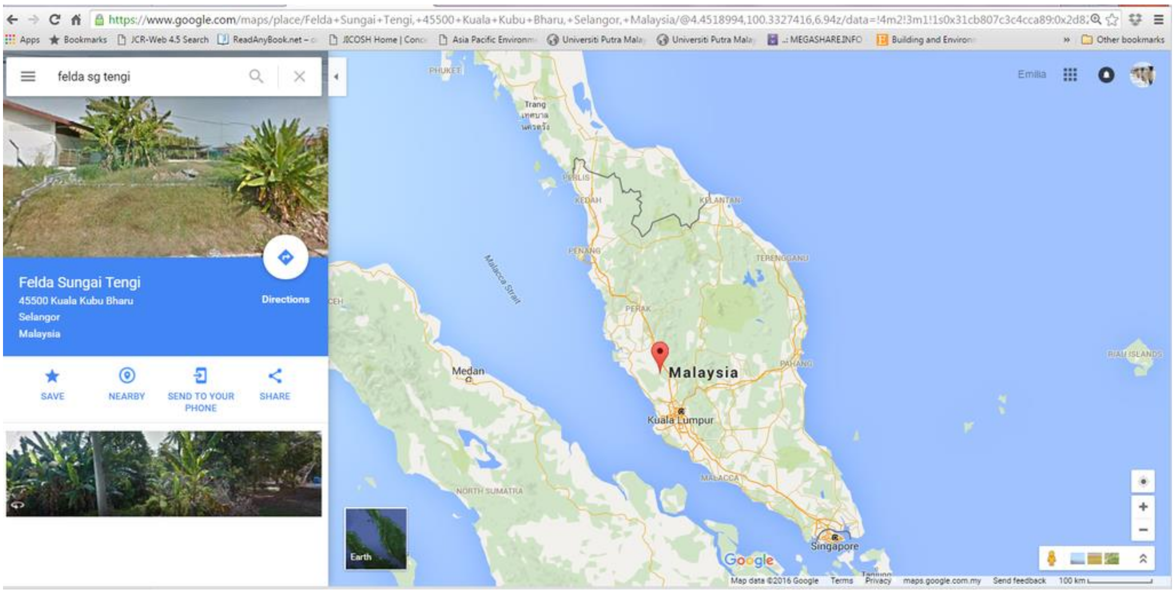


Figure 1: The location of FELDA

The areas of sampling were

a) Indoor of nine selected homes
b) Outdoor of one selected home

Only houses with asbestos roofing were selected randomly in the FELDA for the sampling. For indoor and outdoor, sampling was done directly under the asbestos roofing in the middle of the house for indoor (See Figure 2) and in the middle of the outdoor area (Figure 3).

Figure 2: Setting up of sampling instrument indoor

Figure 3: Outdoor sampling instrument being setting up.

4.2 Asbestos measurement method

Asbestos air sampling was performed by drawing a known volume of air through a mixed cellulose ester (MCE) filter. The method for this study follows closely on the asbestos sampling standard operating procedure which have been laid out by the Environmental Response Team, Environmental Protection Agency (EPA, 1994) and the United Kingdom's Fibers in air: Methods for The Determination of Hazardous Substances (MDHS) 87 (Health Safety Executive, 1998). This method describes the collection of airborne asbestos fibers using calibrated sampling pumps with MCE filters (from pre-loaded cassettes purchased commercially) and analysis by the Phase Contrast Microscopy (PCM).

4.3 Equipment and sampling assembly

Equipment for asbestos sampling is as explained in the following.

a) Filter Cassette

The cassettes are purchased with the required filters in position. When the filters were in position, a shrink cellulose band or adhesive tape was applied to cassette joints to prevent air leakage. An example of the pre-loaded cassette is as presented in Figure 4 and 5. No preservation is required for asbestos samples.

Figure 4: 25mm Preloaded Asbestos PCM Cassettes (Label in blue) (Commercially available)

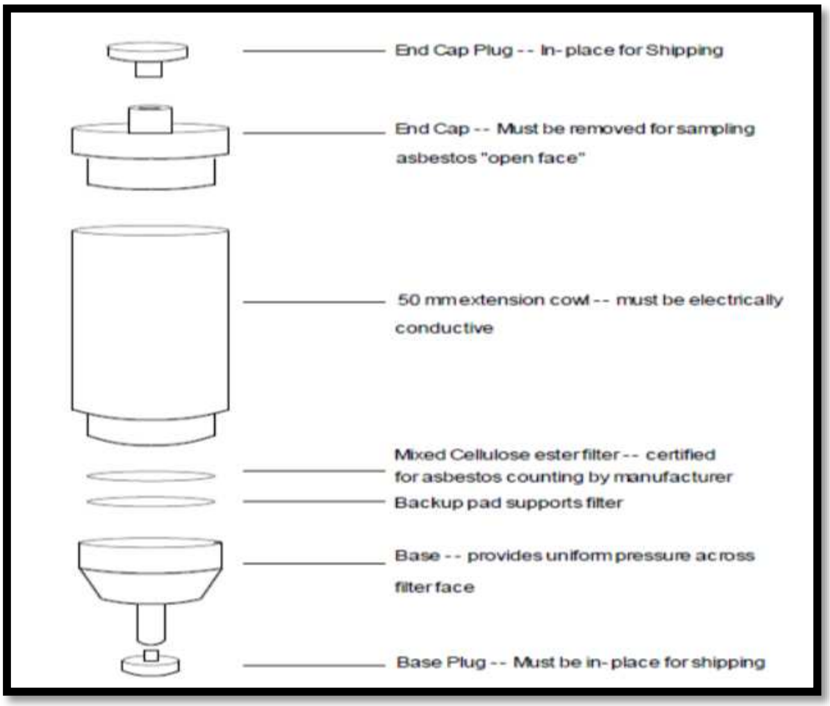


Figure 5: Exploded view of asbestos sampling cassette

According to the NIOSH Method 7400 (NMAM 7400) (See Appendix A), PCM involves using a 0.45 to 1.2 µm mixed cellulose ester membrane, 25 mm diameter, 50 mm conductive cowl on cassette.

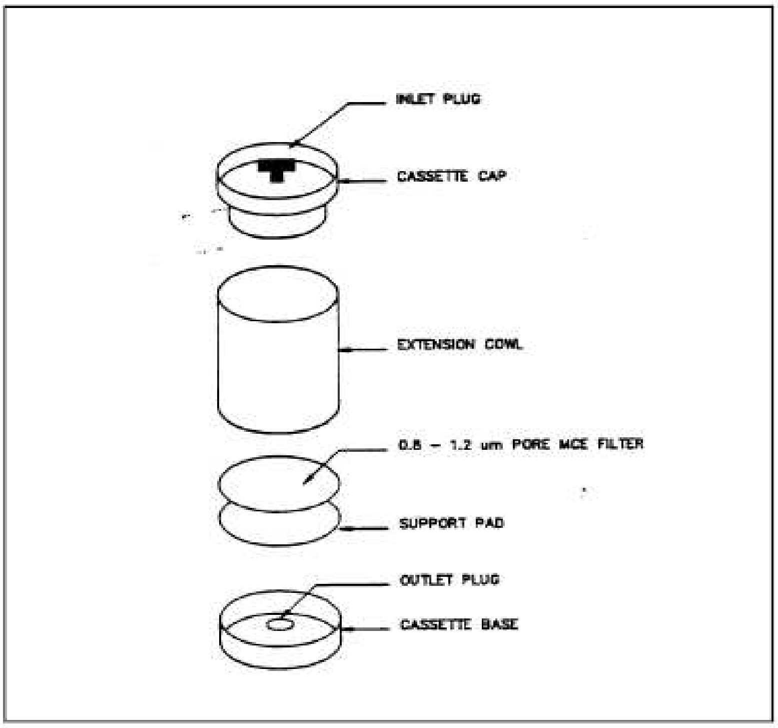


Figure 6 Exploded view of Phase Contract Microscopy Filter Cassette

b) Sampling pump and air flow

In this study, the sampling pump used is shown in Figure 7. The following are the NIOSH analytical method for PCM (Center of Disease Control or CDC, 1994). See Appendix A.

i. The minimum recommended volume for PCM is 400 L at 0.1 fiber/cc. Sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (700 to 2800 L) is appropriate in non-dusty atmospheres containing 0.1 fiber/cc.
ii. In relatively clean atmospheres such as in this proposed study where targeted fiber concentrations are much less than 0.1 fiber/cc, larger sample volumes (3,000 to 10,000 L) shall be used to achieve quantifiable loadings.

Figure 7: Air Sampling Pump (Gillian)

c) Pump calibration

Sampling pumps was calibrated immediately before and after each use. Preliminary calibration was conducted using a primary calibrator such as a soap bubble type calibrator (See figure 8) with a representative filter cassette installed between the pump and the calibrator. Equipment required for pump calibration were:

i. Stopwatch
ii. Bubble tube/burette or electronic meter

Following are the calibration procedures:

i. Calibration train was set up using a rotameter, sampling pump, and a representative sampling cassette.

ii. In the calibration train, one end of the PVC tubing (approx. 2 ft) was attached to the cassette base; the other end of the tubing was attached to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.

iii. The base of the flow meter was assembled with the screw provided and tightened in place. The flow meter was mounted within 6^{o} vertical.

iv. The sampling pump was turned on.

v. The flow adjust screw (or knob) on the personal sampling pump was turned on until the float ball on the rotameter was lined up with the pre-calibrated flow rate value. A sticker on the rotameter should be indicated this value.

vi. A verification of calibration was performed on-site in the clean zone immediately prior to the sampling.

1.0

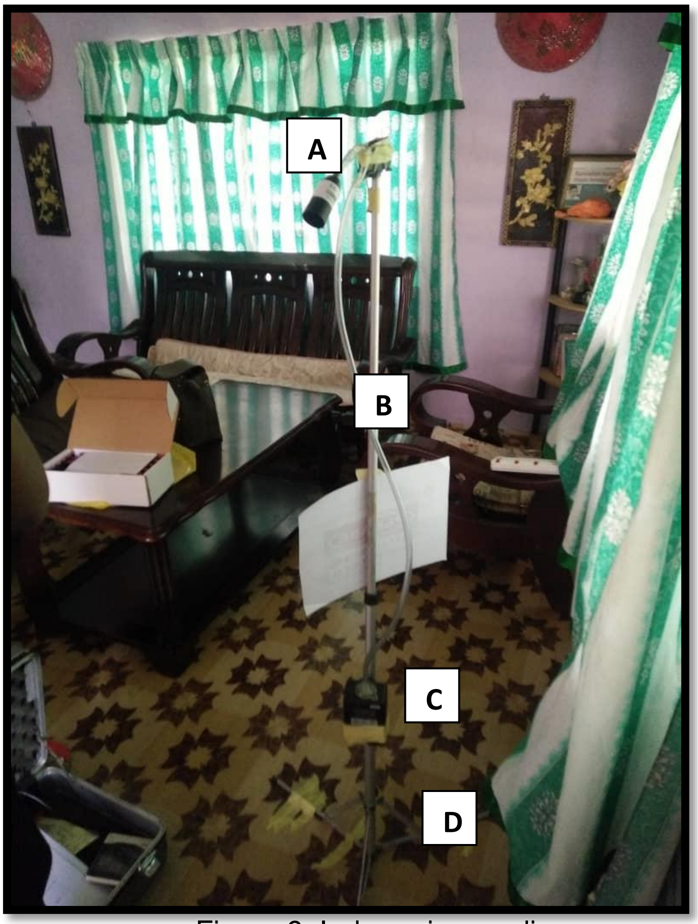
Figure 8: Gillian Sampling Pump Calibrator

In this study, the sampling pump used is shown in Figure 7. The sampling rate chosen was 2L/min for 240 minutes (4 hours). Therefore, for each location, two cassettes were used for 8 hours measurement from morning to late afternoon to ensure the data quality.

There were 10 houses involved. All houses selected used asbestos roofing. One house which used asbestos roofing but covered with ceiling was purposely chosen to see the difference of air asbestos fibre concentration. The duration of measurement was 8 hours for each house and one filter for every 4 hours which gave the total number of samples to 20. Three blank samples were also measured for indoors. Blank samples were used to determine if any contamination has occurred during sample handling. The setting up of the instruments is shown in Figure 8.

4.4 Sampling procedure

The asbestos roofing condition in each selected houses were inspected prior to the air sampling and be recorded. The sampling rate chosen was 2L/min for 240 minutes (4 hours). Therefore, for each location, two cassettes were used for 8 hours measurement from morning to late afternoon to ensure the data quality. There were 10 houses involved. The duration of measurement was 8 hours for each house and one filter for every 4 hours which gave the total number of samples to 20. Three blank samples were also measured for indoors. Blank samples were used to determine if any contamination has occurred during sample handling. The setting up of the instruments is shown in Figure 9. The details of the sampling procedure is as presented in Figure 10.



Label	Equipment
A	Filter Cassette
B	PVC Tube
C	Air Sampling pump
D	Tripod

Figure 9: Indoor air sampling

The point where the base and cowl of each cassette meet was sealed with a gel band or tape.

↓

The pumps were charged completely before beginning.

↓

Each pump was connected to a calibration cassette with an appropriate length of 6-mm bore plastic tubing.

↓

Appropriate flow rate (2L/min) was set up for the situation being monitored to ensure the filter not overloaded

↓

Each sampling pump was calibrated before and after sampling with a calibration cassette in-line. A primary standard (e.g. bubble burette) was used to calibrate each pump at the sampling site.

↓

Each pump was connected to the base of each sampling cassette with flexible tubing. The end cap of each cassette was removed and each air sample taken from open face. Each sample cassette was held open side down with the average height of breathing zone during sampling.

↓

Three blanks were prepared which is around 10% of the samples. The blank samples were handled in the same manner as air samples with one exception: Air was not drawn through the blank samples. The blank cassette was open and held it for about 30 seconds at the same spot of the actual sampling. The cassette was closed and sealed appropriately. The blanks were stored for transportation with the sample cassettes.

↓

Each cassette was closed and sealed immediately after sampling with the base and plastic plugs. The filter membrane cannot be touched to esnure the quality of the anlayses.

↓

A seal was attached around each cassette in such a way as to secure the end cap plug and base plug. The ends of the seal was taped together since the seal was not long enough to be wrapped end-to-end. The tape around the cassette was wraped at each joint to keep the seal secured.

Figure 10: Asbestos sampling procedure

4.5 Analysis of asbestos fibers

The sealed cassettes with paperwork requesting asbestos analysis was sent to the national Institute of Occupational Health (NIOSH) in Bangi, Selangor (See Appendix B). Analysis of asbestos fibers was performed in a reference laboratory according to NIOSH Method 7400. This analyses was conducted at an accredited laboratory in NIOSH Bangi which has complete facilities (Figure 11). In the analysis, when preparing the sample in the lab, the filter was treated with acetone (to collapse) and triacetin (to immerse) to make it transparent and then was analyzed by microscopy at 400x to 500x magnification, with phase-contrast illumination, using a Walton-Beckett Graticule. A fiber is defined as any particle with a length >5μm and a length-to-diameter ratio of >3:1. See Figure 12.

4.6 Quality Assurance and Quality Control

All quality assurance and quality control requirements from the laboratories as well as the analytical methods was followed to ensure the integrity of the results. One of the requirements is for the analysis of lot blanks, field blanks and laboratory blanks, notwithstanding the need for performing duplicates of the sampling to ensure that the results are reliable.

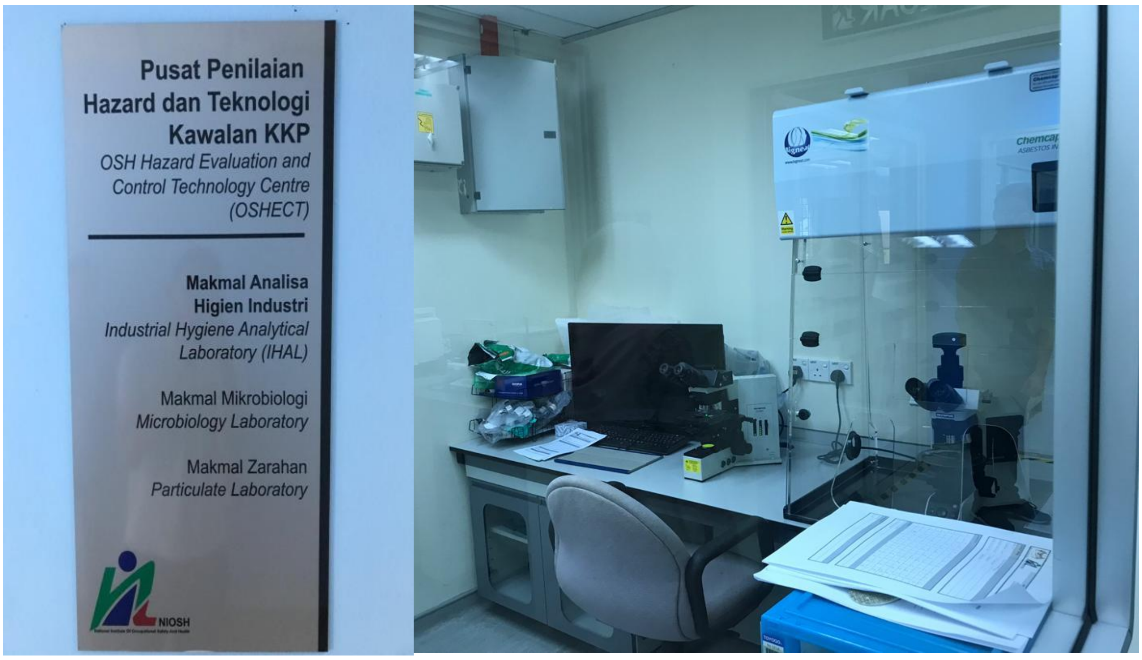


Figure 11: Laboratory Equipment in NIOSH

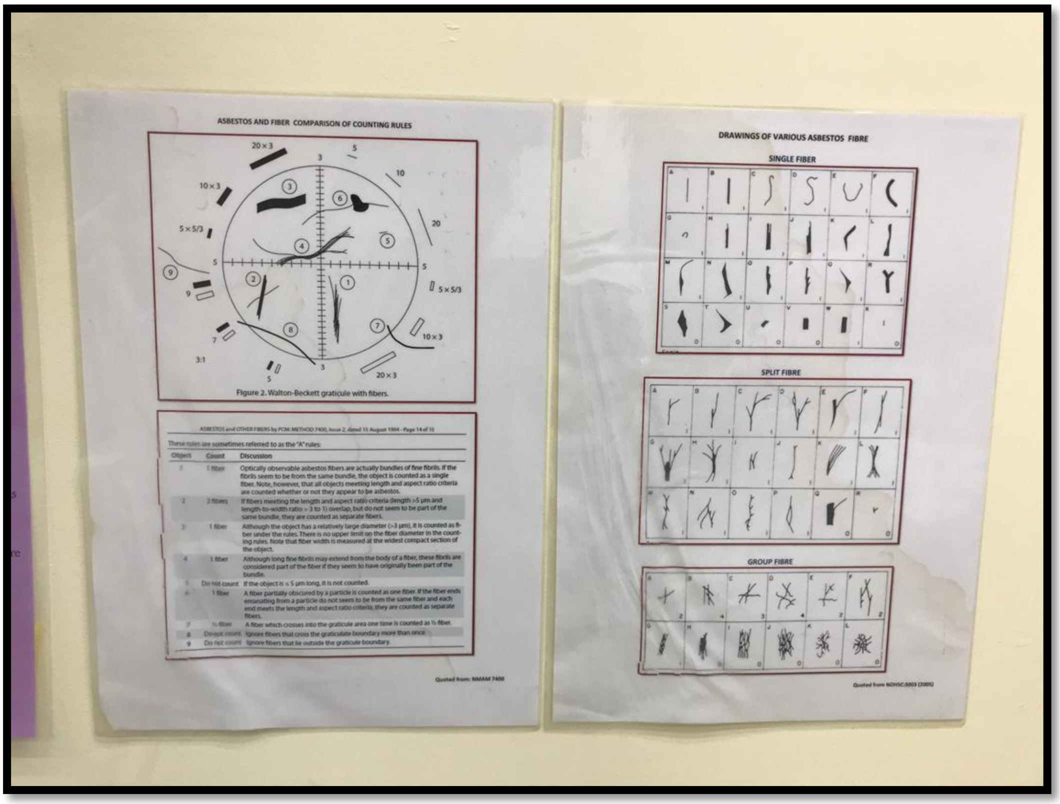


Figure 12: Characteristics used to determine asbestos fibre.

5.0 RESULTS

The condition of asbestos roofing for each house was good. No visible friable asbestos materials was identified. See figure 13 and 14.

Figure 13: Houses with asbestos roofing

Figure 13: Indoor asbestos roofing

Samples of asbestos was sent to the National Institute of Occupational Safety and Health (NIOSH) located at Bangi, Selangor Malaysia. Figure 1 indicates the sampling filter analysed under the microscope. The identification of fibre was based on the characteristics in Figure 12. Table 1 contains results from the laboratory analyses of asbestos.

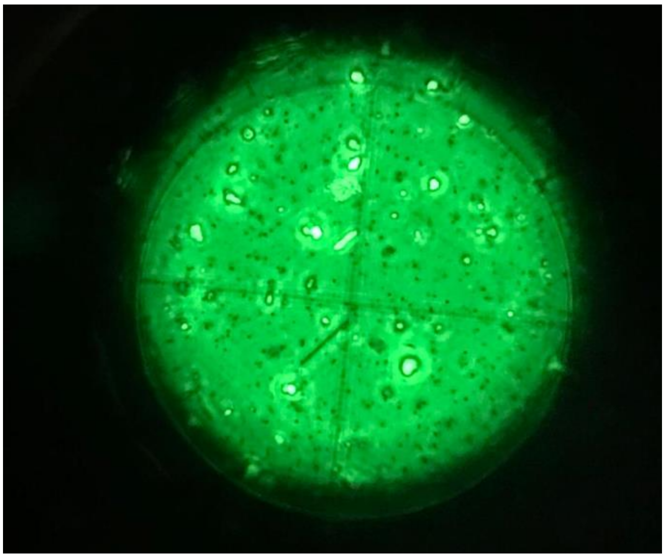


Figure 1: Filter of asbestos sample analysed by microscopy with PCM

Conversion of unit from fb/mm^2 to fb/cc

The original results provided by the NIOSH was in unit of fb/mm^3. The calculation is based on the following formula proposed by the NMAM 7400. Since the obtained value of fibre in fb/mm^3 was zero, the value in fb/cc also become zero.

$$C = \frac{EAc}{V \times 10^3}$$

V = L

A_c = Effective collection area (mm^2)

E = Fibre density (fb/mm^2)

C = Unit of (fb/cc)

$$= \frac{0 \times 385mm^2}{4\ L \times 10^3}$$

= 0 fb/cc = non-detectable.

Table 1: Level of asbestos analysed from laboratory analyses

NO	Sample ID	Environmental ID	Parameter	Result per sample (fb/cc)	Method
1	13(1) 30/3 indoor (house 1-morning)	E11992/19	Total Fiber	ND	NMAM 7400
2	13(2) 30/3 indoor (house 1-afternoon)	E11993/19	Total Fiber	ND	NMAM 7400
3	12(1) 30/3 indoor (house 2-morning)	E11994/19	Total Fiber	ND	NMAM 7400
4	12(2) 30/3 indoor (house 2-afternoon)	E11995/19	Total Fiber	ND	NMAM 7400
5	11(1) 30/3 indoor (house 3-morning)	E11996/19	Total Fiber	ND	NMAM 7400
6	11(2) 30/3 indoor (house 3-afternoon)	E11997/19	Total Fiber	ND	NMAM 7400
7	9(1) 30/3 indoor (house 4-morning)	E11998/19	Total Fiber	ND	NMAM 7400
8	9(2) 30/3 indoor (house 4-afternoon)	E11999/19	Total Fiber	ND	NMAM 7400
9	7(1) 30/3 indoor (house 5-morning)	E12000/19	Total Fiber	ND	NMAM 7400
10	7(2) 30/3 indoor (house 5-afternoon)	E12001/19	Total Fiber	ND	NMAM 7400
11	13(1) 31/3 indoor (house 1-morning)	E12002/19	Total Fiber	ND	NMAM 7400
12	13(2) 31/3 indoor (house 1-afternoon)	E12003/19	Total Fiber	ND	NMAM 7400
13	12(1) 31/3 indoor (house 2-morning)	E12004/19	Total Fiber	ND	NMAM 7400
14	12(2) 31/3 outdoor (house 2-afternoon)	E12005/19	Total Fiber	ND	NMAM 7400
15	11(1) 31/3 indoor (house 3-morning)	E12006/19	Total Fiber	ND	NMAM 7400
16	11(2) 31/3 indoor (house 3-afternoon)	E12007/19	Total Fiber	ND	NMAM 7400
17	9(1) 31/3 outdoor (house 4-morning)	E12008/19	Total Fiber	ND	NMAM 7400
18	9(2) 31/3 outdoor (house 4-afternoon)	E12009/19	Total Fiber	ND	NMAM 7400
19	7(1) 31/3 indoor (house 5-morning)*	E12010/19	Total Fiber	ND	NMAM 7400
20	7(2) 31/3 indoor (house 5-afternoon)*	E12011/19	Total Fiber	ND	NMAM 7400
21	Bi 31/3 indoor (blank)	E12012/19	Total Fiber	ND	NMAM 7400
22	Bii 30/3 indoor (blank)	E12013/19	Total Fiber	ND	NMAM 7400
23	Bi 31/3 indoor (blank)	E12014/19	Total Fiber	ND	NMAM 7400

*Indoor house asbestos roofing covered by ceiling.
Note: ND = Non detectable; NMAM = NIOSH Manual of Analytical Methods

6.0 DISCUSSION AND CONCLUSION

Results indicated that the concentration of asbestos fibre in the sampling location was non-detectable. The non-detectable value did not indicated that there was no fibre present in the air. It indicated that if there are presents of fibre in the air, the concentration is very low and cannot be drawn in through the pump throughout the sampling duration and the concentration is definitely below the permissible exposure level of asbestos proposed by the NIOSH US and OSHA UK. This results can be explained by the fact that the air of the study location appeared to be clean through naked eyes. There were also no active activities involving dusts for example quarries or asbestos factories near the study location.

Also, the condition of the asbestos roofing in each house was good with no detectable friable asbestos materials. According to the World Health Organization (2014), exposure to asbestos occurs through inhalation of asbestos fibres mainly from contaminated air in the vicinity of point sources or indoor air in houses containing friable asbestos materials. The WHO (2014) further explained that exposure can also occur during installation or removal of the asbestos roofing which was not covered in the current study. Therefore findings of the current study do not represent old houses particularly with friable asbestos roofing, houses that under the process of maintenance, alteration, removal and demolition.

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