INTRODUCTION

Asbestos has been known for centuries and is being used in hundreds of different types of products in industry as well as in daily life in countries around the world. With durability, insulation, sound proof and anti-friction, asbestos is now used in heat pipe, boiler cover, insulation, sound proof, roofing production etc.

In Vietnam, asbestos used in industries is mainly imported Chrysotile (white asbestos). Imported chrysotile is mainly used in asbestos cement roof sheet production. According to the report of Vietnam National Roof Sheet Association, at present with an average output of about 90 million m2/year, asbestos cement roof sheet factories have the annual consumption of about 52,000 tons of Chrysotile (White asbestos) [14].

Asbestos is one of the inorganic dust elements that harm workers exposed to the manufacturing process and is a toxic substance on the list of substances subject to strict occupational safety and health requirements. Asbestos and human health have been a pressing problem for decades. So far, it has been confirmed that Asbestos causes Asbestosis, lung cancer, mesothelioma, pleural thickening and calcification [42], [44].

Asbestosis is a pulmonary fibrosis disease, caused by asbestos with or without pleural fibrosis. Since 1950, the world has recognized asbestosis. In 1967, there were an estimated 20,000 workers in the UK with the disease. In Vietnam, in 1976, the Ministry of Health, the Vietnam General Confederation of Labour, Ministry of Labor, Invalids and Social Affairs recognized asbestos-related lung fibrosis as an occupational disease. However, until the year 2014, only three cases were recognized as asbestosis and compensated, representing a very small proportion compared to other occupational diseases in Vietnam [8].

Mesothelioma is a rare type of cancer with a low rate of incidence at 1-2 ‰ and in the last decade this rate increased in industrialized countries from 10 to 25 ‰ in 1990. Mesothelioma is an insured occupational disease in many countries in the world, but in Vietnam, only until 15 May 2016 was the disease included in the list of occupational diseases covered by social insurance.

Many authors in the world believe that this type of cancer is closely related to asbestos and usually occurs after 30 years of asbestos exposure [38], [39]. However, in Vietnam, several studies of mesothelioma, lung cancer have not clearly shown the link between the disease with the history of occupational exposure to asbestos. [12], [20], [29].

Many scientific studies in countries around the world have looked into the health of workers exposed to asbestos, but so far, the health effects caused by asbestos, especially Chrysotile, are still being debated globally and are a concern of many organizations in the country and abroad in recent times.

Many countries in the world have conducted studies on the effects of asbestos on human health, especially the risk of diseases such as asbestosis, mesothelioma, lung cancer due to exposure to asbestos. Studies have shown the effect of amphibole asbestos (brown and blue asbestos) is a risk factor for diseases such as asbestosis, lung cancer, mesothelioma (pleural, peritoneal, pericardial) etc. Particularly for white asbestos (chrysotile), based on the analysis of asbestos-related researches, some countries state that "there is no safety threshold for asbestos exposure" and prohibits the use of asbestos, including Chrysotile.

Contrary to the above opinion, some other studies on chrysotile asbestos have pointed out the major difference between chrysotile and crocidolite asbestos. "Amphibole asbestos is four times more likely to cause cancer than Chrysotile and 800 times more likely to cause mesothelioma" and argue that there is no scientific evidence to suggest that exposure to Chrysotile causes mesothelioma. From the

results of these studies, some countries favor the view that using asbestos in a controlled manner will not harm the health of workers in direct contact and the community.

In Vietnam, there have also been initial studies on the effects of asbestos on human health as well as on the development of asbestos-related disease monitoring systems, and national records on asbestos. However, to date, no comprehensive study has been conducted to assess objectively and in the most detail the effects of chrysotile asbestos on the health of the manufacturer and user of asbestos-cement roofing to decide a complete ban on the use of asbestos or a controlled use of Chrysotile asbestos.

In order to ensure safe production under International Convention 162, since 1998, the Government and other relevant ministries, agencies, and sectors have issued legal documents regulating measures to ensure the safety of workers in the production of AC roof sheets such as Joint Circular No. 1529/1998/TTLT-BKHCN-BXD dated October 17, 1998 promulgating regulations on measures to ensure the health and safety for workers in the production of AC roof sheets in Vietnam; Decision No. 09/2008/QD-BXD dated June 6, 2008 promulgating construction standards of Vietnam "Housing and public works - Life safety and health".

Decision No. 1469/2014/QD-TTg dated August 22nd 2014 of the Prime Minister approving the master plan on development of Vietnam's construction material industry through 2020 with a vision toward 2030 clearly states: The use of amphibole asbestos (brown and blue asbestos) for the production of roof sheets is strictly prohibited; By the end of 2015, fiber asbestos-cement roofing production lines must invest in technological equipment with the capability of automating bag opening, grinding and fiber quantifying processes; All fiber asbestos-cement roofing production establishments must have a waste water treatment system, must manage and reuse solid waste and waste water in the production process to meet the

environmental requirements. The Ministry of Construction has also directed organizations and agencies to carry out research on asbestos substitute material as well as coordinate with the Vietnam National Roof Sheet Association to strengthen the inspection and guidance of the asbestos-cement roofing production facilities to strictly follow the State's regulations on labor safety and hygiene, to study measures of handling the working environment, minimizing pollution and ensuring the health and safety of workers and communities.

To contribute to the assessment of the chrystotile material's effects on human health, following the guidance of the Deputy Prime Minister in Official Dispatch No. 5313/VPCP-KGVX dated July 16th 2014 of the Government Office, the Construction Hospital has conducted the study **"Researching the effect of chrysotile on the health of workers in manufacturing units and users of asbestos-cement roof sheets"**, with the following objectives:

1. Surveying the state of the labor environment and management of occupational safety and health in AC roof sheet manufacturing establishments.

2. Researching the state of occupational health and diseases of workers at AC roof sheet manufacturing establishments.

3. Providing a quick assessment of the health of AC roof sheet users in Tan Trinh commune, Quang Binh rural district, Ha Giang province.

CHAPTER I. OVERVIEW

1.1. Characteristics of asbestos fibers:

Asbestos is a non-flamable, highly insulating, heat-resistant and resistant to chemicals like acids and alkaline and is also highly wear-resistant.

Asbestos is a double chain silicate of calcium (Ca) and magnesium (Mg), containing SiO2 in nature. Based on structure, asbestos is divided into 2 groups:

Serpentine: Chrysotile (white asbestos), the serpentine subgroup has a curly fibrous habit and is the only type of asbestos which is still used widely in many countries in the world, especially in developing countries.

Figure 1.1. Chrysotile fibre

The amphibole group consists of: Actinolite, Amosite (brown asbestos), Crocidolite (blue asbestos), Tremolite, Anthophyllite. Amphibole fibers have an inosilicate form and are collectively called brown and blue asbestos. The use of this amphibole group has been prohibited in many countries including Vietnam [2], [4].

Figure 1.2. Amphibole fibre

1.2. The use of asbestos in the world

The industry of mining and using asbestos had experienced strong growth since the 19th century. Large asbestos mines in Canada, Russia, Finland, South Africa were exploited in large quantities. In recent decades, although millions of tons of asbestos were mined and used annually, asbestos consumption has seen a downward trend in countries all over the world. In 1980, the world consumed about 4.1 to 4.4 million tons of asbestos but by 1993 this figure decreased to 2.8 million tons. The Soviet Union's production of asbestos accounted for 58% the total amount of asbestos worldwide and it also used 90% of the mined amount. Canada, Zimbabwe, Brazil, China, South Africa are also producers and exporters of asbestos. While the demand for asbestos use in North America and West European countries has seen a decrease, asbestos consumption in Africa, Asia and Latin-America has increased.

In the world, the highest consumption of asbestos was around 5 million tons/year and began to decrease in 1980; in 2000, it was around 2 million tons (decreasing by 60% in the past 20 years). [20], [39].

In 2013, the total world production of asbestos was 2,019,000 tons, roughly equivalent to the production of 2011 (2,035,000 tons) and 2012 (1,988,000 tons). Among the 10 countries with the highest consumption are Brazil, Russia, Kazakhstan, Indonesia, India, China, Sri Lanka, Thailand, Uzbekistan, Vietnam, Ukraine and Colombia.

The data below shows the consumption of asbestos in these countries and the distribution of worldwide consumption during the 2009-2012 period.

Table 1.1: The world's largest consumers of asbestos

Country	2009	2010	2011	2012
China	625,000	614,000	638,000	531,000

India	322,000	407,000	303,000	473,000
Russia	277,000	258,000	283,000	196,000
Brazil	141,000	171,000	189,000	168,000
Indonesia	82,300	112,000	124,000	162,000
Uzbekistan	98,600	98,600	17,100	104,000
Vietnam	80,900	67,400	60,400	78,900
Thailand	103,000	79,300	81,400	58,000
Sri Lanka	16,000	47,900	61,100	54,700
Ukraine	63,600	60,300	55,900	42,000
Colombia	8,550	12,300	20,000	25,200
Mexico	17,100	13,800	10,200	17,000

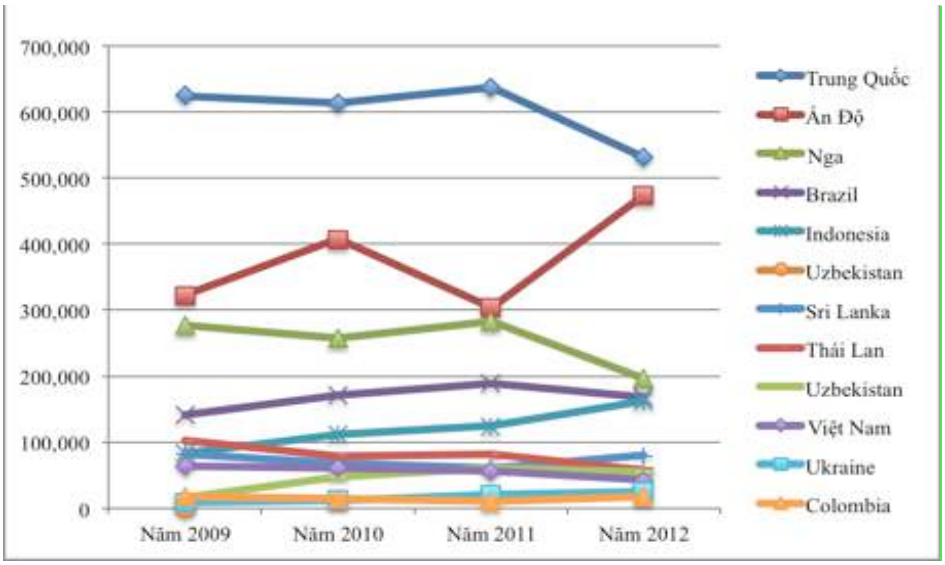


Figure 1.1: The leading consumers of chrysotile

(Source: USGS)

The above Figure shows that the countries' consumption of chrysotile has remained stable without significant fluctuation over the years.

1.3. The state of chrysotile asbestos use in the production of AC roof sheets in Vietnam

In Vietnam, the AC roof sheet manufacturing industry has been in existence for 50 years, since 1963, and has grown into an industry of 41 manufacturing facilities, of which 36 are in operation and 5 have just been out of operation. The design capacity is over 100 million m^2/year, employing more than 3,000 direct workers. From 2008 to now, the industry produces and consumes about 80-90 million square meters per year, accounting for 60-62% of the demand for roof sheets, using an average of 60,000-70,000 tons of chrysotile asbestos per year.

According to a report by the Vietnam National Roof Sheet Association, in 2016, the industry produced 84,596 million square meters, consumed 83,214 million square meters and generated a revenue of about 2.3 trillion VND. AC roof sheets can withstand extreme weather conditions, resulting in long life cycles (30-50 years), and cheap price at only 1/3 of the price of painted galvanized steel sheet of 0.4 mm thickness, which is a 40-50% lower price than roof sheets using alternative fiber. Asbestos chrysotile roof sheet meets 62% of the annual roof sheet demand [14].

1.4. Regulation on asbestos dust in the working environment.

Table 1.2. Regulation on asbestos dust in the working environment in some countries (data up to 2009)

Country	In the workplace		
	Chrysotile Fiber / cm^3	**Crocidolite** Fiber / cm^3	**Amosite** Fiber / cm^3
ARGENTINA	2.0	0.2	0.5

AUSTRALIA	0.5	0.0	0.0
BELGIUM	0.5	0.15	0.15
CANADA	2.0	0.2	0.5
CHILE	2.0	2.0	2.0
DENMARK	0.3	0.3	0.3
ENGLAND	0.5	0.2	0.2
EUROPEAN	0.6	0.3	0.3
FINLAND	0.5	0.5	0.5
FRANCE	0.6	0.3	0.3
GREECE	1.0	0.5	1.0
HONGKONG	0.5	0.2	0.2
INDIA	2.0	2.0	2.0
INDONESIA	1.0	1.0	1.0
IRELAND	0.6	0.3	0.3
ISRAEL	0.4	0.4	0.4
ITALY	1.0	0.5	1.0
JAPAN	1.0	-	0.5
MEXICO	2.0	2.0	2.0
NEW ZEALAND	1.0	0.1	0.1
PORTUGAL	0.6	0.3	0.3
SINGAPORE	0.2	0.2	0.2
SOUTH AFRICA	1.0	1.0	1.0
SPAIN	0.6	0.0	0.2

SWITZERLAND	1.0	1.0	1.0
TURKEY	2.0	0.2	0.5
U.K	0.5	0.2	0.2
USA	0.1	0.1	0.1

Table 1.3: The allowed limit of occupational exposure to asbestos dust in the air of manufacturing areas in Vietnam

No.	Name of substance	Average in 8 hours (fibers/ml)	Average in 1 hour (fibers/ml)
1	Serpentine (Chrysotile)	0,1	0,5
2	Amphibole	0	0

The regulation on the concentration of asbestos fibers in the workplace is different from one country to another, but only ranges from 0.1 to 2.0 fiber/cm^3 of air [20].

1.5. Effects of asbestos to the health of exposed people

1.5.1. Asbestosis:

1.5.1.1. Pathogenic mechanisms:

The pathogenic mechanism of Asbestosis is different from that of Silicosis and Anthracosis. Short Asbestos fibers (<5 μm) are susceptible to phagocytes. Asbestos fibers (Chrysotile) longer than 10 μm are also phagocytic, but part of the outside is macrophagic, increasing the permeability of the cell membrane. On the other hand, in such cases, many macrophages may attach to asbestos fibers which are too long. Unlike silica dust, asbestos dust has no or very little toxicity on macrophages, without post-phagocytosis macrophage destruction but fibrosis persists. The mechanism of pulmonary fibrosis is still unclear, but some studies suggest that hard

asbestos fibers longer than 8 μm in length and less than 0.25 μm in diameter are the most dangerous. When inhaled, this type of fiber will penetrate the bronchial wall, into the lungs and stimulate hyperplasia and fibrosis in the interstitium of the lung. Hard fibers can penetrate the pleura, stimulating the pleura to form pleural plaques, the fibers can even reach the diaphragm and the peritoneum, causing fibrosis in the places where they are present. The pathogenic mechanism of asbestos fibers is explained to be the stimulation causing pulmonary fibrosis, the interaction of antigens and antibodies, and lastly the mechanism of self-producing antibodies evidenced by the presence of rheumatoid factors and antinuclear factors in the patient's [29].

Although the "natural disposition" factor is very clear in this disease, with the same exposure to asbestos dust, the possibility of contracting and severity of the disease varies in each person. In addition, asbestosis is closely related to lung cancer and pleural cancer. According to some studies, between 15% and 30% of people with Asbestosis also have lung cancer and pleural cancer. The mechanism of this combination is unclear, but people with asbestosis may be considered to be at risk of lung and pleural cancer.

1.5.1.2. Clinical symptoms

There are no specific symptoms of the disease, the clinical symptom is mainly dyspnea, initially difficulty in breathing occurs when exerting strength, later breathing difficulty may occur regularly. Chest pain may appear due to the reaction of the pleura. In early stages, bronchial challenge or combined with chronic bronchitis may lead to symptoms like cough or sputum production. In addition, the patient may experience fatigue, weight loss and reduced working capability.

Clinical examination of the lung can detect signs such as limited movement of the chest cavity, decreased vesicular murmur, sometimes coarse crackles at the base of the lung can be detected.

1.5.1.3. Para-clinical symptoms

As with Silicosis, in asbestosis para-clinical signs, especially X-ray images are of value in the diagnosis of the disease.

* Symptoms on X-rays: X-ray images of asbestosis are subject to frequent change and are not specific as other pneumoconiosis diseases; X-ray signs include:

- Irregular opacities: first appear at the base of the lung, combined with the image of lung fibrosis in a reticular pattern, the links in the network are close as in a spider web, usually localized in 2/3 of the lower part of the lung, especially in the right costophrenic angle. The pulmonary apex is never damaged. Pulmonary fibrosis forming lines is different from granular fibrosis like in Silicosis. Images are often not clear as if seen under opaque glass, and not as clear as the granules in Silicosis category.
- The left side of the heart is opaque, in severe cases bristly formation like porcupine's quills appears around the heart.

Figure 1.3. Image of asbestosis

Figure 1.4. Image of pleural plaques

The above X-ray images are typical of asbestosis but are sometimes found in people exposed to plastic dust, cotton dust, or wood dust.

+ Images of pleural calcification: usually symmetric, rarely occurring in the first 20 years after the first exposure. In many cases, there are only signs of pleural calcification without any other clinical manifestations or lesions in the lung parenchyma. This means that in only a few cases there is the simultaneous existence of both pleural calcification and pulmonary fibrosis. Pleural calcification is usually only seen in people without fibrosis, and people who have been exposed for long periods in asbestos-contaminated environments at a low level of concentration.

Calcification can be located in the pleura (Parietal pleura), pericardium, mediastinum, especially in the posterior diaphragm, and rarely in the pleural fissure.

- Pleural effusion (Pleural plaques): scattered throughout the lungs, visible, irregular, similar density, sometimes in the shape of a corolla.
- Pleural thickening: Early onset and sometimes is the only lesion visible due to asbestos exposure. Pleural thickening occurs on both sides, appearing as a thin line several millimeters thick, along the chest wall on X-ray images in the anteroposterior posture.

* Respiratory function:

In the early stage, there is usually no evidence of disorder in the lung ventilation function. When the disease is pronounced, there is usually limited manifestation of disorder in ventilation (FVC decreases). Then, FEV_1 may decrease, from limited syndrome to congestive syndrome. Finally, mixed ventilation disorder occurs (FVC decreases, FEV_1 decreases) [30].

* Sputum testing:

“Asbestos types” can be found in the sputum by direct examination on an optical microscope. Asbestos types appear in the sputum from 1 to 3 months after exposure

because only after this time asbestos types are formed. Asbestos types may still be found in the sputum years after stopping exposure. The presence of discrete asbestos in the sputum only shows that asbestos dust has been inhaled, and does not suggest the presence of asbestosis or that there are lung-pleural changes. In contrast, if there are asbestos aggregates of 15 to 20 fibers, this patient may have clinical symptoms and X-ray images of Asbestosis.

Testing of asbestos types in the sputum is not always positive, so many times of testing may be required.

Some so-called asbestos types should be noted as they are not specific for Asbestosis, as there are many other types of fiber dust, including fiberglass dust that forms "asbestos types", which is also covered in iron-protein shells.

1.5.2. Research on asbestosis and asbestos-related diseases

1.5.2.1. International research results:

According to WHO (1989) and some clinical and epidemiological studies, asbestos is related to asbestosis and some forms of respiratory cancer in humans such as lung cancer, pleural and peritoneal mesothelioma, pleural changes such as pleural thickening, pleural effusion, and pleural calcification [46].

Most authors suggest that asbestos is related to abnormalities in the pleura which are pleural effusion and pleural thickening and can be detected through chest X-ray. Mesothelioma is a rare form of cancer with a low rate of incidence at 1-2 ppm and in recent decades this rate had surged in industrialized countries at 10-25 ppm/year in 1990 in Western European countries, in which there were also cases of asbestos exposure. It is also believed that the disease commonly occurs after 30 years of exposure [41], [43].

Korea has banned the import and use of crocidolite and amosite since 1997. In 1986 the nation regulated the limit of occupational exposure to chrysotile to 2 fibers/ml,

decreasing to 0.1 fibers/ml in 2001 which took effect in 2003. Reports on cancer cases show that lung cancer was increasing more rapidly compared to the previous 15 years, the number of deaths were also three-fold. In 1993, chest X-ray imaging for asbestos textile workers showed that 3% displayed signs of asbestosis, a half of which experienced limited respiratory function changes. There was also a clear correlation in the dose-response in the study group; no one in the group with less than 10 years working experience showed signs of the disease, while 8% of the people working over 20 years showed signs of abnormalities on the chest X-ray [35].

The Russian Federation exports and uses asbestos and has a very high number of workers directly exposed to asbestos. Burmistrova, T. (1997) conducted chest cardiography for over 2,000 workers exposed to chrysotile asbestos in different industries, 15.3% of which showed abnormal X-ray images [33].

According to Takahashi K, Sera Y (1993), chest radiography for 200,000 workers in 5 years showed 36 cases with pleural effusion. Since 1984, there were only 4 cases of mesothelioma due to exposure to asbestos which were compensated; by 1999, this figure rose to 25 cases [43].

The Finnish Institute of Occupational Health (FIOH) in cooperation with the Russian Academy of Occupational Health and the US National Institute for Occupational Safety and Health (NIOSH) have conducted clinical examination and chest X-ray for 2003 workers who were exposed to asbestos in their work; 10% of the workers suffering damage in the form of irregular opacities and 4% showing pleural calcification on their chest X-ray were over 47 years of age with over 10 years of working in their job [38].

Frost, G et al. (2008) conducted a study into the mortality rate of 31,302 asbestos demolition/removal workers in the UK, which showed an overall increase in mortality (SMR=123, CI 95% 119-127) including lung cancer and mesothelioma.

Risk factors that were considered included dust handling techniques, the types of masks used, the removal time each day, and the exposure time during the whole working process [36].

One of the manufacturing industries of asbestos products is the asbestos-cement roof sheet industry. The results of 11 cohort studies including those from the US (Hughes and CS, 1987), from Canada (Finklestein, 1984) and Denmark, Italia, Germany have concluded that workers who were only exposed to chrysotile showed signs of severity in asbestos-related diseases at a lower level as compared to workers producing asbestos-cement roof sheets that contained crocidolite and amosite fibers [20].

Research by Weill, H., Hughes, J. and Waggenspack, C. (1979) in the American Review of Respiratory Disease 120(2):345-354 on 5,645 workers producing asbestos-cement shows that there was no increase in mortality rate when the workers were exposed to chrysotile asbestos for 20 years at levels comparable to or less than 100 MPPCF.y (Million Parts per Cubic Foot.year), equivalent to approximately 15 fibers/ml/year [45].

A study by Hodgson and Darnton published in 2000 showed that the risk of causing lung cancer of Amosite Amphibole fibers was 10 times higher than that of Chrysotile and Crocidolite Amphibole was 50 times higher than Chrysotile. The risk of causing mesothelioma of amphibole amosite was 100 times higher than that of chrysotile and amphibole Crocidolite was 500 times higher than that of chrysotile [38].

According to Sariton Taptagaporn (2002) & Suwadee Thaweesuk (2011), Thailand is a major country in the use of asbestos; in 2009, the imported quantity was 102,738 tons/year and in 2010 the number was 79,250 tons/year, but until now there is no known case of asbestosis. The authors of a study on 701 workers found 13 cases of pleural thickening with over 10 years of occupational exposure to asbestos [20].

The national DGFANO.I study on the health status of workers in India's asbestos industry in 2004 was conducted in five asbestos-cement factories, three brake cable manufacturers and 702 workers with a history of exposure from less than 5 years to over 20 years shows no signs of pulmonary disease or other asbestos-related diseases. [34]

Marina Musti and colleagues (2009) in a control case study on the correlation between mesothelioma and asbestos exposure in the working environment at an asbestos-cement roof sheet manufacturing plant in Bari (Italia) showed that people living within 500 meters of the plant had an odds ratio (OR) of 5.29 in a statistically significant way (95% CI: 1.18-23.74) [40].

A 39-year study on the mortality of workers exposed to white asbestos in Greece by L. Sichletidis D., Chloros D., Spyratos A.-B., Haidich I., Fourkiotou M., Kakoura D. and Patakas (2009) shows no cases of mesothelioma reported. The mortality rate is much lower than the average of the Greek population. The fiber concentration is measured frequently and always below the allowed level. The timing and cause of death are recorded in both retired and current workers. The authors' conclusion is that occupational exposure to pure white asbestos within acceptable levels is not associated with a significant increase in lung cancer or mesothelioma [42].

These studies show that there is a difference in the research results on the effect of Asbestos in general, and Chrysotile asbestos in particular on the human health, however through many studies, the authors believe that the latency time of asbestos-related diseases like pleural effusion, pleural calcification, or lung cancer is usually 10 to 20 years and for mesothelioma it takes 30 to 40 years of exposure.

1.5.2.2. Domestic research

Vietnam has some asbestos mines in Thanh Hoa, Cao Bang, Lang Son etc. but with low reserve and quality. Therefore, the domestic asbestos manufacturing industry is

not developed, asbestos is mostly imported from overseas. At present, in Vietnam asbestos is mostly used to produce asbestos-cement roof sheets.

The asbestos-cement roof sheet manufacturing industry emerged in the South of Vietnam from 1966 to 1968 with 2 factories: Bien Hoa roof sheet factory and Thu Duc roof sheet factory with the total capacity of 6 million m2/year. In early 1986 the first asbestos-cement roof sheet manufacturing plant was constructed in the North.

So far, there have been 36 roof sheet manufacturing plants in operation nationwide in 27 provinces and municipalities with 51 production lines, with a capacity of around 90 million m2/year and about 3,000 direct workers in AC roof sheet manufacturing establishments [14].

In Vietnam, asbestosis (fibrosis of the lung due to asbestos) has been recognized as an occupational disease eligible for compensation since 1976, but by 2014 only 3 cases have been assessed and compensated [8], [28].

Nguyen Xuan Trieu (1999) researching pleural mesothelioma had conducted pleural biopsy for 203 patients with pleural effusion (due to cancer or tuberculosis) at 4 hospitals and found 15 cases (7.5%) of mesothelioma. None of the cases had a record of asbestos exposure in their work [29].

Tran Thi Ngoc Lan (2001), researching the correlation between asbestos exposure and respiratory diseases in 310 workers in the asbestos-cement roof sheet manufacturing industry from Dong Anh, Dong Nai, Navifico roof sheet factories had found that the concentration of asbestos dust was 1,9±0,96 fibers/ml on average, at the grinding machine the dust concentration was 4 – 5 fibers/ml, 2 – 2.5 times higher than the allowed limit; workers exposed to asbestos-cement was 1.23 times more lilkely to develop respiratory diseases than workers only exposed to cement. Pleural effusion and tumor account for 0.58%. There is a linear correlation between the exposure time, concentration of asbestos dust in the air and the incidence rate of

respiratory symptoms and diseases in asbestos-cement roof sheet manufacturing workers [19].

In 2002-2003, the Construction Health Center (now Construction Hospital) conducted the "Study on the situation of asbestosis and occupational cancer in asbestos-cement manufacturing plants" under the study "Research on the environmental status of asbestos-cement roof sheets manufacturing establishments and the effects of asbestos on the human health - Recommendations for solutions" - based on the health survey of 1,032 workers in 12 AC roof sheet manufacturing establishments and 14 retired workers and came to the conclusion that: asbestosis only accounted for 4 cases out of 1032 cases, equivalent to 0.39% among high risk workers. If the incidence rate of the disease on the total number of wokers in the production of asbestos-cement roof sheets is to be calculated, then this rate is about 0.08%. No other benign lesions associated with asbestos were found, such as pleural effusion, pleural thickening and pleural calcification. No known cases of malignant diseases such as lung cancer, bronchial cancer and mesothelioma among the examined workers have been identified. Retrospective study of cases of diagnosed mesothelioma in Hanoi and Ho Chi Minh City from 1991 to 2001 is not conclusive as to whether there are any cases related to asbestos-cement roof sheet production in Vietnam. Of the 14 retired workers, no cases of occupational asbestosis or asbestos-related cancer were found [17].

Nguyen Ba Duc (2008) in a pilot study on a data collection form for patients of occupational lung and pleural cancer at K Hospital from September to December 2008, among 100 interviewed patients 93% were diagnosed with lung cancer and 7% with pleural cancer, including 2 patients having pleural cancer (the patients with malignant mesothelioma were all farmers and did not have a history of smoking). Occupational analysis of these patients showed that most were farmers at 42%, 28% were pensioners, 10% were administration officers, 9% were factory workers [11].

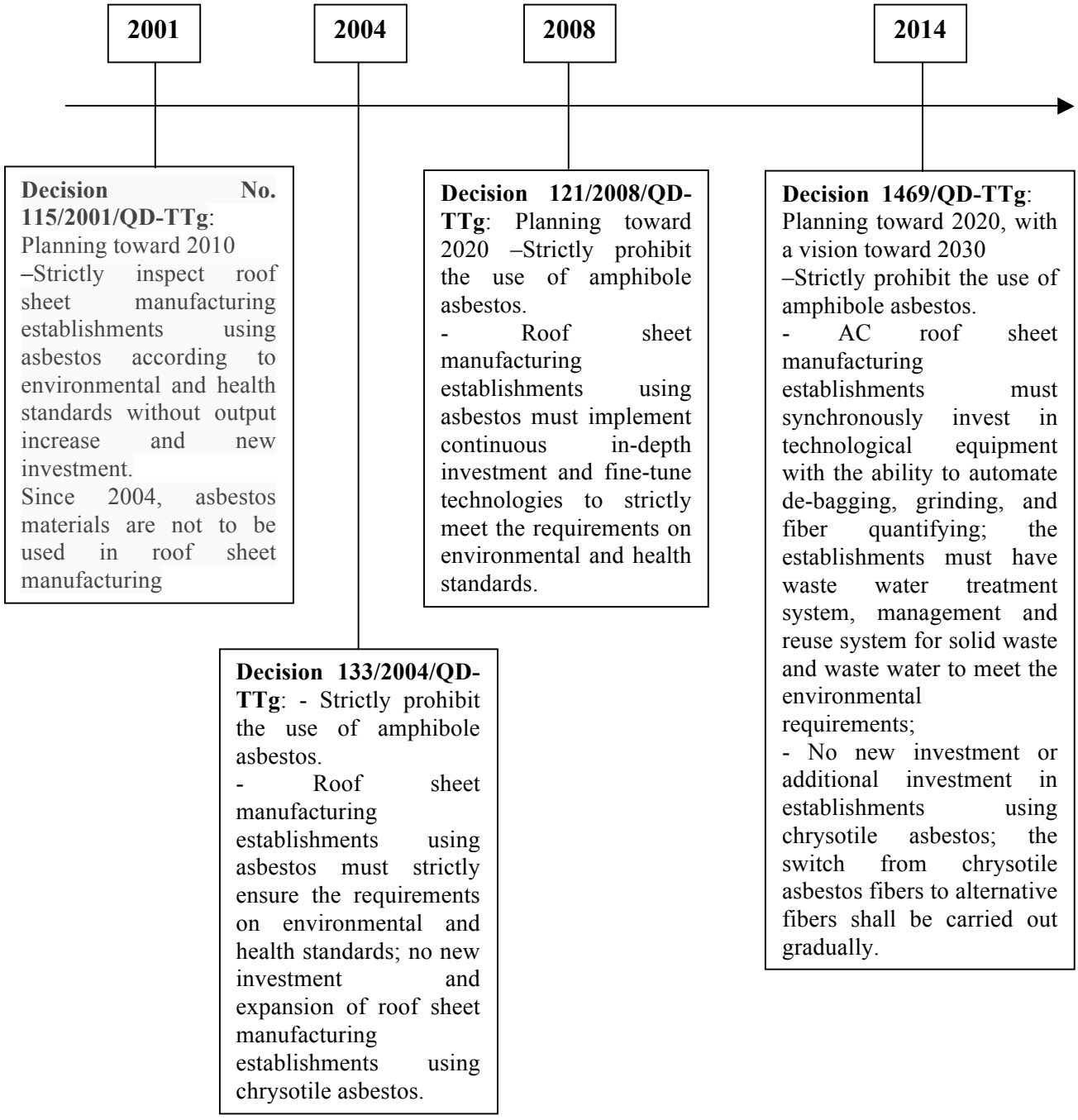
The Health environment management agency - Ministry of Health has implemented the ministerial-level research project "Asbestos-related diseases in exposed individuals" in 2010 and 2011. Interview results looking into the asbestos-related occupational history of 447 cases admitted into six participating hospitals show that 46 cases of mesothelioma were diagnosed accounting for 10.29% of cases, including six Asbestos-related cases (10.86% living in homes with asbestos-cement roofs, 2.17% living near serpentine mines and none had occupational exposure to asbestos). 8 out of 39 specimens (20.51%) were sent to Hiroshima Hospital in Japan, where mesothelioma was diagnosed by experts, none of which had a history of exposure to asbestos; 34 out of 401 cases in the group of other asbestos-related diseases were admitted to hospital, 8.48% were related to asbestos, of which 3.74% had asbestos-related occupations and 4.74% were living in asbestos-cement roofed houses [20].

The National Profile of asbestos from 2009 to 2012 developed by the Ministry of Health and the Institute for Scientific and Technical Research on Labor Protection under Vietnam General Confederation of Labour with the support of the Government of Japan conclude that X-ray and CT scanner films for workers exposed to asbestos from 2004 to present have not shown asbestos-related diseases [7].

1.6. Management policies for white asbestos (Chrysotile) in AC roof sheet manufacturing in Vietnam

The Ministry of Construction is the state agency that manages the construction material sector in general, including AC roof sheets. The provisions on chrysotile asbestos based on the Master Plan on the development of Vietnam’s construction material industry are established over a period of 10 years. The Plan is revised every 5 years.

Chart 1.1: Master Plan on the development of Vietnam's construction material industry



In order to ensure the health of workers exposed to asbestos and environmental protection, many legal documents have been issued such as:

- **Circular No. 19/2016/TT-BYT dated June 30th 2016** on the guidelines for occupational health and hygiene management including the guidelines on managing the labor environment and the health of workers exposed to asbestos.
- **Decree No. 26/2011/ND-CP** of the Government on amending some articles of Decree No. 108/2008/ND-CP classifying white asbestos in Appendix V "List of chemicals that are required to be declared".
- Especially, Article 32 of **Decree 24a/2016/ND-CP** dated April 5th 2016 of the Government on the management of construction materials clearly states the regulations on the use of white asbestos in the serpentine group in the production of construction materials. Specifically:

Regulations on construction material production facilities using white asbestos in the serpentine family as raw materials for production of construction materials:

a. Only use white asbestos in the serpentine family of clear origins for the production of construction materials;
b. Ensure the level of white asbestos fibers in the serpentine family in the production area does not exceed 0.1 fiber/ml of air averaged over an eight-hour period and not exceed 0.5 fibers/ml of air averaged over an one-hour period;
c. Keep packages of white asbestos in the serpentine family from breaking leading to scattering during transportation;
d. Do not use white asbestos in the serpentine family as stuffing, choking and insulting materials in constructions when they are not mixed with binders to ensure no dispersion of white asbestos fibers in the serpentine family into the air;
e. Propose plans for treatment of scrap, materials, dust, water discharged from production for reuse or handling in accordance with regulations on safety;
f. Comply with approved investment decision, environmental impact assessment report, regulations on labor safety and environment protection;

g. Organize monitoring of water and air environment in production facilities every three months;

h. Workers directly involved in production should be equipped with labor protective gear as prescribed;

i. Send officers, workers, and employees in the unit for regular check-ups, having X-ray as stipulated by the Ministry of Health; check-up results shall be stored in medical facilities and production facilities.

Regulations on the controlled use of construction materials using white asbestos in the serpentine family as raw materials:

a. Use construction materials using white asbestos in the serpentine family as raw materials only when they are granted certificates of conformity;

b. Take necessary measures to control the generation of asbestos dust while sawing, cutting, sharpening, and chiseling construction materials containing white asbestos in the serpentine family;

c. Establish plans for environment protection in advance of carrying out demolition, repair and renovation of construction works or industrial equipment with respect to construction materials containing white asbestos in the serpentine family;

d. Collect and transport into designated place scrap from building materials containing chrysotile in the serpentine family; such scrap should not be used as raw materials for road pavement.

CHAPTER 2. RESEARCH SUBJECTS AND METHODOLOGY

2.1. Research subjects, location and period

2.1.1. Research subjects and location

a. Workers currently working:

All laborers, under labor contract, who are currently working directly in nationwide AC roof sheet manufacturing lines of the Vietnam National Roof Sheet Association, divided into three occupation groups based on the risk of exposure to asbestos dust:

+ Group 1: Workers in positions such as: grinding, mixing, de-bagging, pouring asbestos (high exposure risk)

+ Group 2: Workers in positions such as slicing, rolling, cutting, waving, loading/unloading and classifying products (medium exposure risk)

+ Group 3: Workers in positions such as mechanics, boiler operating, paper milling, cement grinding (low exposure risk)

b. Retired workers

In fact, only long-standing manufacturing establishments have retired workers, so we chose 02 establishments with over 25 years of history which are Dong Anh Investment, Construction and Building Materials Corporation (founded in 1980) and Thai Nguyen Roof Sheet Manufacturing Plant - Industrial Investment and Manufacturing Joint Stock Company (established in 1986).

Retired workers participating in the research are also divided into three main occupation groups based on exposure risk to asbestos dust similar to currently employed workers.

c. AC roof sheets users:

AC roof sheets are commonly used in Northern mountainous provinces, therefore we chose residents in Tan Trinh commune – Quang Binh rural district – Ha Giang province as our research subjects.

2.1.2. Research period: From October 2014 – October 2016

2.2. Research methodology

2.2.1. Research design

To achieve the set research objectives, the study's design uses an analytical descriptive epidemiological research method using a combination of cross-sectional description and correlative description, and qualitative and quantitative information collection.

2.2.2. Sampling method

Using the systematic random sampling method, based on the list of workers of each factory, the list of retired workers and the list of residents of Tan Trinh commune.

2.3. Information collection methods

2.3.1. Direct interview method

Using cross-sectional design, information on exposure history and symptoms of respiratory diseases, inspecting the management of occupational safety and health, and the use of roof sheet products in residential areas etc. was collected by the direct interview method with a pre-prepared questionnaire.

Assessing the state of occupational safety and health management at AC roof sheet manufacturing establishments according to current occupational safety and health regulations.

2.3.2. Survey and assess the elements of the labor environment

2.3.2.1. Field survey

Survey and evaluation of labor environment factors at manufacturing establishments in accordance with the technical regulations of Occupational and Environmental Health [27], including:

- Measuring microclimate factors: temperature, relative air humidity, speed of air flow etc.
- Determining total dust concentration:
    - Technical principle: air is drawn into the sampling head containing the filter paper by a suction pump. As the air passes through the filter paper, the dust particles are retained on the filter paper. Measure the filter paper before and after sampling, based on the amount of dust collected and the volume of air sampled to calculate the total dust concentration in the air.
    - The dust samples were taken at the working positions of the workers in the production lines of all 3 research groups.
    - The total dust is the total of dust particles that is less than 50 μm in size. The Bruck Libra Plus L-20 sampler was used with specialized filter paper at 18 times/min sampling rate and the accuracy of 0.1 mg. The result calculated is the total dust concentration mg/m^3 of air.
- Determining respiratory dust concentration:
    - Technical principle: air is drawn into the sampling head containing the filter paper by a suction pump, the cyclone component of the sampler separates the dust particles into two parts: a part of ≥ 5 μm in size shall fall into the cup below, the <5 μm in size particles (respiratory dust) proceeds to the surface of the filter paper and is retained on the filter paper. Measure the filter paper before and after sampling, based on the amount of dust collected and the volume of air sampled to calculate the total dust concentration in the air.

- Use the Bruck Basic 5 respiratory dust sampling pump, with a cyclone fitted onto the sampling head, using specialized filter paper, at a sampling rate of 2 times/min. The result calculated is the respiratory concentration mg/m3 air.

- Determining of asbestos dust concentration: Determine asbestos fiber dust concentration in the air of working areas by the membrane filtration method, using a phase-contrast optical microscope.

  - Technical principle: air is drawn into the sampling head containing the filter paper by a suction pump. As the air passes through the filter paper, the dust is retained on the filter paper. Use the Bruck Basic 5 sampling pump, specialized cellulose or cellulose nitrate ester filter paper, with the filter pore size of 0.8 - 1.2 μm, a diameter of 25 mm, and a sampling rate of 2 times/ min. The filter paper after suction will be treated into specimen with acetone (done on the filter paper) and triacetin solution (to create the highest contrast). Use a phase-contrast optical microscope to count the number of asbestos fibers in the specimen. Based on the results of asbestos fiber count, suction flow and sampling time, the asbestos fiber dust concentration is calculated.

  - Asbestos fiber dust concentration is calculated according to the following formula:

$$C = \frac{A \cdot N}{a \cdot n \cdot r \cdot t}$$

In which:

C : Asbestos fiber concentration in the air (fibers/ml).

A : Effective filter area (mm^2)

N : Number of asbestos fibers counted (fibers)

a : Eyepiece graticule area (mm^2)

n : Number of graticule areas observed.

r : Flowrate of air through filter (ml/minutes)

t : Single sample duration

In each batch of 7 to 10 pieces of filter paper, one piece of paper must be kept for control, which is also brought to the field but not samples. Treat this piece of paper as the filter paper sampled and observe on the specimen under a microscope, if the control sample has more than 5 fibers/100 areas observed then that sample is discarded.

2.3.2.2. Evaluation of the labor environment based on the allowed standards

According to the labor sanitation standard issued together with the Decision No. 3733/2002/QD-BYT dated October 10th 2002 of the Minister of Health.

2.3.3. Monitoring employees' health:

2.3.3.1. General health check-up methodology and examination to detect occupational diseases

Procedure for health examination: Follow the instructions in Circular No. 14/2013/TT-BYT of the Ministry of Health dated May 6th 2013 guiding health examination. The content includes:

- A comprehensive clinical examination, including: weighing; vision test; blood pressure test; specialized tests (Otorhinolaryngology, Odonto stomatology, Ophthalmology); internal, surgical medicine; health classification and consultancy.
- General abdominal ultrasound: ultrasound of the liver, gall-bladder, pancreas, spleen, kidneys, bladder, prostate (in males), uterus, ovary (in females).
- The results shall be evaluated according to health classification standards issued in conjunction with Decision No. 1613/BYT-QD dated August 15th, 1997.

The procedures for examination and detection of occupational diseases shall comply with Circular No. 12/2006/TT-BYT dated November 10th, 2006 of the Ministry of Health guiding the examination of occupational diseases and Circular No. 28/2016/TT-BYT dated

June 30th, 2016 of the Ministry of Health guiding the management of occupational diseases, including the following:

- Investigating and evaluating factors of contact: name, age, gender, occupation, occupational contact factor.
- Clinical examination of occupational diseases: body examination, examination of the respiratory, circulatory, digestive systems etc.
- X-ray of the lungs in accordance with occupational disease diagnostic standards: Using full wave X-ray machines, with an intensity of greater than 200 mA, a shutter speed of less than 0.1 seconds. The films' size is 35 x 35 cm (a film size of 30 x 40 cm is also usable), Kodak film is used. Capture the image in the anteroposterior posture, hold the breath in a forced exhale. Do not over or under expose the film. Ensure the whole image is shown when the film is developed. Do not let the image appear too fast when being developed. Do not compensate an overexposed film with an underdeveloped image. Do not use moldy intensifying screens.
- Performing CT Scanning for suspected cases: Performing CT scanning by the spiral CT scanner VCT Light Speed 64-slice multidetector (GE, USA).
- Examining the lung ventilation function: Using the lung ventilation function measuring machine Model PC10 of Chest – Japan with a software to analyze the results with constants of Asian people.
- Performing hematological tests, including the indicators: red blood cell (T/l), white blood cell (G/l), neutrophils (%), lymphocytes (%), monocytes (%) hemoglobin (G/dL), hematocrite (%), platelets (G/l).
- Performed by the KX21 automated analyzer from Sysmex – Japan at the Construction Hospital.
- Other paraclinical methods: BK sputum test, ECG etc.

2.3.3.2. Results of health examination to detect occupational diseases and other related diseases:

The results of health examination to detect occupational diseases and other occupation-related diseases were approved by the Consultation Council for occupational diseases with the participation of leading experts on occupational diseases and diagnostic imaging.

2.3.4. Survey on the health status of residential areas and other related factors

2.3.4.1. Survey on mortality in the areas of the research in the 2010 – 2014 period: Applying the method of comparative descriptive retrospective research (by factors of demography, time and place), including:

- Collecting available data from A6 mortality statistics of Health stations in Quang Binh rural district in a 5-year period from 2010 to 2014.
- Collecting information on the population of the communes over the years to calculate the mortality rate at those communes.
- Research indicators: gender, age, cause of death, year of death and age of death.
    - Mortality rate: general mortality rate, by gender, by age group, by disease, by area.
    - Groups of causes are categorized into 4 big groups: Non-contagious disease group; contagious disease group, nutrition and maternity; accidents and injuries. Undetermined causes are categorized into group 4 (group of unknown causes).

2.3.4.2. Survey on the health status of residential areas:

- A comprehensive clinical examination, including: weighing; vision test; blood pressure test; specialized tests (Otorhinolaryngology, Odonto stomatology, Ophthalmology); internal, surgical medicine.

- General abdominal ultrasound: ultrasound of the liver, gall-bladder, pancreas, spleen, kidneys, bladder, prostate (in males), uterus, ovary (in females).
- Blood tests: Complete blood count, serum biochemistry, some cancer markers
- Cardiopulmonary X-ray

2.3.5. Data collectors

- Staff of Construction Hospital who has experience in the measurement of the labor environment, examination of occupational diseases as well as has participated in many research projects at the hospital level and at the Ministry of Construction.
- Experienced professionals involved in epidemiological investigation of the School of Medicine and Pharmacy
- Vietnam National University, Hanoi.
- Officials of Ha Giang Department of Health, Health Center of Quang Binh rural district, Health station of Tan Trinh commune.

2.3.6. Process of information collection: is implemented following the research diagrams below:

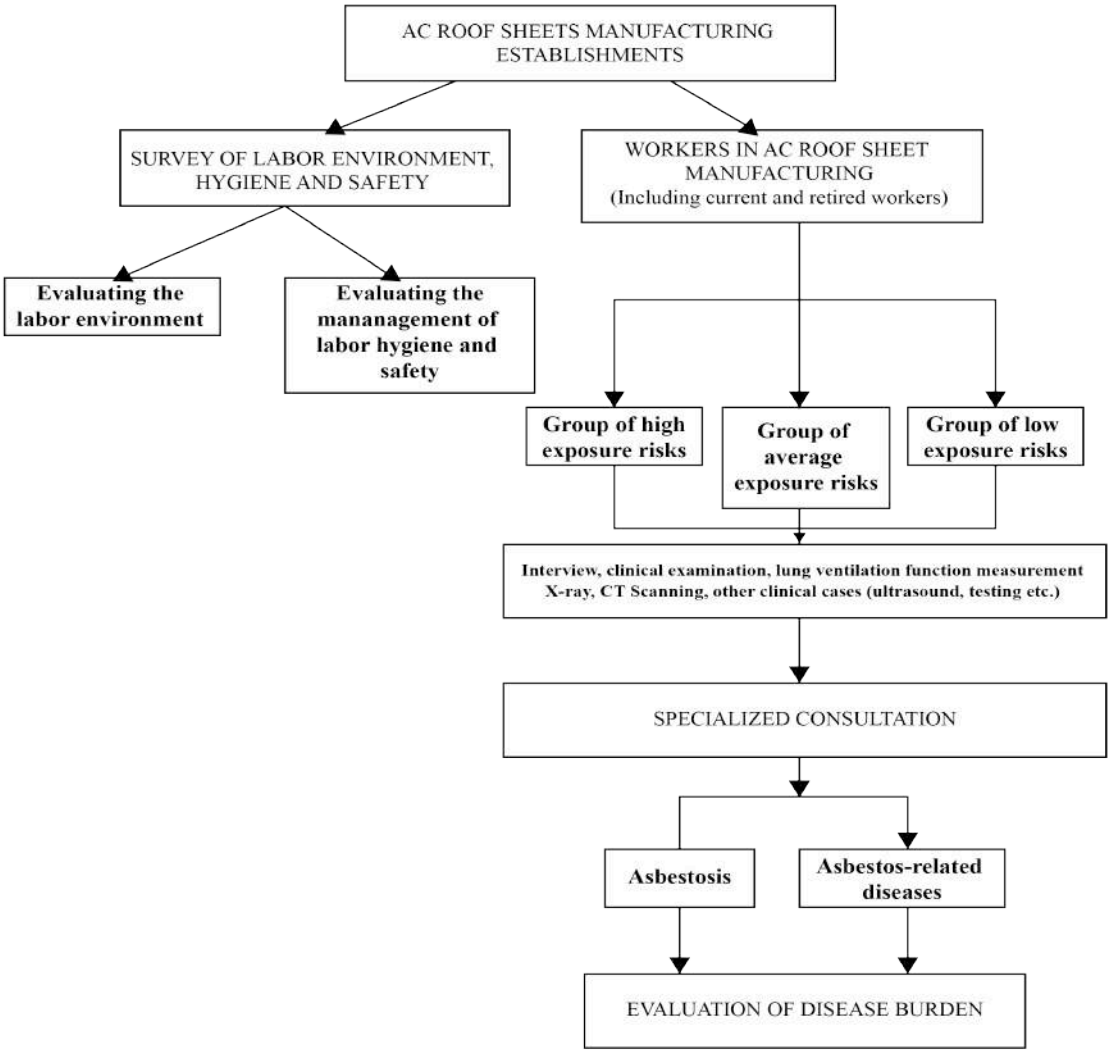


Diagram 2.1. Research diagram on the labor environment and the health of workers at AC roof sheet manufacturing establishments

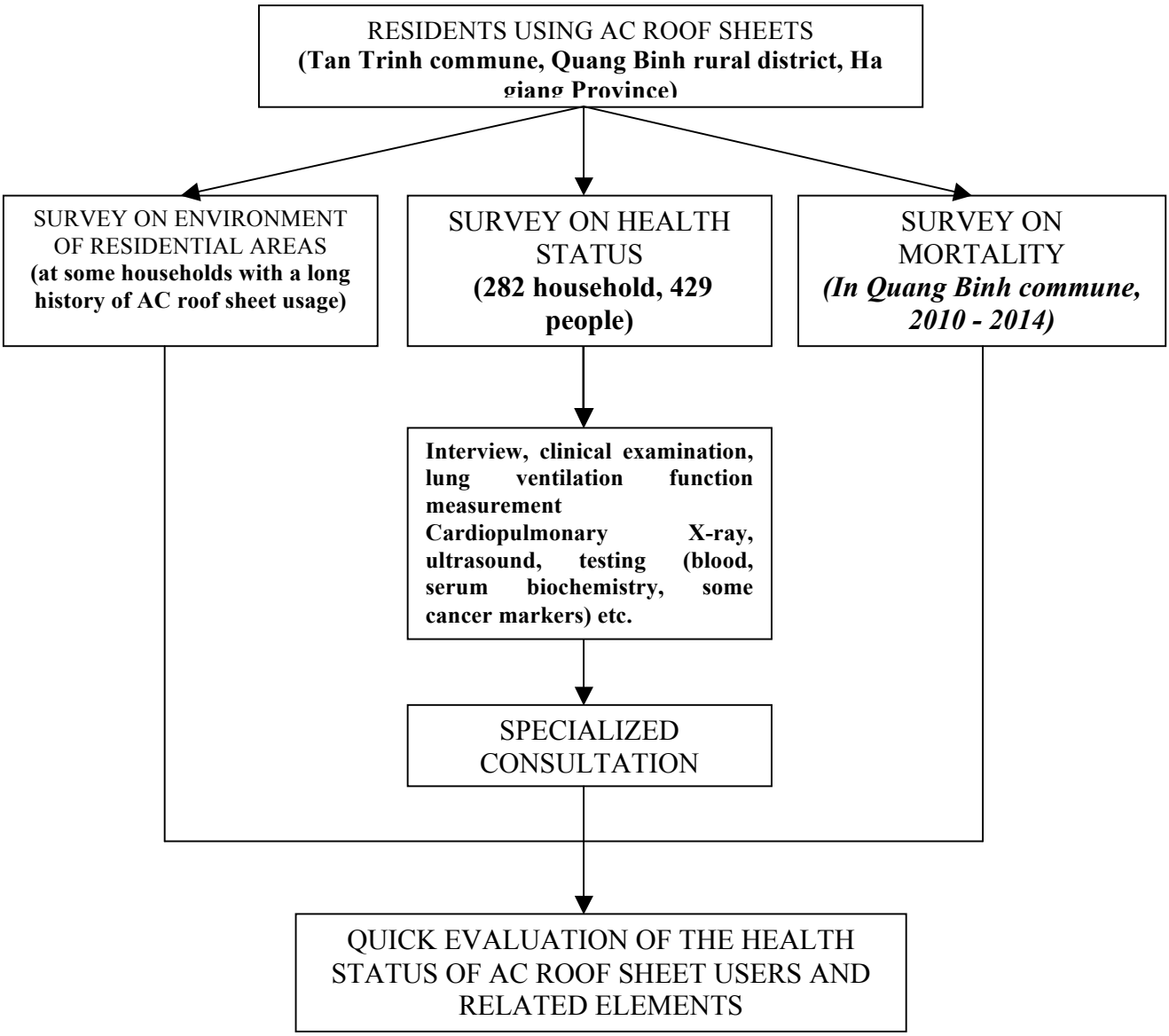


Diagram 2.2. Research diagram on the health of AC roof sheet users

2.4. Research indicators and variables:

2.4.1. Current status of the labor environment and the management of labor hygiene and safety:

- Rate of environmental elements (microclimate, total dust, respiratory dust, asbestos fiber concentration) meeting the allowed sanitation standards, compared among manufacturing establishments of different sizes.
- Rate of indicators on the management of occupational safety and health that meet the requirements in accordance with current regulations.

2.4.2. Health status of workers at AC roof sheet manufacturing establishments:

- Characteristics of workers (currently working or retired): gender, age, years of working, occupation group.
- Rate of lung ventilation function change: by gender, age group, occupation group, years working, level and form of lung ventilation function change.
- Determining the correlation between lung ventilation function change and elements including: chronic diseases of the upper respiratory tract, smoking.
- Incidence rate of damage in the lung shown on X-ray images and CT Scan images.
- Incidence rate of damages suspected to be related to asbestos (pleural thickening, pleural calcification) compared by occupation group and years working.
- Rate of incidence of common diseases and diseases that should be noted.

2.4.3. Health status of AC roof sheet users:

- Characteristics of households in residential areas: having family members working in factories with exposure to asbestos, using roof sheets, using water etc.
- Characteristics of residents: gender, age
- Proportion of underweight, overweight/obese people; rate of incidence of symptoms with the last 30 days; rate of incidence of diseases by the organ system.

- Mortality in Tan Trinh commune and Quang Binh rural district in the 2010 – 2014 period: crude death rate and mortality rate from cancer; mortality distribution by gender, age group, disease group; average mortality rate per annum by from cancer; distribution of mortality causes from cancer by organs; distribution of mortality causes from respiratory diseases.

2.5. Control of error

- The form was designed and consulted by a team of hygiene and epidemiology experts and has been tested for evaluation.
- Investigators (conducting interviews, surveys, clinical exams, respiratory function measurements, chest x-ray, CT scanning, tests and questionnaires) selected were specialized health officers who have been thoroughly trained before proceeding with the information collection. The questionnaire was completed immediately after implementation.
- The equipment used is from specialized firms and is standardized before operation.

2.6. Data processing methods: Using the biostatistics software Stata 11.1 to analyze and process data, and determine the rates according to statistical algorithms in medicine.

2.7. Ethical issues in research

The study from its design to content and research methods does not affect the health of participants in any way. Participants were fully informed and participated on a completely voluntary basis. In the course of researching, the regulations of medical ethics were strictly complied.

2.8. Limitations

Due to short research time, the study was able to monitor all workers with a history of asbestos exposure who had been working at AC roof sheet manufacturing establishments.

The impact of asbestos on AC roof sheet users has not been widely evaluated across the country; only a quick assessment of the health of users in 282 households and 429 residents using AC roof sheets in Tan Trinh commune, Quang Binh rural district, Ha Giang province was conducted.

CHAPTER 3. RESEARCH RESULTS

3.1. Current status of the labor environment and the management of occupational safety and health at AC roof sheet manufacturing establishments

3.1.1. Scale of production at AC roof sheet manufacturing establishments

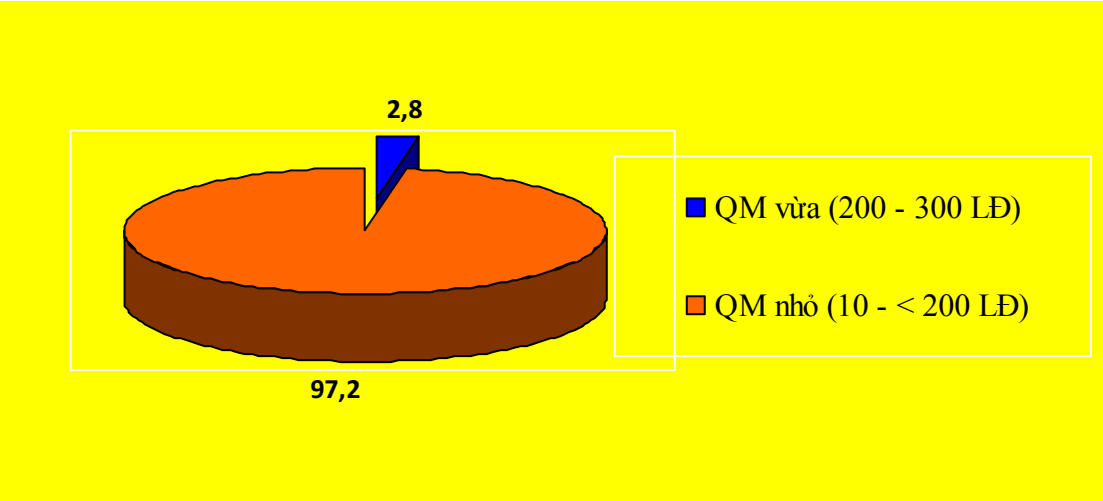


Figure 3.1: Scale of production at AC roof sheet manufacturing establishments

QM vừa (200-300LĐ): Medium-scale (200-300 employees);
QM nhỏ (10-<200LĐ: Small-scale (10 -<200 employees).

Remark: The investigation results of 36 AC roof sheet manufacturing establishments currently in operation nationwide (in which 33 establishments are in the Vietnam National Roof Sheet Association and 3 establishments have not yet joined the Vietnam National Roof Sheet Association), in accordance with the criteria to define an enterprise as specified in Decree no. 56/2009/ND-CP dated June 30th 2009 of the Government on supporting the development of small and medium-sized enterprises show that:

- One in 36 manufacturing establishments is of medium size (200 to 300 workers), accounting for 2.8%;

- 35 out of 36 manufacturing establishments are of small size (10 to under 200 workers), accounting for 97.2%;
- No AC roof sheet manufacturing establishment is of micro size (of under 10 workers).

3.1.2. State of the labor environment at AC roof sheet manufacturing establishments

We have conducted a study on the state of the labor environment at 35 AC roof sheet manufacturing establishments, the investigation of 27 establishments was conducted directly by the Construction Hospital and the investigation of the remaining 8 establishments was conducted by local agencies. However, in order to achieve a consistency in evaluating the state of the labor environment at AC roof sheet manufacturing establishments, as some reports on the labor environment do not have data measuring asbestos fiber dust samples, we only analyzed based on the data measuring the labor environment at 28 AC roof sheet manufacturing establishments, in which the study for 27 establishments was conducted by the Construction Hospital and one was conducted by the Center for the Protection of Labor Health and Environment – Ho Chi Minh City. The specific results are as follows:

Table 3.1: Microclimate characteristics of the labor environment by the scale of manufacturing facilities

No.	Environmental elements / Scale of manufacturing establishments	Temperat-ure		Humidity		Wind speed		Total	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1	Small scale	247	76	227	7	237	0	711	83 (11.7 %)

2	Medium scale	15	0	15	0	15	0	45	0
Total		**262**	**76 (29 %)**	**242**	**7 (2.9%)**	**252**	**0**	**776**	**83 (10.7 %)**
p		$\chi^2 = 4.55$; p = 0.033		$\chi^2 = 0.46$; p = 0.497		-		$\chi^2 = 5.22$; p = 0.022	
Allowed Standard		16 - 32^{o}C		40 - 80%		0.2 -1,5m/s			

(1): Total of samples. (2): No. of samples not meeting occupational and hygiene standards

Remark:

- The rate of microclimate (Temperature, Humidity, Wind speed) samples exceeding the allowed standard at AC roof sheet manufacturing establishments is 10.7%, in which: the number of Temperature samples exceeding the allowed standard accounts for 29.0%, the number of Humidity samples exceeding the allowed standard accounts for 2.9%, all of the Wind speed samples meet the allowed standard.
- By the scale of production, the number of microclimate samples exceeding the allowed standard in the small scale group accounts for 11.7%, in the group of medium scale facilities the microclimate samples all meet the allowed hygiene standard. This difference has statistical significance ($p<0.05$)

Table 3.2: Dust characteristics in the labor environment by the scale of manufacturing facilities

No.	Environmental elements / Scale of manufacturing establishment	Total dust		Respirable dust		Asbestos fiber dust	
		(1)	(2)	(1)	(2)	(1)	(2)
1	Small	225	5 (2,2%)	184	0	191	0
2	Medium	15	0	15	0	15	0
	Total	**240**	**5 (2.1%)**	**199**	**0**	**206**	**0**
	Allowed Standard	**≤ 6 *mg/m^3***		**≤ 4 *mg/m^3***		***≤ 0,1 – average in 8h*** ***≤ 0,5 – average in 1h***	

(1): Total of samples. (2): No. of samples not meeting occupational and hygiene standards.

Remark: No facility has asbestos fiber dust and respirable dust exceeding the allowed standard. There are 5 out of 240 total dust samples exceeding the allowed standard, accounting for 2.1%, all of which are from small sized facilities.

Table 3.3: Analysis results of asbestos fiber's dust concentration in the labor environment according to the scale of AC roof sheet manufacturing establishments

No.	Scale of manufacturing establishment	No. of asbestos measuring samples			Average concentration of asbestos fiber dust (fibers/ml)	Min – Max (fibers/ml)
		Total of samples	Samples containing asbestos fibers	Percentage (%)		
1	Small	191	100	52,4	0,19±0,14	0,005 – 0,5
2	Medium	15	8	53,3	0,15±0,08	0,06 – 0,25
	Total	**206**	**108**	**52,4**	**0,19±0,14**	0,005 – 0,5

Remark: The result of analyzing the concentration of asbestos fiber dust in the labor environment shows that: 108 out of 206 samples containing asbestos fiber dust, accounting for 52.4%. The average Asbestos fiber concentration is 0.19±0.14 fibers/ml; the figure of which in small sized manufacturing facilities is 0.19±0.14 fiber/ml, and 0.15±0.08 fibers/ml in medium sized facilities.

3.1.3. The management of occupational safety and health:

The current state of occupational safety and health management at 35/36 AC roof sheet manufacturing establishments was looked into, in which the Construction Hospital conducted the study in 32 facilities and looked at reports of the remaining 3 facilities. The detailed results are as follows:

Table 3.4. The state of occupational health management at AC roof sheet manufacturing establishments

No.	Activities	No. of facilities studied	Evaluation of results		
			No implement ati-on	Unsatisfact-ory implementa-tion	Satisfact-ory impleme-ntation
1	Prepare occupational health records as regulated	35	0	5 (14.3%)	30 (85.7%)
2	Make periodical occupational health management plans	35	23 (65.7%)	9 (25.7%)	3 (8.6%)
3	Measure and check the labor environment periodically	35	0	7 (20%)	28 (80%)
4	Conduct physical examination before recruitment and allocate appropriate work	35	0	5 (14.3%)	30 (85.7%)
5	Conduct periodic physical examination for workers	35	0	0	35 (100%)
6	Create health and disease management records for workers	35	12 (34.3%)	16 (45.7%)	7 (20%)
7	Perform examination to detect occupational diseases	35	2 (5.7%)	3 (8.6%)	30 (85.7%)
8	Develop plans to handle labor accident emergencies	35	10 (28.5%)	22 (62.9%)	3 (8.6%)

9	Conduct first aid training for health and hygiene officers and workers	35	3 (8.6%)	21 (60%)	11 (31.4%)
10	Create labor accident emergency records	35	2 (5.7%)	18 (51.4%)	15 (42.9%)
11	Provide hazard compensation in kind for workers as regulated	35	8 (22.9%)	13 (37.1%)	14 (40%)

Remark: The survey at 35 AC roof sheet manufacturing establishments on occupational health management as evaluated by current regulations at the time of the survey shows that:

- The indicators evaluated as reaching a high satisfactory rate include: conduct periodic physical examination for workers, perform examination to detect occupational diseases, conduct physical examination before recruitment, measure and check the labor environment, prepare occupational health records (accounting for 80% and over). Some establishments do implement but the implementation has not been in accordance with regulations.
- Indicators on the management of occupational health such as developing periodical plans for managing occupational health, creating health and disease management records for workers, developing plans to handle labor accident emergencies, conducting first aid training etc. have been implemented; however, many facilities have not met the requirements of current regulations.

Table 3.5. The state of the management of occupational safety at AC roof sheet manufacturing establishments

No.	**Activities**	**No. of faciliti es**	**Evaluation of results**		
			No	Unsatisf	Satisfac

		studied	implementation	actory implementation	tory implementation
1	Have labor insurance plans	35	17 (48.6%)	14 (40%)	4 (11.4%)
2	Have specialized/semi-specialized occupational safety and health staff	35	12 (34.3%)	15 (42.9%)	8 (22.9%)
3	Organize health department as regulated	35	15 (42.9%)	9 (25.7%)	11 (31.4%)
4	Manage equipment with strict requirements of occupational safety and health	35	0	7 (20%)	28 (80%)
5	Provide training on occupational safety	35	7 (20%)	17 (48.6%)	12 (31.4%)
6	Equip personal protective equipment	35	0	10 (28.5%)	25 (71.5%)
7	Submit peoridic report on occupational safety and health to competent agencies	35	2 (5.7%)	27 (77.2%)	6 (17.1%)
8	Have safety operating procedures posted at the workplace	32	7 (21.9%)	15 (46.9%)	10 (31.2%)
9	Have signs signifying restriction and dangerous places with hazards of occupational accidents	32	6 (18.8%)	18 (56.2%)	8 (25%)
10	Have structures to cover equipment and operating floor to ensure occupational safety	32	0	24 (75%)	8 (25%)
11	Use personal protective equipment as regulated	32	0	18 (56.2%)	14 (43.8%)

Remark: The survey into the compliance of occupational safety regulations at AC roof sheet manufacturing establishments has provided the specific results as follows:

- The percentage of establishments with good practice regarding the regulations of occupational safety at manufacturing facilities is not yet high. The indicators having a high "satisfactory" rate include "Manage equipment with strict

requirements of occupational safety and health" (28 out of 35 establishments meet the requirements, accounting for 80%) and "Equip personal protective equipment" (25 out of 35 establishments meet the requirements, accounting for 71.5%). Other indicators have had some implementation but it has not been fully in line with current regulations or the implementation is still just for show.

- The on-site survey at 32 AC roof sheet manufacturing establishments about occupational safety shows that:
    - 25 out of 32 establishments have safety operating procedures at the workplace (accounting for 71.8%); however, only 10 (accounting for 31.2%) have sufficient operating procedures for all equipment.
    - 26 out of 32 establishments (accounting for 81.2%) have installed signs of restriction or signs signifying dangerous places, or places with hazards of occupational accidents at the workplace; however, only 8 establishments (accounting for 25%) have sufficient signage in hazardous places.
    - All establishments have installed structures covering equipment and operating floor ensuring occupational safety; however, only 8 establishments (accounting for 25%) have installed sufficiently in hazardous places.
    - Workers have been asked to use personal protective equipment when working, however only 14 out of 32 establishments have workers who use personal protective equipment regularly. In the remaining establishments, workers mostly use clothes, face masks and rarely use other forms of personal protective equipment (especially noise-cancelling earplugs when working in areas with high noise levels).

3.2. Health status of workers at AC roof sheet manufacturing establishments

We conducted a survey on the health status of 2563 out of 2950 workers, accounting for 86.9% of the workers directly working in 35 out of 36 AC roof sheet manufacturing establishments currently in operation (in which the survey in 31 establishments was conducted by the Construction Hospital and retrospective data of 4 establishments was retrieved by local health agencies) and 100 retired workers of AC roof sheet manufacturing establishments. However, to achieve consistency in data, we have chosen to analyze 2459 workers working in 32 AC roof sheet manufacturing establishments (in which the survey in 31 establishments was conducted by the Construction Hospital and retrospective data of 1 establishment was retrieved by the Center for the Protection of Labor Health and Environment – Ho Chi Minh City) and 100 retired workers. The specific results are as follows:

3.2.1. Characteristics of research subjects:

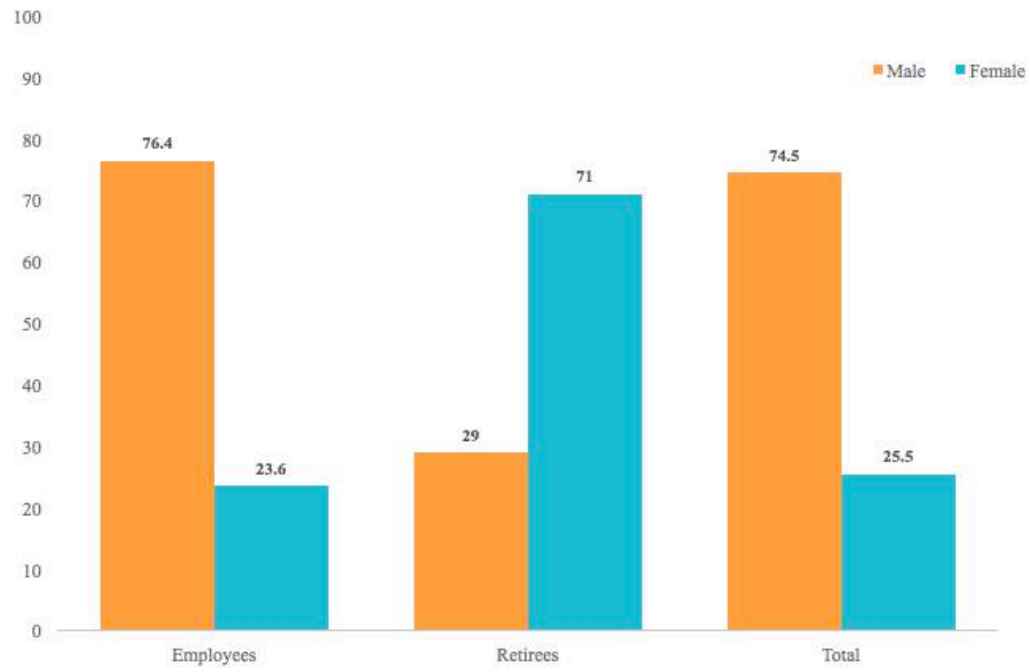


Figure 3.2: Distribution of research subjects by gender

Remark: 74.5% of the research subjects are male (in which 76.4% are workers and 29% are retirees), 25.5% of the research subjects are female (in which 23.6% are female workers and 71% are female retirees). There is a difference in the distribution of gender in workers and retired workers due to the fact that women retire earlier than men (at 55 years of age in women as compared to 60 in men).

Table 3.6: Some characteristics of the research subjects

Research characteristics		**Workers**	**Retirees**
Age (years)		37.5±8.8	59.4 ± 5.3
Time on the job (years)		8.7±7.2	18.7 ± 7.8
Time exposed to asbestos up to now (years/for retirees)			29.0 ± 6.8
Longest time exposed up to now (years/for retirees)	Occupation group 1		43
	Occupation group 2		46
	Occupation group 3		50

Remark:

- The average age of the research subjects is 37.5±8,8 (years) for workers and 59.4 ± 5.3 (years) for retirees.
- The average number of years on the job for the research subjects is 8.7±7.2 for workers and 18.7 ± 7.8 for retirees.

- The time exposed to the risk factor (asbestos fiber) up to now for retired workers is 29.0 ± 6.8 on average, in which the longest time since being exposed to the risk factor up to now in workers of Occupation Group 1 is 43 years, Occupation Group 2 is 46 years and Occupation Group 3 is 50 years.

Table 3.7: Distribution of research subjects by Occupation groups and time on the job

No. of years on the job	**Group 1**		**Group 2**		**Group 3**		**Total**	
	NO.	%	NO.	%	NO.	%	NO.	%
< 10	184	52.7	903	59.0	428	63.0	1515	59.2
10 – 19	116	33.3	461	30.1	173	25.5	750	29.3
20 – 29	45	12.9	155	10.1	63	9.3	263	10.3
≥ 30	4	1.1	12	0.8	15	2.2	31	1.2
Total	**349**	**13.7**	**1531**	**59.8**	**679**	**26.5**	**2559**	**100**

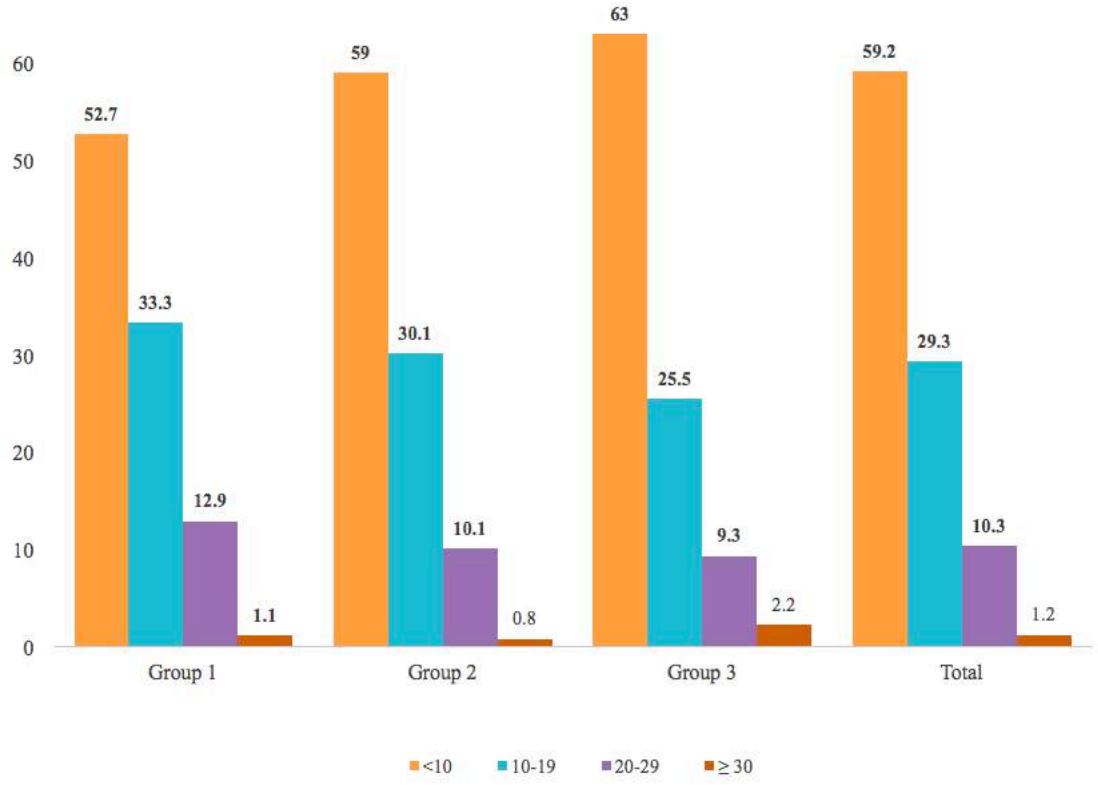


Figure 3.3: Distribution of research subjects by Occupation groups and time on the job

Remark: Most workers have spent less than 10 years on the job (accounting for 59.2%), the group of workers with 10 – 19 years on the job accounts for 29.3%, the group of workers with 20 – 29 years on the job accounts for 10.3%, the group of workers with more than 30 years on the job accounts for the lowest percentage at 1.2%.

Table 3.8: Distribution of research subjects by Occupation group and time since being exposed to asbestos up to now *(for retired workers)*

Time of exposure	Group 1		Group 2		Group 3		Total	
	NO.	%	NO.	%	NO.	%	NO.	%
< 20	2	22.2	6	66.7	1	11.1	9	9.0

20 – 29	11	21.6	34	66.7	6	11.7	51	51.0
≥ 30	8	20.0	20	50.0	12	30.0	40	40.0
Total	**21**	**21**	**60**	**60**	**19**	**19**	**100**	**100**
Comparison	$\chi^2 = 4.83$; $p = 0.306$							

Remark: In terms of the time since being exposed to asbestos up to now, the majority of retired workers have been exposed for 20 to 29 years (51 out of 100 people, accounting for 51%), the number of workers with over 30 years of asbestos exposure up to now is 40 out of 100 people, accounting for 40%; the number of workers with less than 20 years of exposure up to now is 9 people, accounting for 9%. There is no statistically significant difference in the exposed time by occupation groups ($p>0.05$).

3.2.2. Health status of workers:

Table 3.9: Distribution of the rate of change in lung ventilation function by gender

Gender	**No. of subjects**	**Normal lung ventilation function**		**Change in lung ventilation function**	
		NO.	%	NO.	%
Male	1907	1823	95.6	84	4.4
Female	652	602	92.3	50	7.7
Total	**2559**	**2425**	**94.8**	**134**	**5.2**
Comparison	$\chi^2 = 10.43$; $p < 0.01$				

Remark: The rate of change in lung ventilation function in the research subjects is 5.2%, in which for males the figure is 4.4% and in females it is 7.7%, the difference is statistically significant ($p < 0.01$).

Table 3.10: Distribution of the rate of change in lung ventilation function by age group

Age group	No. of subjects	Normal lung ventilation function		Change in lung ventilation function	
		NO.	%	NO.	%
< 40	1396	1355	97.1	41	2.9
40- 49	847	790	93.3	57	6.7
50- 59	253	225	88.9	28	11.1
≥ 60	63	55	87.3	8	12.7
Total	**2559**	**2425**	**94.8**	**134**	**5.2**
Comparison	$\chi^2 = 43.08$; $p < 0.01$				

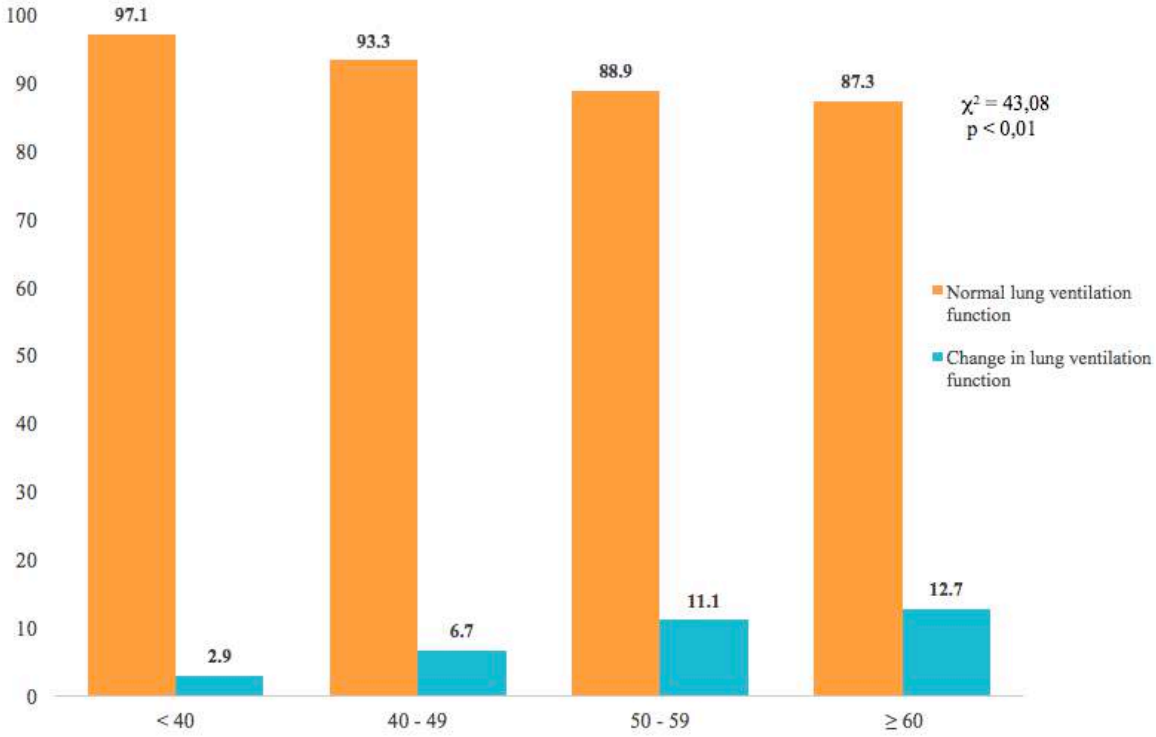


Figure 3.4: Distribution of the rate of change in lung ventilation function by age group

Remark: The rate of change in lung ventilation function tends to increase with age, as it is highest in the age group of 60 and over (accounting for 12.7%); the figure is 11.1% for the 50 – 59 age group, 6.7% for the 40 – 49 age group, and is the lowest in the under 40 age group (accounting for 2.9%). The difference is statistically significant ($p<0.01$).

Table 3.11: Distribution of the rate of change in lung ventilation function by occupation group

Occupation group	No. Of subjects	Normal lung ventilation function		Change in lung ventilation function	
		NO.	%	NO.	%
Group 1	349	326	93.4	23	6.6
Group 2	1531	1457	95.2	74	4.8
Group 3	679	642	94.6	37	5.4
Total	**2559**	**2425**	**94.8**	**134**	**5.2**
Comparison		$\chi 2 = 1.856$; $p = 0.395$			

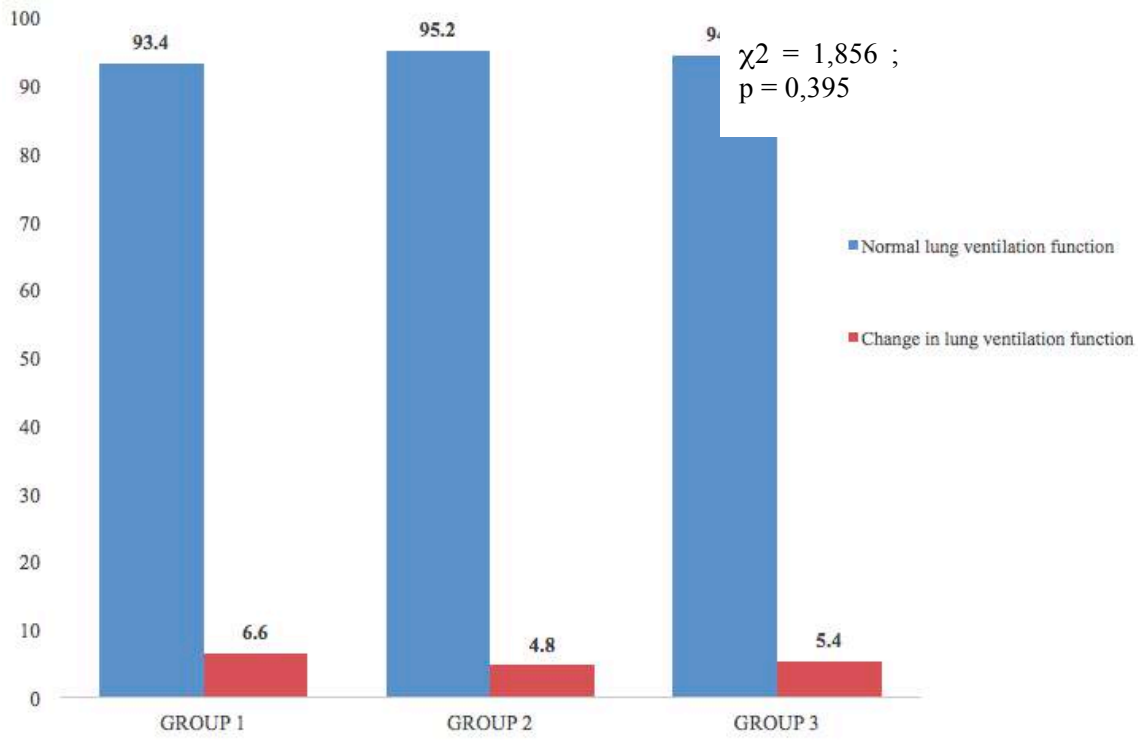


Figure 3.5: Distribution of the rate of change in lung ventilation function by occupation group

Remark: The rate of change in lung ventilation function is 5.2%, and is the highest in group 1 (accounting for 6.6%), following by group 3 (accounting for 5.4%), and is the lowest in group 2 (accounting for 4.8%). However, this difference is not statistically significant with $p > 0.05$.

Table 3.12: Distribution of the rate of change in lung ventilation function by number of years on the job

Years on the job	No. Of research subjects	Normal lung ventilation function		Change in lung ventilation function	
		NO.	%	NO.	%
< 10	1515	1455	96.0	60	4.0
10 - 19	750	700	93.3	50	6.7
20 - 29	263	245	93.2	18	6.8
≥ 30	33	27	81.8	6	18.2
Total	**2559**	**2425**	**94.8**	**134**	**5.2**
Comparison		$\chi 2 = 20.59$; $p < 0.01$			

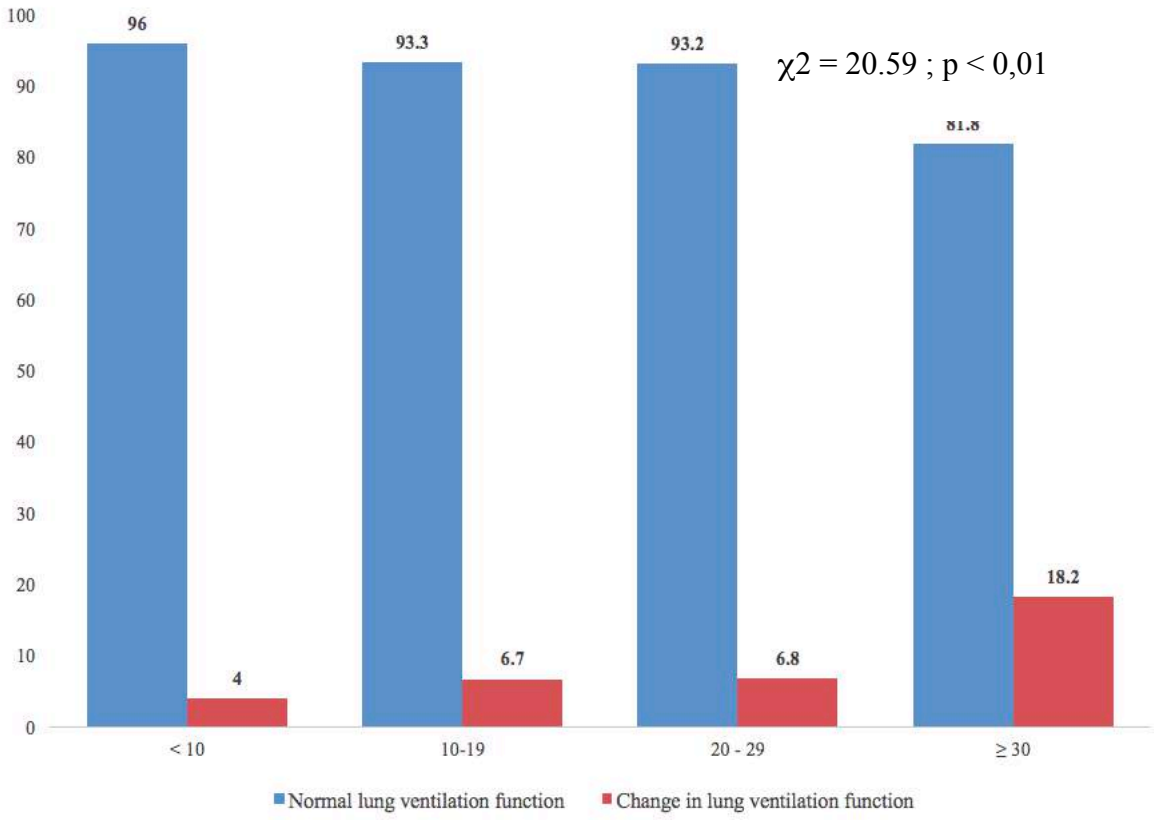


Figure 3.6: Distribution of the rate of change in lung ventilation function by number of years on the job

Remark: Based on the number of years on the job, it can be seen that the rate of change in lung ventilation function is the highest in the group of workers with more than 30 years on the job (accounting for 18.2%), the group with 20 – 29 years on the job accounts for 6.8%; the group with 10 – 19 years on the job accounts for 6.7%; the figure is the lowest in the group with less than 10 years spent on the job (accounting for 4.0%). The difference is statistically significant ($p < 0.01$).

Table 3.13: Distribution of the level of change in lung ventilation function by the indicators %FVC and %FEV1

Level of change / Form of change	Not serious		Moderate		Serious		Total	
	NO.	%	NO.	%	NO.	%	NO.	%
% FVC	96	94.1	21	67.7	6	54.5	123	85.4
% FEV1	6	5.9	10	32.3	5	45.5	21	14.6
Total	**102**	**70.8**	**31**	**21.5**	**11**	**7.7**	**144**	**100**

Remark: The form of change in lung ventilation function is mainly restrictive diseases (decreased %FVC), accounting for 85.4%; obstructive diseases (decreased %FEV1) account for 14.6%. The level of change in lung ventilation function is mainly not serious (accounting for 70.8%); change at a moderate level accounts for 21.5% and change at a serious level accounts for 7.7% among the workers with changes in their lung ventilation function.

Table 3.14: Link between the change in lung ventilation function and chronic upper respiratory tract diseases

Chronic upper respiratory tract diseases	No. Of subjects	Change in lung ventilation function		Normal lung ventilation function	
		NO.	%	NO.	%
With disease	1231	85	6.9	1146	93.1
Without disease	1328	49	3.7	1279	96.3

Total	**2559**	**134**	**5.2**	**2425**	**94.8**
		OR = 1.94; χ^2 = 13.31; p < 0.01			

Remark: The results in Table 3.14 show that people with chronic upper respiratory tract diseases are 1.94 times more likely to have changes in the lung ventilation function as compared to people without the disease. The link is statistically significant (p < 0.01).

Table 3.15: Link between the change in lung ventilation function And smoking

Smoking	**No. Of subjects**	**Change in lung ventilation function**		**Normal lung ventilation function**	
		NO.	%	NO.	%
Smokers	1420	83	5.8	1337	94.2
Non – smokers	1139	51	4.5	1088	95.5
Total	**2559**	**134**	**5.2**	**2425**	**94.8**
		OR = 1.32; χ^2 = 2.38; p=0.1228			

Remark: The results of the study show that smokers are 1.32 times more likely to have changes in their lung ventilation function compared to non-smokers. However, this relationship is not statistically significant (p > 0.05).

Table 3.16. The rate of change in lung ventilation function by the level of smoking

Smoking	No. Of subjects	Normal lung ventilation function		Change in lung ventilation function	
		Number	Percentage	Number	Percentage
No	1139 (44.5%)	1088	95.5	51	4.5
Light (< 5 cigarettes/ day)	802 (31.3%)	765	95.4	37	4.6
Moderate (5 – 10 cigarettes/ day)	514 (20.1%)	483	94.0	31	6.0
Heavy (> 10 cigarettes/ day)	104 (4.1%)	89	85.6	15	14.4
Total	**2559**	**2425**	**94.8**	**134**	**5.2**
Comparison		$\chi^2 = 20.28$; $p < 0.01$			

Remark: Workers are considered a smoker when they smoke continually for over 6 months. The results of the study show that 55.5% of the research subjects smoke. The rate of change in lung ventilation function tends to increase with the average daily level of smoking, which is the highest in heavy-smoking workers (accounting for 14.4%), followed by moderate-smoking workers (accounting for 6.0%); 4.6% of the workers who are light smokers have change in lung ventilation function; this figure in the group of workers who are non-smokers or who have quit smoking for

over 10 years is 4.5%, which is the lowest. The difference is statistically significant ($p < 0.01$).

Table 3.17: Consulting results of X-ray and CT Scanner images

Image of lesions	Workers (n=2459)		Retirees (n=100)		Total (n=2559)	
	NO.	Percentage	NO.	Percentage	NO.	Percentage
Normal	2346	95.4	75	75	2421	94.6
Asbestosis	0	0	0	0	0	0
Silicosis (pre-existing, not diffused 0/1p category)	1	0.04	1	1	2	0,1
Pleural effusion	0	0	0	0	0	0
Pleural thickening/pleural calcification	13	0.5	6	6	19	0.7
Pulmonary calcification, fibrosis, infiltrate due to tuberculosis, inflammation (pre-existing/diffuse)	77	3.1	16	16	93	3.6
Emphysema	11	0.4	3	3	14	0.5
Other lesions	18	0.7	2	2	20	0.8

Remark: The consulting results on 2559 X-ray images and 180 CT Scanner images of suspected cases show that:

- There are 2421 normal cases, accounting for 94.6% (in which the normal rate in workers is 95.4% and in retirees is 75%).
- 93 cases show images of pulmonary calcification, fibrosis, infiltrate due to tuberculosis, inflammation (pre-existing/diffuse), accounting for 3.6%.
- 19 cases show pleural thickening/pleural calcification, accounting for 0.7%, in which the rate in workers is 0.5% and retirees is 6%.
- 14 cases show images of emphysema, accounting for 0.5%;
- There are two silicosis cases (pre-existing, not diffused 0/1p category), accounting for 0.1%
- 20 Cases show other lesions (rib lesion, calcified node of lung hilum, calcified node near the aortic arch, bronchiectasis, post-injury pleural plaque, tracheal stenosis...), accounting for 0.8%.
- No cases of asbestosis and pleural effusion were detected.

Table 3.18: Distribution of Pleural thickening/pleural calcification lesions by occupation groups

Occupation group	**No. Of research subjects**	**No lesions**		**Lesion present**	
		NO.	%	NO.	%
Group 1	349	339	97.1	10	2.9
Group 2	1531	1525	99.6	6	0.4
Group 3	679	676	99.6	3	0.4
Total	**2559**	**2540**	**99.3**	**19**	**0.7**
Comparison		$\chi^2 = 24.73$; $p < 0.01$			

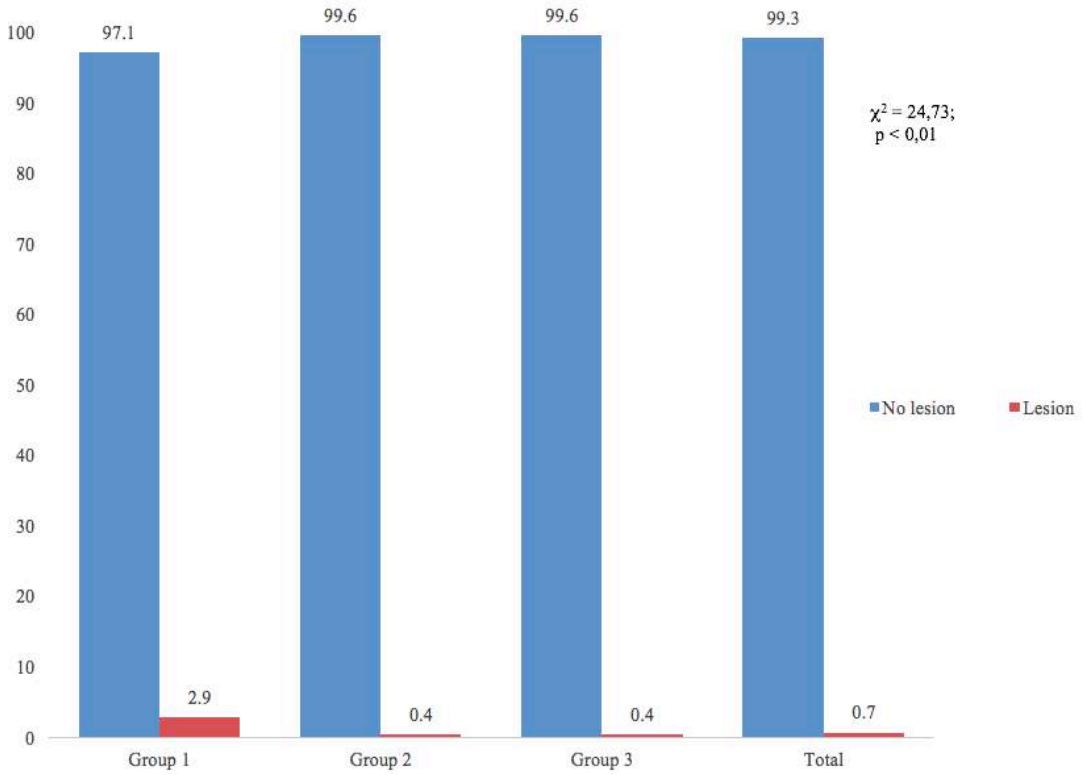


Figure 3.7: Distribution of Pleural thickening/pleural calcification lesions by occupation groups

Remark: The number of workers with pleural calcification/thickening lesions possibly relating to asbestos accounts for 0.7%, in which workers in Occupation group 1 have the highest rate of lesions at 2.9%, followed by group 2 and group 3 accounting for 0.4%. This difference is statistically significant ($p<0.01$). However, the pleural thickening lesions are only localized and small in size.

Table 3.19: Distribution of Pleural thickening/pleural calcification lesions by number of years working

No. Of years working	No. Of subjects	No lesions		Lesion present	
		NO.	%	NO.	%
< 10	1515	1514	99.9	1	0.1
10 – 19	750	744	99.2	6	0.8
20 - 29	263	253	96.2	10	3.8
≥ 30	33	31	93.9	2	6.1
Total	**2559**	**2540**	**99.3**	**19**	**0.7**
Comparison		$\chi^2 = 61.8186$; $p < 0.01$			

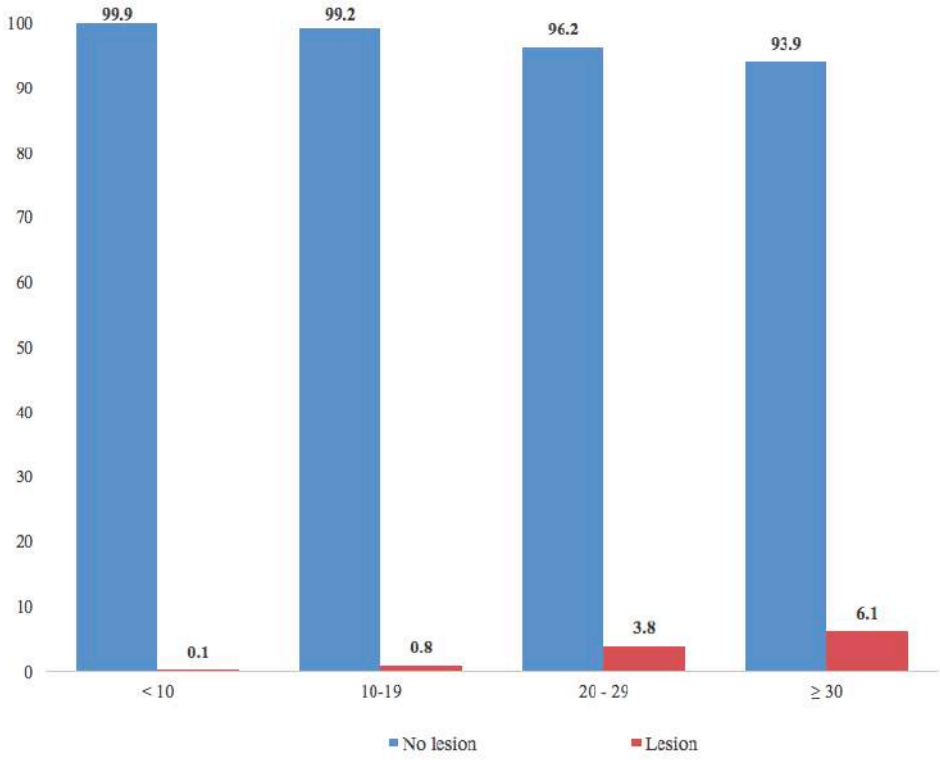


Figure 3.8: Distribution of Pleural thickening/pleural calcification lesions by number of years working

Remark: The rate of workers with pleural thickening and/or pleural calcification is the highest in workers with over 30 years on the job (accounting for 6.1%), followed by the group with 20 – 29 years on the job (accounting for 3.8%), and the group with 10 – 19 years on the job (accounting for 0.8). The group with less than 10 years on the job accounts for the lowest percentage at 0.1%. This difference is statistically significant ($p < 0.01$).

Table 3.20: Prevalence of common medical conditions and conditions requiring attention in the research subjects

Condition	Workers (n=2459)		Retirees (n=100)		Total (n=2559)	
	NO.	Percentage	NO.	Percentage	NO.	Percentage

Odonto-Stomatological conditions *(tooth decay, gingivitis, inflammation around the tooth...)*	1682	68.4	96	96	1778	69.5
Chronic sinusitis, nasopharyngitis, laryngitis	1076	43.8	86	86	1162	45.4
Eye conditions *(conjunctivitis, pterygium, refractive error...)*	487	19.8	87	87	574	22.4
High blood pressure	279	11.3	24	24	303	11.8
Kidney, urologic condition *(kidney stones, nephrocystosis, urethritis...)*	233	9.5	12	12	245	9.6
Musculoskeletal disorder *(rheumatoid arthritis, osteoarthritis...)*	209	8.5	19	19	228	8.9
Hepatobiliary conditions *(gallbladder stones, liver stones, hepatitis...)*	143	5.8	12	12	155	6.1
Conditions of the stomach and the duodenum *(Peptic ulcer disease…)*	143	5.8	9	9	152	5.9
Chronic bronchitis	94	3.8	3	3	97	3.8
Cancer (breast)	0	0	2	2	2	0.1
Occupational disease (Silicosis 0/1p)	1	0.04	1	1	2	0.1

Remark: The main medical conditions detected in the research subjects include: Odonto-Stomatological conditions *(tooth decay, gingivitis, inflammation around the tooth...)* with the highest percentage (69,5%), followed by chronic sinusitis, nasopharyngitis, laryngitis (accounting for 45.4%); eye conditions *(conjunctivitis, pterygium, refractive error...)* accounting for 22.4%; high blood pressure accounting for 11.8%; kidney, urologic condition *(kidney stones, nephrocystosis, urethritis...)* accounting for 9.6%; musculoskeletal disorder *(rheumatoid arthritis, osteoarthritis...)* accounting for 8.9%. Hepatobiliary conditions, conditions of the stomach and the duodenum, disorder in the lower back and chronic bronchitis account for a lower percentage (from 3.8 to 6.1%). There are 02 occupational disease cases (Silicosis (pre-existing, not diffused 0/1p category)), accounting for 0.1%, two breast cancer cases currently receiving treatment, accounting for 0.1% and 0.3% among women.

Table 3.21: Results of health classification

(for workers working at AC roof sheet manufacturing establishments)

Health classification	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
Level I	81	4.3	7	1.2	88	3.6
Level II	766	40.8	181	31.0	947	38.5
Level III	915	48.8	374	64.2	1289	52.4
Level IV	114	6.1	21	3.6	135	5.5
Total	**1876**	**100.0**	**583**	**100.0**	**2459**	**100.0**

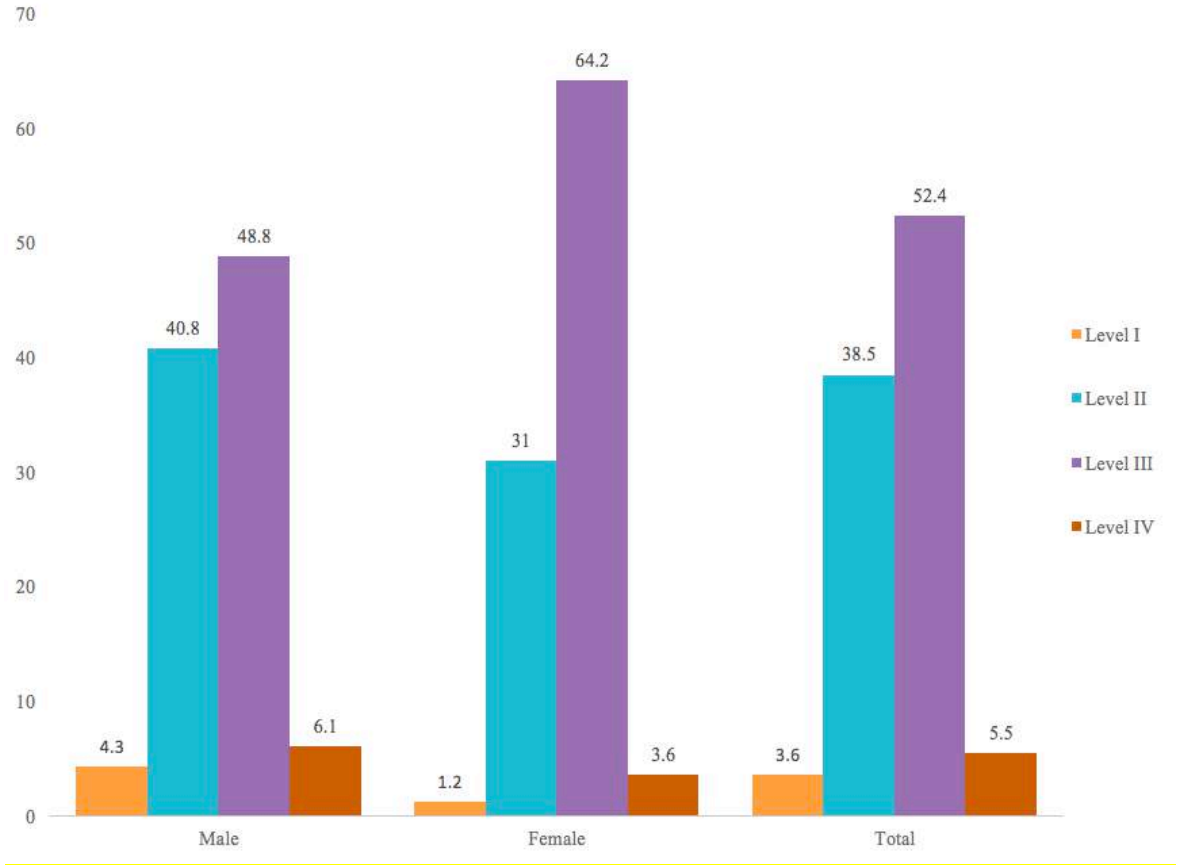


Figure 3.9: Results of health classification of workers in AC roof sheet manufacturing

Remark: A majority of research subjects have level III health (accounting for 52.4%), following by level II at 38.5%; level IV accounts for 5.5%, and the lowest is level I at 3.6%. There is a similarity in this indicator for male and female workers.

Some typical cases showing images of lesions with suspected link to Asbestos

Case 1:

Full name: Duong Ngoc T. – Year of birth 1971

Occupation: Grinding asbestos, mixing materials, molding – No. of years on the job: 21 years

Place of work: Roof sheet plant – Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Normal

2. Internal: - Blood pressure: 120/80 mmHg

- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal
- Kidney, urinary system: Normal

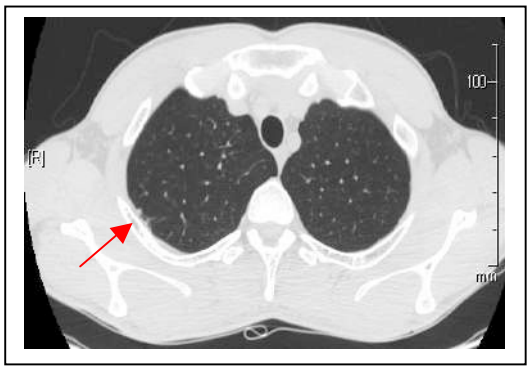
3. Neuromusculoskeletal: Normal

4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	Normal
3.	Test results	Slight increase in blood lipids and liver enzymes
4.	X-ray/CT Scanner images	**Pleural thickening of the right lung's upper lobe**



Case 2:

Full name: Nguyen Van T. – Year of birth 1972

Occupation: Grinding asbestos – No. of years on the job: 21 years

Place of work: Roof sheet plant – Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Normal

2. Internal: - Blood pressure: 110/70 mmHg
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal
- Kidney, urinary system: Normal at the moment

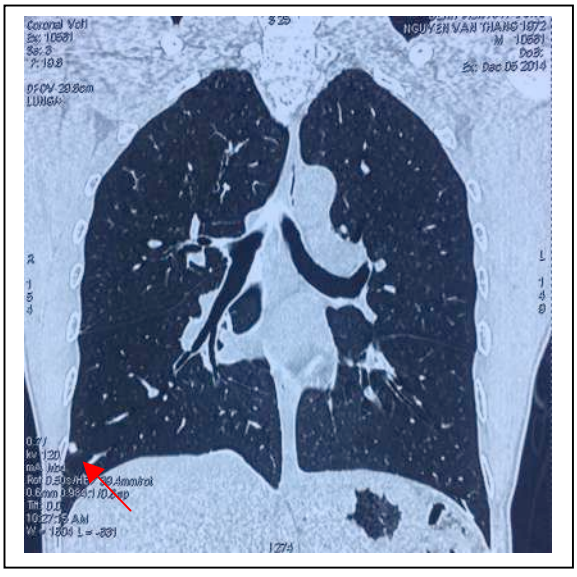
3. Neuromusculoskeletal: Normal

4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Stones in the left kidney with the size of: 8mm
2.	Respiratory functions	Normal
3.	Test results	Slight increase in liver enzymes
4.	X-ray/CT Scanner images	**Spots of pleural thickening on the side of the right lung, not diffused after one year (Image of lesions in 2014 vs 2015)**



Case 3:

Full name: Duong Danh T. – Year of birth 1971

Occupation: Slicing – No. of years on the job: 20

From: Thai Nguyen Roof Sheet and Building Materials Joint Stock Company

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): presbyopia in two eyes; having tartar, gingivitis

2. Internal: - Blood pressure: 120/80 mmHg
   - Heart: normal heart rate, normal T1, T2 without heart murmur
   - Lung: clear RRPN, no rales
   - Digestion: Normal
   - Kidney, urinary system: Normal at the present

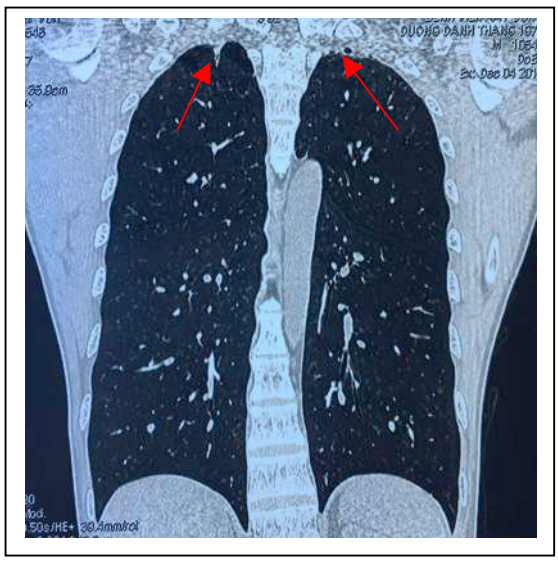
3. Neuromusculoskeletal: Normal

4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Stones in the left kidney with the size of: 10mm
2.	Respiratory functions	Normal
3.	X-ray/CT Scanner images	**Pleural thickening, Emphysema on two sides of the apical lung**



Case 4:

Full name: Do Van L. – Year of birth 1963

Occupation: mixing materials, molding – No. of years on the job: 20 years

Place of work: Roof sheet plant, Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): presbyopia in two eyes; having tartar, gingivitis

2. Internal: - Blood pressure: 110/75 mmHg

- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Underwent surgery to remove 2/3 of the stomach, currently stable.
- Kidney, urinary system: Normal at the present

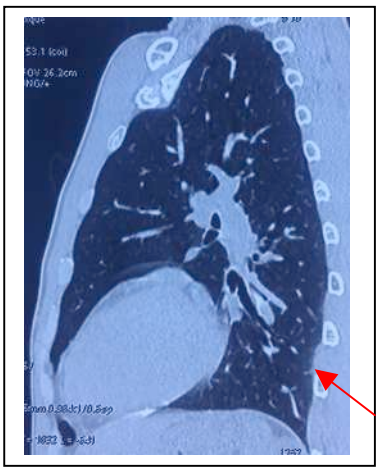
3. Neuromusculoskeletal: Normal 4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Stones in the left kidney with the size of: 10mm
2.	Respiratory functions	Normal
3.	Test results	Slight increase in blood lipids
4.	X-ray/CT Scanner images	**Pleural thickening, pleural institial thickening, on the posterior of the two sides, follow up after 2 years**

Images in 2013



Images in 2015

Case 5:

Full name: Dau Ba T. – Year of birth 1972

Occupation: mixing materials, Grinding asbestos – No. of years on the job: 20 years

Place of work: Roof sheet plant, Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Chronic pharyngitis

2. Internal: - Blood pressure: 110/80 mmHg
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal at the present.
- Kidney, urinary system: Normal at the present

3. Neuromusculoskeletal: bones of the 2^{nd}, 3^{rd}, 4^{th} toes were broken due to occupational accident

4. Endocrine: Normal 5. Surgical, dermatological: Normal

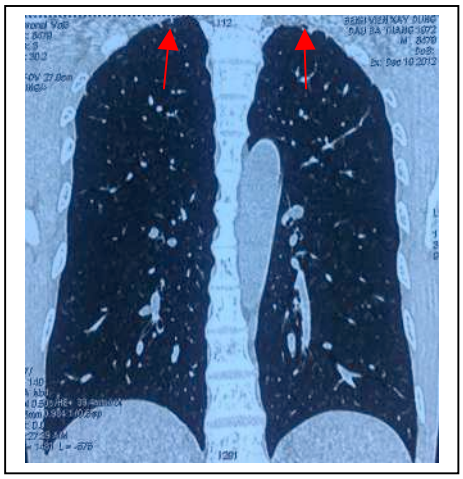
II. Paraclinical

1. Abdominal Liver cyst with the size of: 21mm

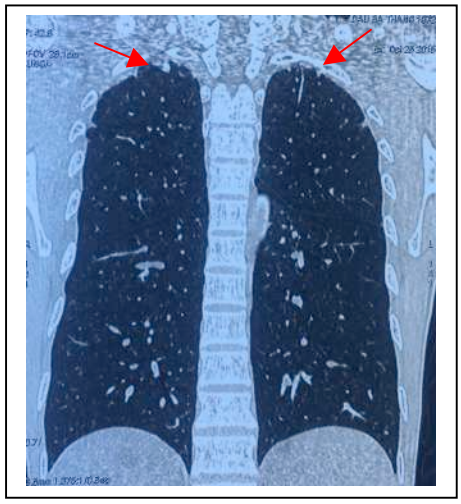
ultrasound

2. Respiratory functions Normal
3. Test results Normal
4. X-ray/CT Scanner images **Pleural thickening in the apical lung on both sides, not diffused after 3 years**

Images in 2012



Images in 2015



Case 6:

Full name: Le Van Y. – Year of birth 1976

Occupation: Slicing and rolling – No. of years on the job: 20 years

Place of work: Roof sheet plant, Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Having tartar, gingivitis

2. Internal: - Blood pressure: 120/80 mmHg
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal at the present.
- Kidney, urinary system: Normal at the present

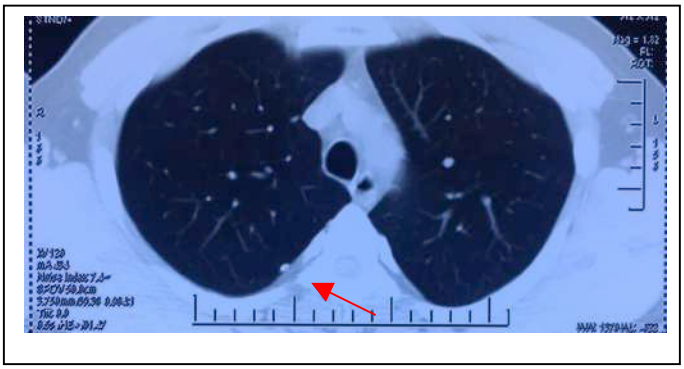
3. Neuromusculoskeletal: Normal

4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	Normal
3.	X-ray/CT Scanner images	**Pleural calcification nodules in the posterior wall of the upper lobe on the right.**



Case 7:

Full name: Nguyen Thanh H. – Year of birth 1950

Occupation: Technician (retired) – No. of years on the job: 30 years,

Time exposed to asbestos up to now: 34 years

Place of work: Roof sheet plant - Dong Anh Investment, Construction and Building Materials Corporation

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): presbyopia in two eyes, chronic pharyngitis

2. Internal: - Blood pressure: 130/80 mmHg

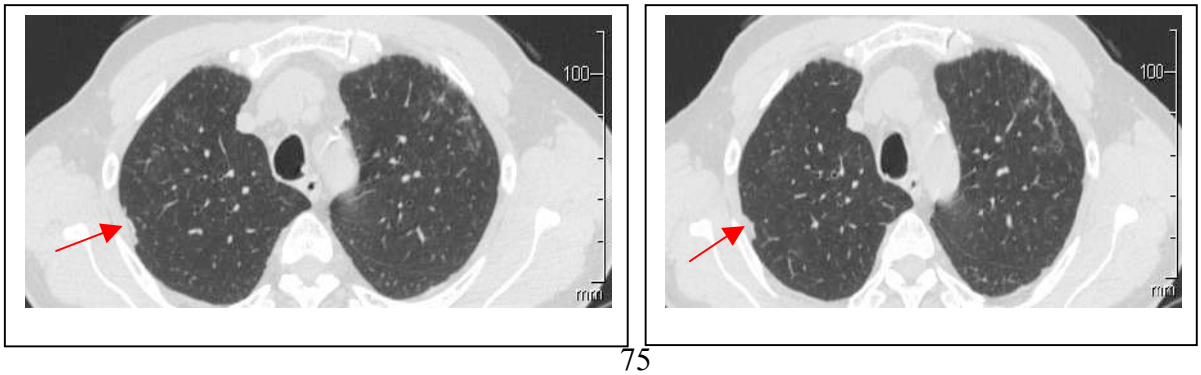
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal
- Kidney, urinary system: Normal

3. Neuromusculoskeletal: Normal 4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	Normal
3.	Test results	Slight increase in blood sugar and blood lipids Cyfra 21-1 Normal (1.7 ng/ml)
4.	X-ray/CT Scanner images	**Pleural thickening of the upper lobe of the right lung**



Case 8:

Full name: Vu Huy D. – Year of birth 1953

Occupation: waving (retired) – No. of years on the job: 16 years,

Time exposed to asbestos up to now: 26 years

Place of work: Thai Nguyen Roof Sheet Plant – Investment and Industrial Manufacturing Joint Stock Company

Medical summary:

I. Clinical:

1**.** Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): presbyopia in two eyes, chronic pharyngitis

2. Internal: - Blood pressure: 130/80 mmHg/ patient receiving treatment for hypertension

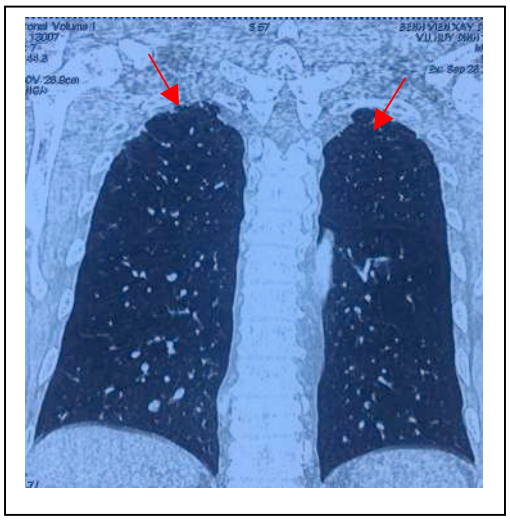
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal
- Kidney, urinary system: Normal

3. Neuromusculoskeletal: Normal 4. Endocrine: Normal

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	minor obstruction
3.	Test results	Biochemistry, hematology: Normal Cyfra 21-1: Normal (1,9 ng/ml)
4.	X-ray/CT Scanner images	**Pleural thickening in the apical lung on two sides**



Case 9:

Full name: Vu Thi H. – Year of birth 1955

Occupation: Grinding asbestos (retired) – No. of years on the job: 19 years,

Time exposed to asbestos up to now: 29 years

Place of work: Thai Nguyen Roof Sheet Plant – Investment and Industrial Manufacturing Joint Stock Company

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Two eyes underwent surgery to have IOL implanted, chronic pharyngitis.

2. Internal: - Blood pressure: 120/70 mmHg

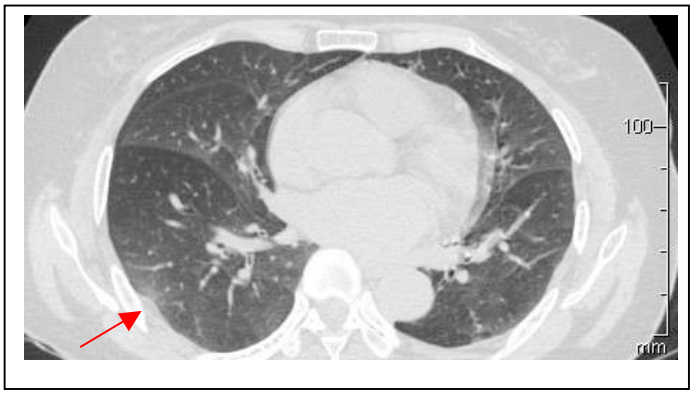
- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal
- Kidney, urinary system: Normal

3. Neuromusculoskeletal: Normal 4. Endocrine: Normal

5. Surgical, dermatological: Underwent surgery for appendicitis, condition currently stable

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	Normal
3.	Test results	Slight increase in blood lipids Cyfra 21-1: Normal (1,9 ng/ml)
4.	X-ray/CT Scanner images	**Pleural thickening localized in the 8th segment, on the back base of the right lung, 20mm in size**



Case 10:

Full name: Luong Ngoc T. – Year of birth 1954

Occupation: Repairing equipment (retired) – No. of years on the job: 30 years,

Time exposed to asbestos up to now: 37 years

Place of work: Thai Nguyen Roof Sheet Plant – Investment and Industrial Manufacturing Joint Stock Company

Medical summary:

I. Clinical:

1. Specializations (ophthalmology, otorhinolaryngology, Odonto stomatology): Presbyopia, periondotitis in the 2nd, 3rd stage.

2. Internal: - Blood pressure: 120/80 mmHg

- Heart: normal heart rate, normal T1, T2 without heart murmur
- Lung: clear RRPN, no rales
- Digestion: Normal

- Kidney, urinary system: Normal

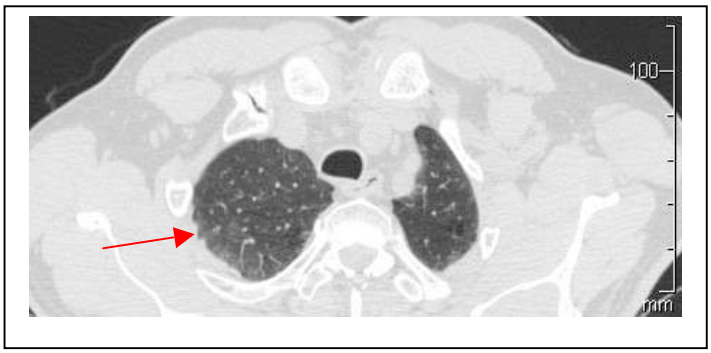
3. Neuromusculoskeletal: Normal

4. Endocrine: Diabetes currently receiving treatment

5. Surgical, dermatological: Normal

II. Paraclinical

1.	Abdominal ultrasound	Normal
2.	Respiratory functions	Normal
3.	Test results	Increased blood sugar (8,3 mmol/L); Slight increase in blood lipids, liver enzymes; Cyfra 21-1: Normal (2,4 ng/ml)
4.	X-ray/CT Scanner images	**Pleural thickening on the apical right lung**



3.3. Status of the environment and health of the residential area of Tan Trinh Commune – Quang Binh – Ha Giang

Quang Binh rural district is an important transport hub in the South – West of Ha Giang Province, to trade with Lao Cai and Yen Bai provinces. By the end of 2013, the district had 62,355 residents living on an area of 79,188.04 km^2. People mostly work in agriculture and animal husbandary for a living. Tan Trinh is a commune in the lower region of Quang Binh rural district, 16 km southwest of the district center. The commune has a total natural land area of 5,181.96 ha, a total of 1046

households and 4,565 people. There are 11 ethnic groups living in the commune: Pa Then, Tay, Dao, Nung, La Chi, Cao Lan, Mong, Hoa, Kinh, Thai, Phu La. Since 2009, with the authority's policy of providing financial support for purchases of asbestos roof sheets, the rate of households in the commune in particular and in Quang Binh rural district in general with asbestos roof sheets has been high (about 70%).

3.3.1. Status of the environment in the residential area

The survey of the environment in the residential area of 30 households (with typical architecture of people in the highlands, which mainly uses AC roof sheets, the time of usage is long) in Tan Trinh commune shows that:

Table 3.22: The microclimate characteristics of the residential area

Factors measured / **Location**	**NO.**	**Temperature** *(^oC)*	**Humidity** *(%)*	**Wind speed** *(m/s)*
Area 1.5 meters from the entrance	10	29.6±0.08	69.2±0.6	0.44±0.08
In-door area	10	29.2±0.05	70.2±0.4	0.20±0.00
Entrance	10	29.5±0.07	69.8±0.8	0.32±0.06

Remark: At the measuring time, the microclimate factors (Temperature, Humidity, Wind speed) of the residential areas in Tan Trinh commune were: Temperature: from 29.2±0.05 to 29.6±0.08 (^{o}C); Humidity: from 69.2±0.6 to 70.2±0.4 (%); Wind speed: from 0.20±0.00 to 0.44±0.08 (m/s)

Table 3.23: Total suspended dust (TSP) at the residential areas *($\mu g/m^3$)*

TSP / Location	NO.	Min ($\mu g/m^3$)	Max ($\mu g/m^3$)	Average ($\mu g/m^3$)	Standard deviation
Area 1.5 meters from the entrance	10	281	498	**382.4**	±87.7
In-door area	10	252	339	291.4	±27.5
Entrance	10	253	410	**347.6**	±87.5
Allowed standard				**≤ 300 – 1 hour average**	

Remark: At the time the measure was conducted, the Total suspended dust (TSP) at the residential areas were from 291.4±27.5 ($\mu g/m^3$) to 382.4 ±87.7 ($\mu g/m^3$); some samples, especially at the entrance and in the area 1.5 from the entrance were over the allowed standard as specified in the National Standard QCVN 05/2013-BTNMT.

The survey of 16 samples of asbestos fiber dust concentration at the households of Tan Trinh commune as chosen above shows that there was no asbestos fiber in the samples collected.

3.3.2. Survey of households and medical examination of people in Tan Trinh commune – Quang Binh – Ha Giang

As there were many geographical obstacles, the number of people in Tan Trinh commune participating in our survey was 429 people from 282 households. The results are as follows:

3.6.2.1. Status of households in Tan Trinh commune, Quang Binh rural district

Table 3.24: Characteristics of the households (n=282)

Characteristics		NO.	%
Households with people working at factories that exposed them to asbestos	Yes	3	1.1
	No	279	98.9
Roof sheet materials	Flat roof	15	5.3
	Tiled roof	3	1.1
	Asbestos cement roof	195	69.4
	Thatched roof	64	22.8
	Others	4	1.4
Main stove	Coal stove	5	1.8
	Firewood and straw stoves	252	90.0
	Gas stove	22	7.9
	Others	1	0.4

Remark: The results of the household survey show that: only 1.1% of the households have a member of the family working directly at asbestos or AC roof sheet manufacturing plants. 69.4% of the households use AC roof sheets in their house's roofing. The households mostly use firewood and straw stoves (90.0%).

Table 3.25: Water usage habits of the households (n=282)

Characteristics		NO.	%
Main source of	Tap water	5	1.8

domestic water supply	Well water	131	46.5
	Pond water	3	1.1
	Water from rivers and streams	139	49.3
	Rain water	3	1.1
Main source of drinking water	Tap water	4	1.4
	Well water	131	46.5
	Pond water	2	0.7
	Water from rivers and streams	134	47.5
	Rain water	9	3.2
Rain water collecting roofs	Asbestos-cement roofs	9/9	100.0
	Others	0	0.0
Water containers	Lidded jars, pots, buckers, drums	40	14.2
	Unlidded jars, pots, buckets, drums	14	5.0
	Lidded water tanks	119	42.2
	Unlidded water tanks	36	12.8
	Others	72	25.5

Remark: The domestic water of people in Tan Trinh is mainly from rivers and streams (49.3%), and wells (46.5%). Similar results are also found with regards to main sources of drinking water. Rain water only accounts for 3.2%; however, for households using rain water, 100% of the households use AC roofs to collect the

water. The households mainly use lidded water tanks to store water, and according to observation as well as the responses of the people, only a few of them use water tanks with asbestos-cement lids.

3.3.3. State of people's health in Tan Trinh commune, Quang Binh rural district

Table 3.26: Age and gender of the residents (n=429)

Age group	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
• <5 years old	21	12.5	8	3.1	29	6.8
• 5- < 15 years old	28	16.7	35	13.4	63	14.7
• 15 - < 60 years old	99	58.9	193	74.0	292	68.1
• ≥ 60 years old	20	11.9	25	9.6	45	10.5
Total	**168**	**100.0**	**261**	**100.0**	**429**	**100.0**

Remark: People in Tan Trinh commune are mainly in the working age (from 15 to 60 years old). The rate of boys less than 5 years old is higher compared to girls (12.5% as compared to 3.1%).

Table 3.27: Nutritional status of people in Tan Trinh commune

(adults 18 years of age and over)

Characteristics	Male	Female	Total
	X ± SD	**X ± SD**	**X ± SD**
Height (cm)	161.6 ± 6.8	154.0 ± 5.0	156.6 ± 6.8

Weight (kg)	60.5 ± 51.7		51.4 ± 35.7		54.4 ± 35.7	
	n	**%**	**n**	**%**	**n**	**%**
Underweight	33	29.2	67	31.2	100	30.5
Normal	67	59.3	132	61.4	199	60.7
Overweight/obese	13	11.5	16	7.4	29	8.8
Total	**113**	**100.0**	**215**	**100.0**	**328**	**100.0**

Remark: The rate of males in Tan Trinh commune having problems relating to nutrition (including being underweight and overweight/obese) is 40.7%, which is higher than that of females at 38.6%.

Table 3.28: Blood pressure of people in Tan Trinh commune

(adults 18 years of age and over)

Characteristics	**Male**		**Female**		**Total**	
	X ± SD		**X ± SD**		**X ± SD**	
Maximum blood pressure (mmHg)	121.0 ± 13.6		115.6 ± 16.7		117.5 ± 15.9	
Minimum blood pressure (mmHg)	78.2 ± 9.3		73.0 ± 9.5		74.8 ± 9.5	
	n	**%**	**n**	**%**	**n**	**%**
Normal	89	78.8	179	83.3	268	81.7
High blood pressure	24	21.2	36	16.7	60	18.3
Total	**113**	**100.0**	**215**	**100.0**	**328**	**100.0**

Remark: The rate of males in Tan Trinh commune with high blood pressure is 21.2%, higher than that of females at 16.7%.

Table 3.29: Health status of people in Tan Trinh commune

(adults 18 years of age and over)

Characteristics	Male n=113		Female n=215		Total n=328	
	NO.	%	NO.	%	NO.	%
Pain and discomfort						
• Problem present	81	78.6	168	83.6	249	81.9
• No problem	22	21.4	33	16.4	55	18.1
Anxiety, sadness						
• Problem present	66	64.1	142	70.7	208	68.4
• No problem	37	35.9	59	29.4	96	31.6
Difficulty in walking						
• Problem present	48	46.6	109	54.2	157	51.6
• No problem	55	53.4	92	45.8	147	48.4
Difficulty in self-care						
• Problem present	39	37.9	86	42.8	125	41.1
• No problem	64	62.1	115	57.2	179	58.9
Difficulty in daily life						
• Problem present	58	56.3	116	57.7	174	57.2

• **No problem**	**45**	**43.7**	**85**	**42.3**	**130**	**42.8**

Remark: The results presented in the above Table show that the rate of females having problems of pain and discomfort, anxiety and sadness, or difficulty in daily life is all higher than that in males.

Table 3.30: Blood test results of people in Tan Trinh commune

No.	Indices	Male (X ± SD)	Female (X ± SD)	Total (X ± SD)
1	RBC	4.68 ± 0.66	4.33 ± 0.50	4.45 ± 0.59
2	HGB	138.35 ± 15.45	128.50 ± 13.19	132.07 ± 14.81
3	HCT	0.38 ± 0.04	0.54 ± 2.70	0.48 ± 2.15
4	PLT	200.05 ± 50.27	213.22 ± 41.55	208.44 ± 45.28
5	WBC	7.47 ± 2.05	7.51 ± 1.91	7.50 ± 1.96
6	NEUT	59.70 ± 8.93	59.33 ± 9.64	59.46 ± 9.38
7	MDX	5.71 ± 1.58	5.61 ± 2.13	5.65 ± 1.95
8	LYM	33.67 ± 7.56	34.46 ± 8.41	34.17 ± 8.11

Remark: The above Table shows the blood test results of people in Tan Trinh Commune, all values are within the normal range according to standards.

Table 3.31: Some symptoms in 30 days of people in Tan Trinh commune *(adults 18 years of age and over)*

Symptoms	Male n=113	Female n=215	Total n=328

	NO.	%	NO.	%	NO.	%
Headache	24	21.2	57	26.5	81	24.7
Dizziness	52	46.0	89	41.4	141	43.0
Difficulty breathing, wheezing	50	44.3	108	50.2	158	48.2
Coughing, sneezing, runny nose	29.0	25.7	68	31.6	97.0	29.6
Chest pain	24.0	21.2	29	13.5	53.0	16.2
Nausea, vomitting	24	21.2	57	26.5	81	24.7
Others	52	46.0	89	41.4	141	43.0

Remark: In 30 days, the majority of the residents had symptoms like dizziness or difficulty breathing. Chest pain is the least common symptom (16.2%).

Table 3.32: Medical conditions by organ system of people in Tan Trinh commune

Organs	**Male n=168**		**Female n=261**		**Total n=429**	
	NO.	%	NO.	%	NO.	%
Cardiovascular system	24	14.3	36	13.8	60	14.0
Respiratory system	8	4.8	7	2.7	15	3.5
Digestion	17	10.1	24	9.2	41	9.6
Kidney - unirary	9	5.4	2	0.8	11	2.6
Neurological - mental	17	10.1	66	25.3	83	19.3

Musculoskeletal	34	20.2	53	20.3	87	20.3
Dermatology	10	6.0	7	2.7	17	4.0
Ophthalmology	10	6.0	20	7.7	30	7.0
Otorhinolaryngology	67	39.9	86	33.0	153	35.7
Odonto-Stomatology	68	40.5	146	55.9	214	49.9
Obstetric	0	0.0	16	6.1	16	3.7
Cancer	1	0.6	1	0.4	2	0.5
Endocrine	3	1.8	12	4.6	15	3.5

Remark: People of Tan Trinh commune participating in the study mainly have medical conditions relating to Odonto-Stomatology and Otorhinolaryngology, followed by conditions relating to the Cardiovascular system and Musculoskeletal system. A very small number of people were diagnosed with Cancer (2 Cases, accounting for 0.5%). The results of consulting X-ray images show 08 cases with lesions on the lungs visible on X-ray images, in which:

- There is one case of lesions from pneumonia.
- 06 Cases of lesions from tuberculosis (old and new)
- 01 case with opaque lesion with a size of 2.5cm at the bottom of the left lung, which needs CTScanner image to diagnose for determination *(Patient Nguyen Dinh Thi – Year of birth 1959).*

3.3.4. Some preliminary results on deaths in Tan Trinh commune and Quang Binh rural district – Ha Giang province

3.3.4.1. Deaths in Quang Binh rural district and Tan Trinh commune in the 2010 –

2014 period

Table 3.33: Fluctuations in crude death rate and deaths due to cancer across Quang Binh rural district in the 2010-2014 period

Indicator	2010	2011	2012	2013	2014
Total population	52,106	53,213	54,415	56,263	56,561
Number of deaths	205	232	243	266	249
Number of deaths due to cancer	33	37	38	71	57
Crude death rate rate (‰)	3.93	4.36	4.47	4.73	4.40
Death rate due to cancer (‰)	0.63	0.70	0.70	1.26	1.01

Remark: Overall, the death rate increases year on year, reaching a peak in 2013 at 4.73‰. Death due to cancer ranges from 0.63 to 1.26‰, reaching a peak in 2013 (1.26‰).

Table 3.34: Trends in changing of the death rate in Tan Trinh commune from 2010 to 2014

Indicator	2010	2011	2012	2013	2014
Total population	4,442	4,581	4,697	4,796	4,788
Number of deaths	18	16	16	20	19
Number of deaths due to cancer	7	3	2	4	4
Crude death rate(‰)	4.05	3.49	3.41	4.17	3.97
Death rate due to cancer (‰)	1.58	0.65	0.43	0.83	0.84

Remark: The above results show that the death rate in Tan Trinh commune ranges from 3.49‰ to 4.17‰, reaching a height in 2010 and 2013 (4.05‰ và 4.17‰). Deaths by cancer fluctuate irregularly from 0.43‰ to 1.58‰, reaching a height in 2010 and 2014.

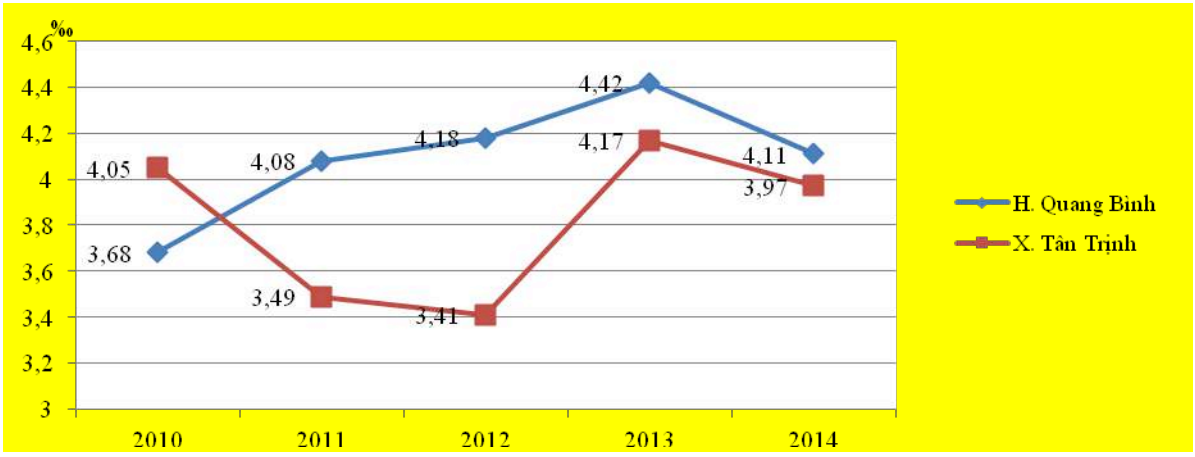


Figure 3.10: Crude death rate of Quang Binh rural district and Tan Trinh commune from 2010 to 2014

Remark: The above Figure shows that the death rate in 2010 of Tan Trinh commune in particular is higher than the average of Quang Binh rural district but the difference is not statistically significant with $p > 0.05$.

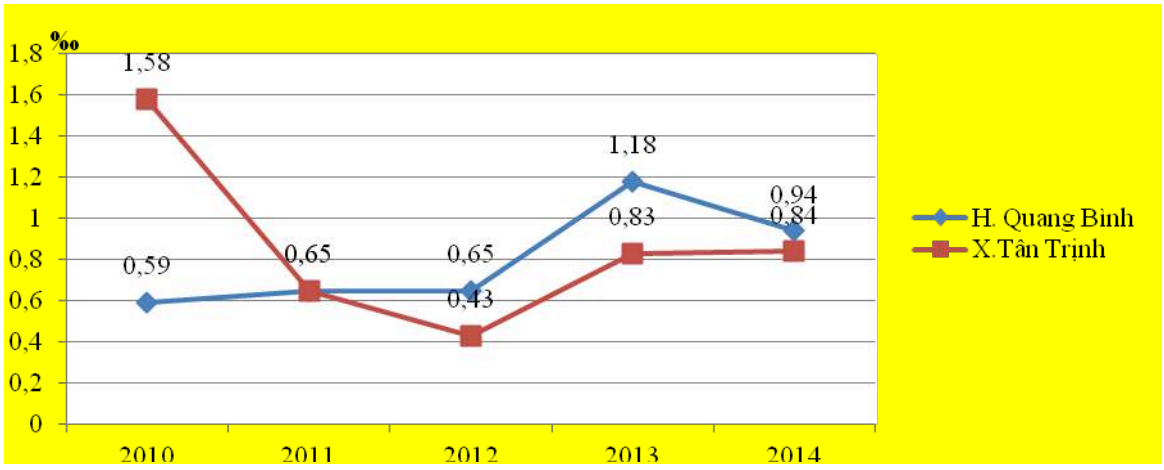


Figure 3.11: Death rate by cancer in Quang Binh rural district and Tan Trinh commune from 2010 to 2014

Remark: The death rate by cancer in Tan Trinh decreased sharply from 2010 to 2012 and increased in the following two years, reaching a peak in 2010 at 1.58‰. The difference of the same year as compared to the district average is statistically significant with $p < 0.05$.

Table 3.35: Distribution of deaths by gender and Age group

Age group	Male		Female		Aggregated		p
	NO.	%	NO.	%	NO.	%	
< 1 year old	2	0.3	5.0	1.0	7	0.6	0.000
1 - < 5 years old	45	6.5	38.0	7.6	83	7.0	
5 - < 10 years old	7	1.0	6.0	1.2	13	1.1	
10 - < 15 years old	8	1.2	7.0	1.4	15	1.3	
15 - < 20 years old	12	1.7	8	1.6	20	1.7	
20 - < 30 years old	43	6.2	30	6.0	73	6.1	
30 - < 40 years old	53	7.7	24	4.8	77	6.4	
40 - < 50 years old	81	11.7	34	6.8	115	9.6	
50 - < 60 years old	99	14.3	44	8.8	143	12.0	
60 - < 70 years old	95	13.7	46	9.2	141	11.8	
≥ 70 years old	248	35.8	260	51.8	508	42.5	
Total	**693**	**100.0**	**502**	**100.0**	**1,195**	**100.0**	

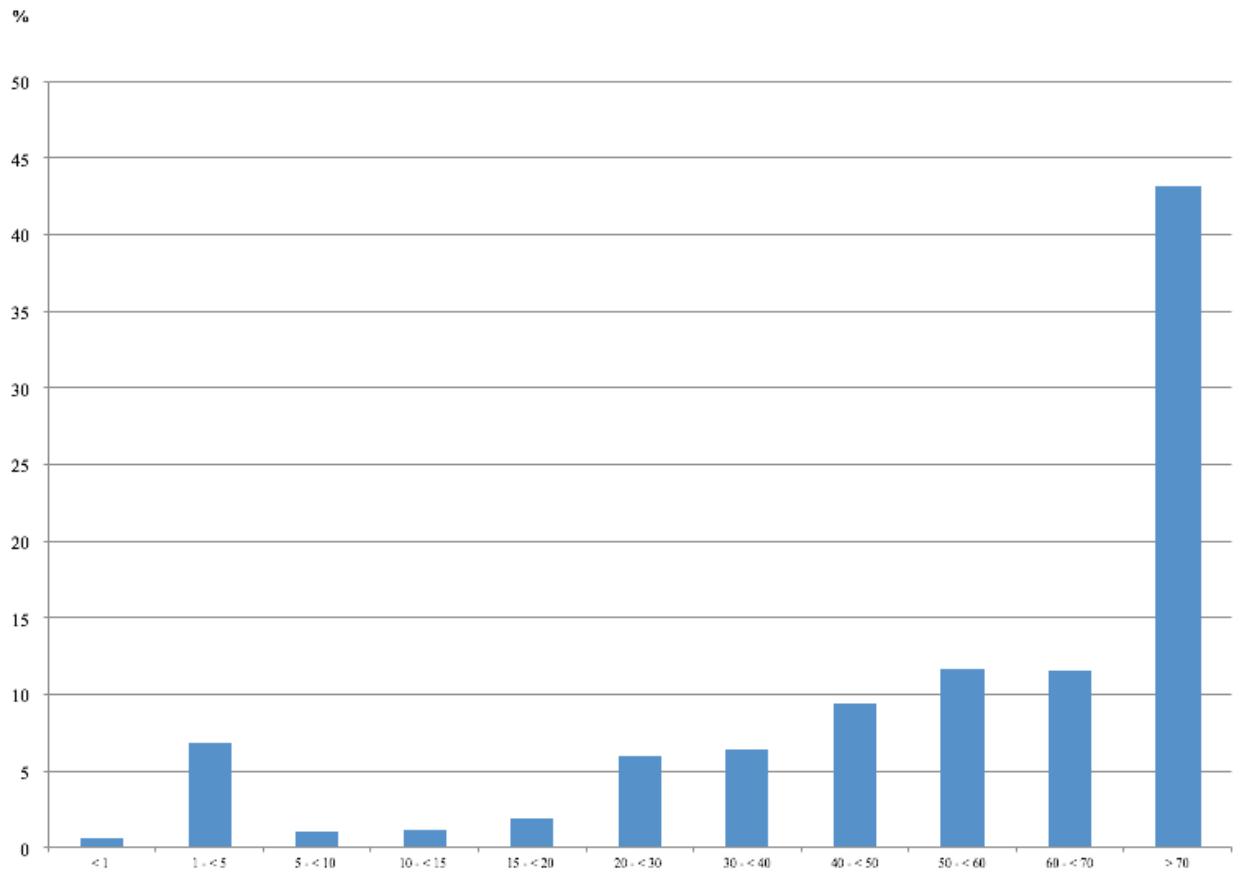


Figure 3.12: Distribution of death cases by age group across the district – 2005 (%)

Remark: The data in the above Table and Figure clearly shows that most of the death cases are in older people and senior people (the over 60 years old group accounts for 54.3%). The age group of people from 1 to under 5 years old also accounts for a high death rate at 7.0% of the total cases of death.

Table 3.36: Distribution of causes of death by Disease group and gender

Disease group	Male		Female		Aggregated		p
	NO.	%	NO.	%	NO.	%	
Non-communicable diseases	462	66.7	285	56.8	747	62.5	0.000
Communicable diseases	10	1.4	22	4.4	32	2.7	
Accidents and injuries	98	14.1	50	10.0	148	12.4	
Unknown Causes	123	17.8	145	28.9	268	22.4	
Total	**693**	**100.0**	**502**	**100.0**	**1,195**	**100.0**	

(Communicable diseases include communicable, nutritional, obstetric diseases)

Remark: The results of the Table show that deaths due to non-communicable diseases account for the highest proportion in both men and women. If the senior age group and group of deaths by unknown causes were not taken into account, then accidents and poisoning would be in the second place for both men and women.

Table 3.37: Distribution of causes of death by Disease group and Age group

Age group	Non-communicable diseases		Communicable diseases		Accidents and injuries		Unknown causes		Total
	NO.	%	NO.	%	NO.	%	NO.	%	n
< 1 year old	3	0.4	2	6.3	0	0.0	2	0.8	7
1- < 5 years old	50	6.7	9	28.1	18	12.2	6	2.2	83
5 – < 15 years old	11	1.5	4	12.5	11	7.4	2	0.8	28
15 - < 60 years old	272	36.4	15	46.9	100	67.6	41	15.3	428
≥ 60 years old	411	55.0	2	6.3	19	12.8	217	81.0	649
Total	**747**	**100.0**	**32**	**100.0**	**148**	**100.0**	**268**	**100.0**	**1.195**

Remark: The above results show that in the group of children under 15 years old, among 118 death cases the majority are in the group of children under 5 years old with 90 cases, in which non-communicable diseases are the main cause of death (63/118 cases = 53.3%). These diseases are mainly related to pneumonia and inflammation of the respiratory system.

In the groups of people in the working age and adults (15 - < 60 years old), deaths by non-communicable diseases account for a high proportion (62.0%), accidents and poisoning take the second place with 26.1% and communicable diseases account for the lowest proportion at 4.6%. Deaths by non-communicable diseases in people over 60 years of age account for a higher percentage compared to the group of people in the working age, but deaths by accidents and poisoning account for a much lower proportion.

Table 3.38: Distribution of death by organs and gender (over 5 years old)

Cause of death	Male		Female		Aggregated	
	NO.	%	NO.	%	NO.	%
Digestive system	61	9.4	18	3.9	79	7.2
Tumor	154	23.8	79	17.2	233	21.1
Cardiovascular system	131	20.3	105	22.9	236	21.4
Accident, poisoning	89	13.8	41	8.9	130	11.8
Respiratory system	46	7.1	41	8.9	87	7.9
Urinary system	12	1.9	8	1.7	20	1.8
Nervous system	13	2.0	4	0.9	17	1.5
Endocrine	3	0.5	5	1.1	8	0.7
Obstetric	0	0.0	1	0.2	1	0.1
Others	18	2.8	17	3.7	35	3.2
Unknown causes	119	18.4	140	30.5	259	23.4
Total	**646**	**100.0**	**459**	**100.0**	**1105**	**100.0**

Remark:

The results from the above Table show that in the group of children over 5 years old and adults, among the death cases, the most common cause is due to tumor in males (23.8%) and medical conditions of the cardiovascular system in females (22.9%). The cause with the lowest rate is obstetric-related at 0.1%.

Table 3.39: Distribution of causes of death in Quang Binh rural district and Tan Trinh commune (2010-2014 period)

Cause of death	Quang Binh rural district		Tan Trinh commune	
	NO.	%	NO.	%
Digestive system	81	6.8	7	7.9
Tumor	236	19.8	20	22.5
Cardiovascular system	243	20.3	21	23.6
Accident, poisoning	148	12.4	9	10.1
Respiratory system	124	10.4	21	23.6
Urinary system	21	1.8	1	1.1
Nervous system	19	1.6	2	2.3
Endocrine	8	0.7	1	1.1
Obstetric	8	0.7	6	6.7
Others	40	3.4	1	1.1
Unknown causes	267	22.3	7	7.9
Total	**1195**	**100.0**	**89**	**100.0**

Remark:. The above results show that the cause of death in the over 5 years old group in Tan Trinh commune is mainly due to tumor, diseases of the cardiovascular system and respiratory system. The medical conditions with the lowest death rate are related to the urinary system and endocrine system. The distribution of death cases due to cancer in Tan Trinh in the whole 2010 – 2014 period is higher than the whole Quang Binh rural district (22.5% as compared to 19.8%). The rate of deaths due to medical conditions of the respiratory system in Tan Trinh commune is significantly higher than the whole Quang Binh rural district (23.6% compared to 10.4%).

Table 3.40: Distribution of the average annual rate of death due to cancer by communes of Quang Binh rural district in the 2010 – 2014 period

Commune/Town	Population in 5 years	Number of deaths due to cancer	Rate of death due to cancer (‰)
Vi Thuong Commune	28,348	34	1.199
Tien Yen Commune	19,200	14	0.729
Huong Son Commune	12,175	9	0.739
Xuan Giang Commune	25,233	32	1.268
Na Khuong Commune	13,681	11	0.804
Bang Lang Commune	33,696	25	0.742
Yen Binh Town	30,861	27	0.875
Yen Thanh Commune	15,545	10	0.643
Tan Nam Commune	15,030	4	0.266
Tan Bac Commune	21,364	12	0.562
Tan Trinh commune	23,304	20	0.858
Tien Nguyen Commune	22,033	5	0.227
Xuan Minh Commune	12,088	12	0.993
Total in the district *	272,558	215	0.789

*(*Not including Ban Ria commune and Yen Ha commune due to lack of data)*

Remark: The above results show that, although the communes are all in the same district, there is significant difference in the distribution of death cases due to cancer from 2010 to 2014 in the communes, ranging from 0.227‰ to 1.268‰, which

means 6 times the difference. However, in Tan Trinh commune the rate of death due to cancer is only average as compared to other communes in the district (0.858‰).

Table 3.41: Distribution of causes of death due to cancer by body organs (in adults, 2010-2014 period)

Organ system	Male		Female		Aggregated	
	NO.	%	NO.	%	NO.	%
Gastrointestinal cancer	73	47.4	29	36.7	102	43.8
Lung cancer	65	42.2	20	25.3	85	36.5
Nasopharynx cancer	9	5.8	5	6.3	14	6.0
Brain cancer	1	0.7	2	2.5	3	1.3
Blood cancer	3	2.0	3	3.8	6	2.6
Cervical cancer	0	0.0	8	10.1	8	3.4
Breast cancer	0	0.0	8	10.1	8	3.4
Other forms of cancer	2	1.3	1	1.3	3	1.3
Unidentified forms of cancer	1	0.7	3	3.8	4	1.7
Total cases of cancer	154		79		233	
Total cases of death from 2010-2014	646		459		1105	
Rate of deaths caused by cancer		23.8		17.2		21.1

Remark: Deaths by cancer account for 23.8% of the total number of deaths in adults, in which Gastrointestinal cancer accounts for the highest proportion (43.8%), followed by lung cancer (36.5%), and cancer of the urinary system. Between the two sexes, the proportion of men dying of gastrointestinal cancer and lung cancer is

higher than that of women, while the proportion of deaths by other forms of cancer in the two sexes is roughly the same.

Table 3.42: Distribution of causes of death due to diseases of the respiratory system
(including cancer, in adults, 2010-2014 period)

Organ system	Male		Female		Aggregated	
	n	%	n	%	n	%
Asthma	10	7.6	4	5.2	14	6.7
Tuberculosis	1	0.8	1	1.3	2	1.0
Lung cancer	65	49.2	20	26.0	85	40.7
Bronchitis	18	13.6	18	23.4	36	17.2
Pneumonia	36	27.3	33	42.9	69	33.0
Others	2	1.5	1	1.3	3	1.4
Total	**132**	**100.0**	**77**	**100.0**	**209**	**100.0**

Remark: Females mostly die from pneumonia (42.9%), while men die primarily from lung cancer (49.2%).

CHAPTER 4. DISCUSSION

4.1. Current situation of asbestos cement production in Vietnam

As reported by the Vietnam National Roofsheet Association, there are currently 36 asbestos cement roof sheet production facilities in the country; 33 facilities are members of Vietnam National Roofsheet Association (VNRA) and 03 others have not jointed the VNRA. 04 factories have shut down [14]. According to the results of the survey, among 35 out of 36 factories producers, accounting for 97.2%, are small-scale factories based on the number of employees in accordance with the Decree No. 56/2009 / ND-CP dated 30 June 2009 of the Government for enterprises with less than 200 employees. There is only one medium-sized enterprise with around 200 - 300 employees, accounting for 2.8%; None of factories is micro business.

The number of direct employees in AC roof sheet industry is around 3,000 employees which is much less than the number of 5,000 employees in previous studies [17]. The main reason is that many production lines have stopped their operation. Moreover, the change in technology with innovated and automated process requires less labour force in production.

4.2. The occupational safety and hygiene in AC roof sheet production facility

The study on the management of occupational safety and hygiene in 35 out of 36 AC roofing facilities has indicated that:

- 80% of facilities have fully conducted the requirements for occupational safety and hygiene management such as health examination for employees to detect occupational diseases, pre-recruitment medical examination, occupational environment measurement, occupational safety and hygiene profile. Some producers have implemented but not in accordance with the regulations such as compiling labor hygiene profile not based on the provided template, lack of dust

concentration measurement, inadequate examination of occupational diseases such as the lack of audiometry and respiratory function measurement.

- Although most facilities have implement occupational health management indicators such as periodic labor safety management plans, employee health records, preparation of occupational accident management plans, safety and hygiene training for workers, compilation of emergency work accident records, the proportion of facilities which fulfill the requirements of the current regulations are low.
- There are 14 out of 35 entities (40%) implementing chemical and hazard training using real objects as stipulated in Circular No. 25/2013/TT-BLDTBXH dated 18/10/2013 of the Ministry of Labor, Invalids and Social Affairs. Other entities have also conducted but not complied with the regulations.
- The majority of AC roof sheet factories have less than 300 employees; therefore, it is not required to establish the Council for Labour Insurance and Council for Occupational Safety & Hygiene.
- The percentage of enterprises complying with the regulation on occupational safety is not high. Some criteria are well implemented including managing equipment with high requirement on labour safety and hygiene (80%) and equipping personal protection for workers (71.5%). Other criteria have been implemented but not yet fully complied with current regulations.
- The inspection on labour safety and hygiene at 32 AC roof sheet production factories has indicated that only 43.8% of them apply personal protective equipment; the percentage of companies with qualified operation process is only 31.2%; the proportion of companies which install warning posts and boards in dangerous and high risk of labour accidents sites is 25%; the percentage of

companies that have installed the shielding equipment to cover machinery and floor to ensure occupational safety is 25%.

Compared to the inspection results of the Ministry of Labor, Invalids and Social Affairs (MOLISA) in 2006 and 2007 [18], the indicators for occupational safety and health management at AC roof sheet producers have significantly improved, especially the health management indicators such as regular health checks for employees, health check-up for occupational-related diseases, pre-recruitment medical examination, occupational environment measurement and health records. This is achieved by the instruction of the Government, the Ministry of Construction and related organizations, the active participation of the Vietnam National Roofsheet Association in raising awareness as well as supervising the occupational safety and hygiene at roofing production factories.

Since 2016, the National Assembly has promulgated the Law on Occupational Safety and Hygiene which has come into effect since 1st July 2016; a number of decrees have been issued by the Government regulating some articles of the Law on Occupational Safety and Health such as Decree No. 39/2016 / ND-CP dated 15 May 2016 and Decree No. 44/2016/ND-CP dated 15May 2016. Regarding the construction material management in general and construction materials using chrysotile in particular, the Government issued Decree No.24a/2016/ND-CP dated 5 April 2016 [21], [22], [23], [24]. The Ministry of Health and the Ministry of Labor, Invalids and Social Affairs also issued regulations on occupational safety and health such as the Circular 19/2016/TT-BYT and Circular No. 07/2016/TT-BLDTBXH dated 30 June 2016 [3], [6].

The Law on Occupational Safety and Hygiene along with other legal documents have strictly regulated the business entities in implementing the occupational safety and hygiene management. To well implement the current regulation on occupational safety and hygiene, the AC roof sheet production companies need to enhance the

management and implementation of regulation on occupational safety and hygiene. Moreover, the local occupational health center should enhance the capacity to ensure the ability to conduct specialized techniques such as the analysis of chrysotile fiber concentration in environment to meet the requirements of the production entities in accordance with the regulation in Decree No. 24a/2016/ND-CP “Production entities using chrysotile materials must organize measurement and supervision of water and air environment in the production facility with every three months ".

4.3. Situation of working environment in AC sheet production facilities

** Microclimate factors:*

The rate of the microclimate measurement sample (temperature, humidity, wind speed) exceeds the standard in the production facilities of AC roofing is 10.7%; in which, the number of exceeding temperature samples is 29.0%, the sample of moisture exceeding the permissible standard is 2.9%, all wind speed measure samples are within the standard. This rate is 20.3% lower than the results of a general survey on construction materials manufacturers [26].

In term of producer group, the number of microclimate samples exceeding the standard in the small producer group is 11.7%; whereas, all samples of microclimate from in medium-size group are within the standard. This difference was statistically significant ($p < 0.05$).

** The dust concentration in working environment:*

No facilities have the concentration of chrysotile fiber and inhalable dust exceeding the standard. There are 5 out of 240 samples of overall dust exceeding the standard which accounts for 2.1%; all are sample collected from small-size factories and makes up 2.2% of this group.

The analysis of chrysotile dust concentration in the working environment showed that there were 108 out of 206 samples containing chrysotile dust which accounts for

52.4%. The average chrysotile fiber concentration was 0.19 ± 0.14 fibe /ml, the highest concentration was 0.5 fiber/ml. In the small-scale manufacturing facilities, the concentration was 0.19 ± 0.14 yr/ml; whereas, the medium-size factories had an average fiber concentration of 0.15 ± 0.08 fiber/ml.

This result is lower comparing to results of previous researches at AC roofing production facilities; the study conducted by Le Van Trung (1999) at AC roof sheet manufactures and brake pad manufactures showed the concentration of fiber varying from 0.8 to 5 fiber/ml with the average of 2.8 fiber/ml [31]. Some results of survey on dust concentration in working environment at asbestos cement roofing factories over the years have showed that in the years 2000-2002, the chrysotile concentration in the working environment of AC roofing facilities were from 1 to 22 times higher than allow standard.

In 2005, an inspection at 23 facilities indicated that there were 6 factories with the concentration of chrysotile from 4.2 to 5.6 fiber/ml which is from 8 to 11 times higher than the standard, 04 factories have the concentration of chrysotile being from 2 to 4 times higher than standard, 13 other factories with the concentration from 0.18 – 0.53 fiber/ml; most chrysotile fibers are released from material milling and mixing process [19]. Similar to the research results of the State-level project in 2013 on 15 asbestos cement roofing production facilities, the average chrysotile concentration of the grinding area was 0.43 fibers/ml, the blender area was 0.24 fibers per milliliter, the machine operating area was 0.16 fibers per milliliter and the cutting area was 0.13 fibers/ml, which was all lower than the allow standard [17].

The reason for this improvement is due to the construction of the Government and Ministry of Construction, some AC roofing facilities have actively researched and invested in technology to improve working environment as well as installed and enhanced vacuum equipment for milling and mixing machine. The solid waste and furnace emissions handling has also been improved. Dong Anh Investment and

Construction Materials JSC is one of the leading company in occupational environment improvement. During 2000 – 2001, the company had installed the production process which allows milling and mixing in a closed area equipped with dust handling cyclone. As the result, the concentration of chrysotile fiber had reduced from 3-4 fiber/ml to 0.4 – 0.5 fiber/ml which is within the allow standard. This is an excellent production model which should be implemented in other factories as well [13], [19].

4.4. Health situation of workers producing AC roofing sheets

The results of investigating and analyzing the health status of 2,559 AC roofing workers in 32 AC panel manufacturing establishments, of which 2,459 are current workers and 100 are retired workers, are as follows:

* Similarities:

- The average age of working people was 37.5 ± 8.8 and the retirees were 59.4 ± 5.3.

- The average working time of current employees was 8.7 ± 7.2 and the retired workers was 18.7 ± 7.8, the current chrysotile exposure time of retired workers was 29, 0 ± 6.8.

- The majority of employees has working time less than 10 years (59.2%); The group with the working time of 10-19 years accounts for 29.3%, the age group of 20 - 29 years working time occupies 10.3%; where as only 1.2% are in the group with over 30 years of working This feature is similar to that of the State level research project in 2003 with the occupational age <10 years accounting for a high proportion (48%) and the highest risk group is the occupational age of over 20 years occupying only 19% [17]. Because of the production scale of AC roofing producers are mostly small and medium-size enterprises, the labor force frequently changes; many factories use seasonal labor. Therefore, the occupational age of workers is not high, including labor in long-term production facilities.

- Regarding the time since the exposure to asbestos, most retired workers have had between 20 and 29 years of age (51/100 people, accounting for 51%). The number of employees with the duration of exposure with asbestos over 30 years is 40/100 people, accounting for 40%; the number of workers with exposed time under 20 years is 9 people, accounting for 9%. There was no statistically significant difference in the duration of occupational exposure ($p > 0.05$).

* The rate of changes in pulmonary ventilation function of AC roofing workers is 5.2%, the rate in female workers is 7.7% while that of male workers is 4.4%. The rate of change in pulmonary ventilation function tends to increase with age, highest in the age group of 60 or over (accounting for 12.7%), the age group 50 - 59 is 11.1%, the age group 40 - 49 is 6.7%, the lowest is age group under 40 accounting for 2.9%, the difference is statistically significant ($p < 0.01$); There is no difference in the rate of change of pulmonary ventilation function among occupational groups; The difference in lung function among duration of employment groups is significant; the highest among workers with 30 years of employment or more with 18.2%, the group with 20-29 years of employment duration of 20 - 29 years with 6.8 % following by the group of 10-19 years with 6.7%, the lowest in the group with the employment duration less than 10 years (4.0%).

The most popular change in pulmonary ventilation function is restrictive lung disease with 85.4% and obstructive lung disease with 14.6%. Among the cases of changes in pulmonary ventilation function, the majority of change in pulmonary is mild with 70.8%, the medium level is 21.5% whereas only 7.7% of severe cases.

The change in pulmonary ventilation function in workers with chronic respiratory diseases such as rhinitis, throat, and chronic laryngitis was 6.9% higher than that in the non-chronic respiratory diseases workers group (3.7%). The difference is statistically significant ($p < 0.01$).

The rate of changes in pulmonary ventilation function tends to increase in accordance with the average daily intake of cigarettes; the group of employees with high dose of smoking (more than 10 cigarettes per day) shows highest rate of pulmonary function change of 14.4%; the group of workers with 5-10 cigarettes per day accounts for 6.0%; the rate is 4.6% in workers smoking less than 5 cigarettes per day whereas the percentage is only 4.5% in non-smokers or former smokers who has quitted smoking for more than 10 years. The difference is statistically significant ($p < 0.01$).

*** The results of consultation on X-ray and CT scanner:**

A total of 2,559 chest X-ray scanner and 180 CT scanner were used for suspected cases, including 2,459 workers working directly in the AC roofing production line and 100 retired workers. The X-rays scanning was conducted according to the occupational disease diagnostic criteria; the results approved by the X-ray Film Council with the participation of leading experts in occupational diseases are as follows:

- There were 2,421 cases showing normal results accounting for 94.6% of which the normal rate was 95.4% for current workers and 75% for retired worker.
- There are 93 cases of lung calculus and fibrosis, pulmonary infiltrates due to tuberculosis, old inflammation or new progression, accounting for 3.6%.
- No case of asbestosis is found.
- 02 cases, accounting for 0.1%, show the image of occupational silicosis lung disease with 0/1p ILO category.
- To the cases suspected to be associated with chrysotile, the results have shown that:

  + No case of pleural plaque has been detected.

+ There are 19 cases of pulmonary fibrosis/focal cystic fibrosis with size of 1.5 - 20 mm, accounting for 0.7%, in which the proportion of current workers is 0.5% and retired workers is 6%, only lesions on the pleura are found with no other lung injury. These cases were checked annually on CT scans, of which 04 cases of lung pleural thickening were followed; after 2 years; of no progressive lesions or new lesions in the lungs have been found.

- 14 cases of dilated lesions detected on CT scanner, accounting for 0.5%.
- 20 cases of other lesions (rib injury, calcification of the umbilical cord, lymph nodes near the aorta, bronchiectasis, posterior pleural thickening, tracheal narrowing) which make up 0.8%.

This result is close to the results of the State-level project implemented in 2003 which indicated the average number of workers with normal health status is 98%; whereas, the number of workers with abnormal signs is 2%, of which:

- 04 cases of mild level asbestosis which is 0,4% (Category: 1/0t and 1/1s)
- 04 cases of mild level silicosis accounting for 0.4% (Category 1/0p as previously reported).
- 02 cases of suspicious signs which is subjected to CT scanning
- There is a picture of TB infection: 9 cases = 0.8%
- 05 cases were found with images of other old and benign lung disease such as alveolar swelling, thick and sticky costodiaphragmatic angle due to sequelae of old inflammation, foreign objects in the lungs or surgery to remove a part of the lung).
- No case of pleural plaque (thickening and pleural effusion) - one of the sign of asbestos impact [17].

- A study by DGFASLI (2004) on the health status of workers in the asbestos industry in India was conducted in 702 workers in five companies producing AC roofing and 03 units producing brake lines and chest radiographs also gave the similar result:
    - Obscured costophrenic angle lesion in 1.65 of total cases
    - Thickened interlobar fissure lesion accounting for 0.3%.
    - There are no cases of nodular lesions in the lungs and asbestos-related pathologies [32], [34].

The results of our study shows similar results to what conducted by Somchai Bovornkitti et al (2013) in 30 employees (29 males and 01 female from 24 to 66 years old) at 02 factories manufacturing AC pipe and AC roof sheet. The average age is 49.8 ± 8.8 years old, the average working duration is 24.0 ± 10.9 years. Results of chest x-ray examination find 03 cases (accounting for 10%) with nodular or reticular lesion on lung lopes, 2 cases (7%) of pulmonary fibrosis [25].

Regarding the association between plural thickening lesion and/or calcified pleural nodules in suspicious cases of asbestos-related diseases shows that: Workers in job group 1 (chrysotile milling, bag-cutting and materials mixing) has the highest rate of lesion with 2.9%, followed by group 2 and group 3 at 0.4%.

In term of employment duration, the rate being 6.1% is highest at workers with over 30 years of employment, the age group of 20 - 29 years occupies 3.8%, followed by the age group of 10 - 19 years with 0.8%, the age group under 10 years occupies the lowest rate with 0.1%. This difference is statistically significant ($p < 0.01$).

Therefore, long-term working at milling, bag cutting and material mixing might be at risk for pleural thickening and/or calcification of pleura. Although the lesions are found to be small and localized lesions that have not significantly affected workers'

health, in order to limit the impact of the working environment on workers' health, it is necessary to improve production line with automated high-risk production phases.

** Structure of diseases:*

Diseases with high incidence rate are: dental diseases (tooth decay, gum disease, inflammation of the teeth, etc.) accounting for 69.5%) sinusitis, nasopharynx, chronic laryngitis which make up 4%, eye diseases (conjunctivitis, diverticular eye, refractive error, etc.) accounting for 22.4%, high blood pressure with 11.8%.

Moreover, there are some noteworthy diseases such as kidney disease, urology; musculoskeletal disease; peptic ulcer disease; liver disease; hip reduction syndrome; chronic bronchitis, constituting for from 3.8 to 9.6%.

** Classification of workers' health:*

For current workers, the health classification results show that the majority of the workers have average health (type II, type III), which is 91.9%; only 3.6% are classified as Type I, Type IV health comprises of 5.5%, while no Type V is found.

The result of disease structure and workers' health classification of AC roofing production workers shows similarity with workers in other building material manufacture industries in construction sector [26].

4.5. Environment situation at Tan Trinh commune, Quang Binh district, Ha Giang province.

Survey of microclimatic elements, light, noise, total suspended particles, and chrysotile dust in 30 locations in Tan Trinh commune area showed results:

- The microclimatic elements such as temperature, humidity and wind speed are within the allowed standard.
- The concentration of total suspended particles at community area: some samples collected at the entrance and 1.5 meters from the door showed the

concentration of TSP exceeding the allowed standard according to QCVN 05/2013- BTNMT. Most are dust from soil, stone, ashes and traffic.

- The results of survey on the concentration of chrysotile fibers at 16 measurement points in Tan Trinh commune did not detect any chrysotile fiber in the collected samples.

4.6. Health situation of people in Tan Trinh commune, Quang Binh district, Ha Giang province

The survey results in 282 households and 429 people in Tan Trinh commune indicated that:

- The majority of households are roofed with fibro cement roofing (69.4%) and most households use wood and straw for cooking (90.0%).
- The main sources of water are from natural stream (49.3%) and well (46.5%). Only 3.2% of the household are using rain water and 100% of those use water running from fibro cement roof. Rain water is contained in a tank with cover (42.2%).
- The average height of people in Tan Trinh commune is 156.6 ± 6.8 (cm) with the average weight of 54.4 ± 35.7 (kg).
- People in Tan Trinh commune have nutritional problems with high rate underweight and obesity (40.7% and 38.6%, respectively); the rate in male is higher than in female. The results showed normal hematological parameters compared to the standard.
- Within 30 days, the most common symptoms in local people are dizziness with 43.0% and shortness of breath with 48.2%. Dental disease (49.9%) and otorhinolaryngology disease (35.7%) are the two most common ones in the community, followed by musculoskeletal diseases accounting for 20.3%,

neurological diseases accounting for 19.4%, cardiovascular disease with 18.3%. The number of people with cancer is only 02 cases which is 0.5%.

- The results of consultation of lung X-ray scanning show 08 cases with abnormality in lung including:

  + 01 case of pneumonia

  + 06 cases of pulmonary tuberculosis (old and new)

  + 01 case of blurred vison lesion in the left lung which needs use CT scanner for further diagnosis.

The study was conducted on the people living in asbestos cement roofed house in Brazil. The results of X-ray and CT scanning of 500 people including 130 males and 420 females in 5 different areas with over 20 years of living in AC roofed house showed:

- 03 cases of pleura abnormality, in which 01 case shows the sign of pleura calcification on x-ray; however, this abnormality is not confirmed by CT scanner thus it is considered as false.
- 02 cases of pulmonary tuberculosis or other interstitial lung lesions;
- 29 cases with other lesions including sarcoidosis, rheumatoid arthritis, bronchiectasis, isolated blisters in the lung. These cases were further monitored in local, in which there were three cases showing small patches in the lung, which showed no significant change by tracking [12].

The initial results of the cancer research show that:

The crude death rate in Quang Binh district from 2010 to 2014 has varied from 3.93‰ to 4.73‰. This rate is higher than the results presented by other researchers such as Le Vu Anh in An Hai – Hai Phong province with 3.0 – 3.1‰ [1], Vu Thinh in Soc Son distruct (2001) with 2.14‰, Tran Van Ngoc in Soc Son district (2003)

from 3.52 to 4.38‰ [15], Nguyen Ngoc Hung in Phu Cat – Binh Dinh province (2002 - 2004) from 3.1 to 4.08‰ [16], and Nguyen Dung (2006) in Thua Thien Hue province with 3.85‰ [9]. However, this results is lower comparing to that in Minh Lap – Thai Nguyen province in 2005 – 2010 which is 6.49‰ [37] and similar to the rate in Lam Thao – Phu Tho province (2005) in the period 1999 – 2005 which is from 3.87‰ to 4.90‰ [10]. Meanwhile, the national death rate in the period 2009 – 2011 is from là 6.8-6.9‰ and the rate in Ha Giang province in 2011 is 7.7‰ [5].

This rate is a significantly lower than the mortality rate in other countries in Southeast Asia in the period 2010 – 2012 such as Thailand (7-8‰), the Philipines (6‰), Cambodia (6‰), Laos (6‰) or other countries in the world such as China (7‰) or the United Sates of America (8‰) [47]. The numbers indicate the inconsistency in methodology and data which makes it difficult to compare. From this perspective, the mortality rate of this study is based on the information accessed from the A6 book of local healthcare central. However, it is not required to report the cause of death, the result is estimated. The results have showed that the mortality rate in Quang Binh district is within the national average rate; the difference with other district is insignificant. Therefore, it can be concluded that there is no abnormality in the death rate of Quang Binh district.

The mortality rate in Tan Trinh commune

In this research, we separate the data of Tan Trinh commune, where the rate of AC roofed houses is high, to compare to the data of the whole district. The result indicates that the mortality rate of Tan Trinh commune was higher than the average rate of the district in 2010 but was lower than that of the district in other years. However, the impact factors cannot be controlled if only based on the on the statistics in A6 book. Without direct investigation, the missing data is about 6% [15]. In order to obtain more accurate results, the research should be conducted on a bigger population (more districts) or in a longer time span.

The mortality rate based on age and gender:

In children, a comparison of mortality rates among age groups shows that at age younger than 01-year-old, the mortality rate is much higher in girls than in boys (1.0 ‰ in girls versus 0.3‰ in boys). However, with the age group older than 30, especially over 40 years old, the mortality rate in male has risen much faster and higher than that in female. According to the results of Tran Van Hoc in 2002 in Soc Son district [15], the mortality rate of children under 5 years old in males was higher than that of females, but not much difference. In 2000, the rate in male children under 5 years old was 17.2% comparing to 13.2% in female children; this numbers in 2001 were 16.4‰ and 9.4‰ and in 2002 were 19.4‰ and 18.6‰ respectively. The results of this study is similar that these of Trung Viet Dung et al (2005) in Lam Thao – Phu Tho province [10] and Cao Thi Thu Ha (2010) in Minh Lap – Thai Nguyen province in the period 2005 – 2010 [37].

The comparison in general as well as in particular age groups, especially among children under 5 years of age often shows lower mortality rate of commune health stations than actual numbers; according to the previous study in Soc Son district, 60% of perinatal deaths are missed [15].

There are a lot of errors with this group due to the insufficient data system; especially in rural and remote areas where the cases of perinatal and neonatal death in unnamed children or even children unregistered in household registration are not reported which leads to the inaccuracy in mortality rate and disease pattern.

Some reported have proved that there is a significant difference between the mortality rate reported in community and that in hospitals; that is not to mention the report of death at the hospital on the part of treatable diseases, mostly near-death cases ask to be released from the hospital to die at home [5], [15].

In order to ensure the best quality of research results, the research team recognizes the need for further research with a more diversified data collecting method to gather the most reliable information.

The distribution of death by causes:

The results presented by the three main causes of death showed that the non-communicable diseases account for the largest share in which the percentage in males was 66.7% comparing to 56.8% in females. The comparisons by causes of death with other publications are presented in the following table:

Table 4.1: The cause of death distribution of death by diseases

Location	Year	KLN %	LN %	TNTT %	Other %	Total (n)
Quang Binh, Ha Giang	2014	62.5	2.7	12.4	22.4	1195
National wise	2011	67.34	16.62	16.04		
Lam Thao, Phu Tho	2005	67.37	9.9	8.93	13.80	620
Soc Son, Ha Noi	2002	70.85	3.7	15.12	10.53	978
Phu Cat, Binh Dinh	2004	70.0	9.39	20.61	0	791

(KLN: non-communicable diseases; LN: communicable diseases (including communicable diseases, nutrition, pregnancy); TNTT: accident; KRNN: unidentified cause)

The rate of death by non-communicable diseases in Quang Binh was 62.5% which was the lowest comparing to other places in 2015. The highest was in Soc Son in 2002 [15].

The mortality pattern inclined toward the mortality pattern of developed countries. This was the results of the preventative programs, in-time diagnosis and trearment to

minimize the dealth due to communicable diseases. Moreover, the proportion of people over the age of 60 was high and comparable to that in developed countries (more than 10% of total population) [5]. Hence, the percentage of dealth by non-communicable diseases was the highest among the causes.

The causes of death by age groups, genders and disease groups

The results showed that the prevalence of non-communicable diseases was high in both men and women (66.7% and 56.8%). The domestic data presented different results. In 2002, the percentage of death due to non-communicable diseases was 70.9%; the rate of death due to communicable diseases was 3.5% but up to 15.1% of death were because of accidents and poisoing; 10.5% were died from undetermined reasons 10,5% [15].

The research results in Phu Cat - Binh Dinh, Lam Thao - Phu Tho and Thua Thien Hue in 2006 indicated that when calculating the mortality rate per 1000 people by gender and cause of death group, the non-communicable diseases have the highest rate and was followed by accident and poisoning, communicable diseases, pregnancy and nutrition was the third group [9], [10], [16]. Gender analysis demonstrated that the mortality in male is higher than in female.

Analyzing the mortality rate by age groups and disease groups showed that non-communicable diseases was the most common cause of death in people over 60 years. This result is consistent with the results of other surveys [10], [15], [16], [37].

Comparing to the regional results indicated that communicable diseases were the most common cause of death in developing countries; whereas, the non-communicable diseases were the main cause in developed countries. According to the study results, the mortality pattern of Vietnam had the characteristics of both developed and developing countries but leaned toward the developed one.

The cause of death by organs

The results showed that the leading causes of death were tumors with 21.1% and cardiovascular diseases with 21.4%; the tumor was the leading cause in men with 23.8% while cardiovascular diseases were the leading cause in women with 22.9%.

The mortality rate was lowest among diseases relating to endocrine system and nervous system. This result was consistent with the data by Le Vu Anh in Hai Phong (2000) which showed cancer being the leading cause of death[1]. Studies in Lam Thao - Phu Tho and Phu Cat - Binh Dinh also showed similar results [10], [16]. However, the study in Minh Lap - Thai Nguyen (2010) found that HIV/AIDS is the leading cause, followed by cardiovascular diseases and injuries [37]. The rate death from cancer in Quang Binh was lower than that in Phu Cat - Binh Dinh (23.47%) [16] and Lam Thao - Phu Tho (26.4%) [10]. The results showed that mortality rate from cancer in Quang Binh was lower than in other localities [10], [15], [37]. As for the mortality rate of cancer, the statistical reports in the commune was not much different from the survey data directly in the household [15]. Overall, the results showed no abnormality in cancer mortality in the studied district.

Due to the small population of the commune which was not sufficient to analysis the annual mortality rate of cancer, we combined the cases of cancer in 5 years reported by the local healthcare center to obtain a bigger mortality rate. The result indicated that the average mortality rate of cancer in Thach Son within 5 years ranked the fifth. Assuming that the reliability of reports from local healthcare center in the district was similar, the results showed that Thach Son was not the commune with the highest cancer death rate in the district and even lower than other places in the country [10], [37]. However, due to the lack of information of the consumption of asbestos cement roof sheet in communes, we found it necessary to investigate further on this issue.

The distribution of mortality from cancer in the district from 2010 to 2014 showed gastrointestinal cancer being the leading one (43.8%), the second was lung cancer

(36.5%), the lowest was brain cancer (1.3%). We also found that excepting for lung cancer and gastrointestinal cancer, the difference in genders was not significant; this may be related to lifestyle as men tend to smoke or drink alcohol more than women.

In summary: The crude death rate in Quang Binh, Ha Giang was at an average level in comparison with other regions in Vietnam and in the world and tends to increase over time: 3.9 ‰; 4.4 ‰; 4.5 ‰; 4.7 ‰; 4.4 ‰.

- The annual mortality from cancer in the district ranged from 0.63‰ to 1.26‰.
- Of the cases of death, the majority was the elderly which accounted for 54.3%, while the age group between 5 and 40 accounted for only 16.6% of total deaths.

The distribution of death cause in community did not show any abnormality:

- The highest rate being non-communicable disease group with 62.5% in which 66.7% were men and 56.8% were women.
- The group of communicable diseases, maternity, and nutrition accounted for 2.7% of which the percentage of female was 4.4% and the percentage of men was 1.4%.
- Accident and poisoning as cause of death was 12.4%, in which male was 14.1%, female was 10.0%.

The cause of death by organs featured following characteristics:

- Cardiovascular diseases and tumors accounted for the highest number of deaths with 21.4% and 21.1% respectively, which similar to those in other regions.
- The number of death due to accidents and poisoning occupied 11.8%.
- 7.9% of death were related to respiratory system diseases.
- 7.2% of death were related to digestive system diseases.

Situation of death in Tan Trinh commune: Among the communes of Quang Binh district, Tan Trinh commune had lower rate of mortality.

Tan Trinh was not the commune with highest mortality rate from cancer; it ranked 5th among 13 communes in Quang Binh with 0.858‰ which is within the normal range and lower and the average rate of the district.

CONCLUSION

1. **The occupational environment and safety and hygiene management at AC roof sheet production facilities:**

- The number of microclimate samples which are not within the permitted standard was 10.7%.
- The rate of total dust sample exceeding the standard is 2.1%, there is no sample of asbestos fiber and respiratory dust exceeding the permission.
- Evaluation on the safety and hygiene management:
    - Some criteria on the safety and hygiene management are well conducted such as annual occupational health examination for employees, health examination in recruitment, occupational environment measurement, occupational hygiene record, equipment management for strictly required equipment, occupational protection equipment (71.5 - 100%).
    - Other criteria are also implemented; however, the number of facilities meeting the requirement is limited.
    - The field inspection showed the low percentage of entities complying with the occupational safety regulation.

The criteria to evaluate the occupational safety management were based on the regulations at the time of the survey; however, new regulations have been issued, the occupational safety and health at the facilities AC should be strengthened to ensure occupational safety and hygiene for manufacturing facilities using chrysotile materials.

2. **The health of workers at AC roof sheet production facilities**

- The average age of working employees is 37.5 ± 8.8 while that of retired workers is 59.4 ± 5.3. The average working duration of current workers is 8.7±7.2

whereas that of former workers is 18.7 ± 7.8. The time since chrysotile exposure in retired workers is 29.0 ± 6.8. The majority of workers have worked less than 10 years with 59.2% and only 1.2% of workers have more than 30 years of working duration.

- The health status of most current workers is classified as average in Type II and Type III accounting for 91.9%; only 5.5% of employees are in Type V.
- The rate of dentomaxillofacial diseases is high with 69.5%; the percentage of sinusitis, nasopharynx, chronic larynx diseases is 45.4%; whereas, the amounts of eye-related diseases and high blood pressure are 22.4% and 11.8% respectively. There are 02 cases of breast cancer being treated, accounting for 0.1% of the total and 0.3% of the women.
- The rate of change in lung ventilation function in both current and retired workers is 5.2%, in which the number of female is higher than that of male and has a tendency to increase in accordance with working duration. The most popular change is restrictive lung syndrome with 85.4% but most changes are mild level. People with chronic respiratory disease are likely to suffer from pulmonary function changes 1.94 times more than those who do not. The rate of change in lung ventilation function tends to increase with the average daily intake of cigarettes.
- The consultation result on X-ray and CT Scanner films shows that:
  - No cases of workers in the study group have asbestos-related lung lesion and asymptomatic lesions associated with asbestos, such as lung cancer and mesothelioma.
  - 3.6% of images show fibrosis lesions, pulmonary infiltrates due to tuberculosis.

- 7% of images show small focal lung thickening (5-20 mm), pleural calcified lesions, in which the rate of lesions in retired workers (6%) is higher than that of current worker (0.5%);
- 0.5% had alveolar dilatation lesions; 0.1% of silicosis lung type 0/1p non-progress.

- There is an association between pleural thickening and/ or pleural calcination (suspected asbestos-related lesions) by occupation group and occupational age: the highest rate of injury is in the group of workers working in the bag tearing, material crushing and mixing group (2.9%) while other workers groups account for 0.4%. The group of employees with over 30 years of working duration has the incidence rate of 6.1%, and the rate gradually decreases, the lowest rate is in the group of people with under 10 years of working duration with the incidence rate of 0.1%.

3. **The health status of people using AC roof sheets in Tan Trinh commune, Quang Binh district, Ha Giang province.**

- The results of environmental measurement at 30 residential locations in Tan Trinh commune showed that the total suspended particles (TSP) in some samples exceeded allowed standard, which is mainly due to dust from soil and stone, scattered ash; no chrysotile fibers were detected in the samples.
- The majorities of houses are roofed by asbestos cement roof sheets (69.4%); up to 90% of houses use wood and rice straw for cooking. More than half of the household use water from streams with 49.3% and 46.5% are using water from wells. Only 3.2% of the household use rain water and all those households use the rain water running through the AC roof sheets.
- The initial research on the cancer and death rate in Tan Trinh commune - Tuyen Quang province are as the followings:

- The crude death rate in Quang Binh commune, Ha Giang is at average level compared to other regions in Vietnam and in the world and that tends to increase over time: 3.9‰; 4.4‰; 4.5‰; 4.7‰; 4.4‰.
- The annual death rate of cancer in the district is from 0.63 ‰ to 1.26 ‰.
- The majority of death is in the older people making up 54.3%; the death rate in age group from 5 to 40 years old is 16.6%.
- The causes of death in community does not show any abnormality; the cause of non-communicable diseases accounts for the highest proportion (62.5%); the number of death due to communicable diseases, maternity and nutrition accounts fro 2.7%; the percentage of death caused by accidents and poisoning is 12.4%. The cause of death ranked by the disease of the organ system shows that cardiovascular diseases and tumors are the leading cause of death (21.4% and 21.1%), similar to other areas, the rate of death by accident and poisoning is 11.8%; respiratory system diseases are responsible for 7.9% of death; digestive system diseases accounts for 7.2%.
- As for death rate in Tan Trinh commune, comparing to other communes in Quang Binh district, the death rate of Tan Trinh is lower than the average rate of district and ranks 5th out of 13 communes with 0.858%.

RECOMMENDATION

1. AC roof sheet production facilities

To strictly comply with the law and regulation regarding on occupational safety and hygiene in production facilities using chrysotile, especially paying attention to the followings:

- The regulation of the safe production of AC roof sheet to control and prevent the dust exposure in working environment; well cover the plants to prevent the contamination of general dust and chrysotile fiber in particular.
- Regular environmental and chrysotile fiber concentration measurement for every 3 months to ensure safe occupational environment.
- Provide and maintain occupational protection equipment, organize training course to raise awareness of workers on potential occupational risks including chrysotile, install warning signs at workplace.
- Keep track on health status of workers exposed to chrysotile as regulated by law especially on retired workers.
- Handle disposal and waste during the production as regulated by law.

2. Healthcare plan

- Invest in specialized medical by region, improve staff capacity and equipment of labor health centers and units with the function of monitoring local occupational environment in monitoring and measuring environment at AC roof sheet manufacturing facilities.
- Continue monitoring, studying, evaluating the progression of lesions in the lungs and pleura (pleural thickening, pleural calcification ...) and health for workers who have detected the disease annually.
- Continue studying and evaluating in national scale on the impact of chrysotile on workers' health at AC roof sheet production facilities and users.

APPENDIX

Some X-ray and CT scanner images of pathology

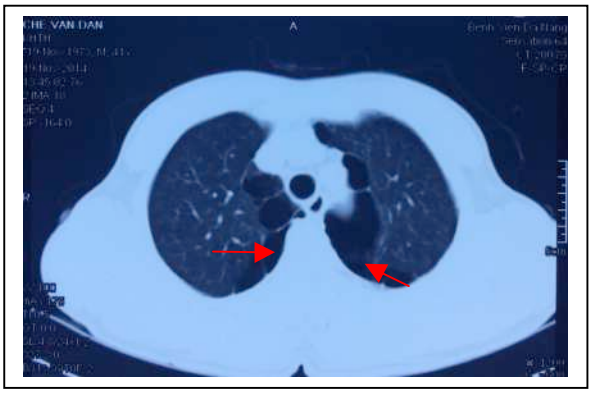
Case 1:

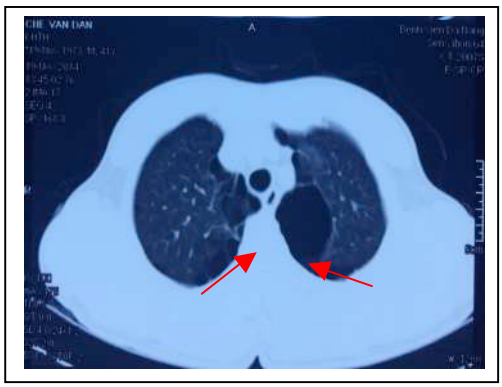
Full name: Che Van D. – Year of birth: 1973

Occupation: Roof sheet unloading – No of years on the job: 5 year

Company: Van Long Ltd – Da Nang

Diagnosis: The image of emphysema scattered at 2 lungs





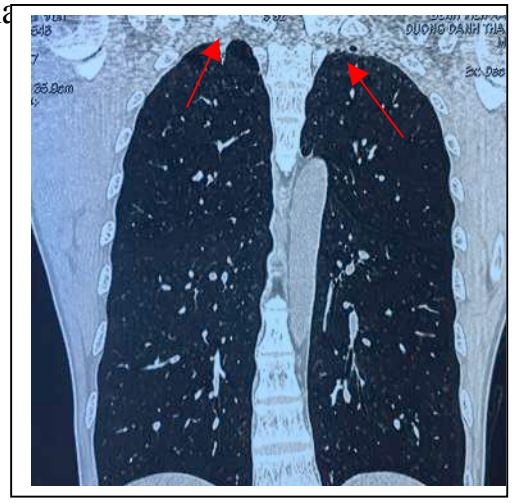
Case 2:

Full name: Duong Danh T. – Year of birth: 1971

Occupation: Sheet forming – No of years on the job: 20 years

Factory: Thai Nguyen JSC

Diagnosis: Pleural thickening, emphysema



Case 3:

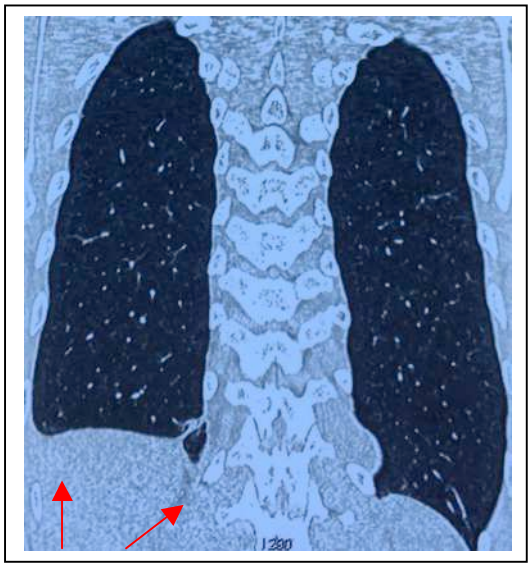
Full name: Pham Van C. – Year of birth: 1983

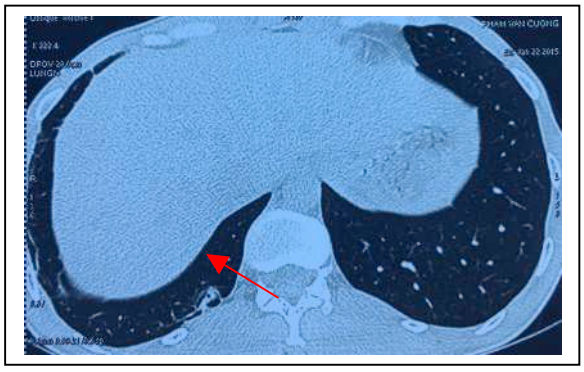
Occupation: Sheet Loading – No of years on the job: 7 years

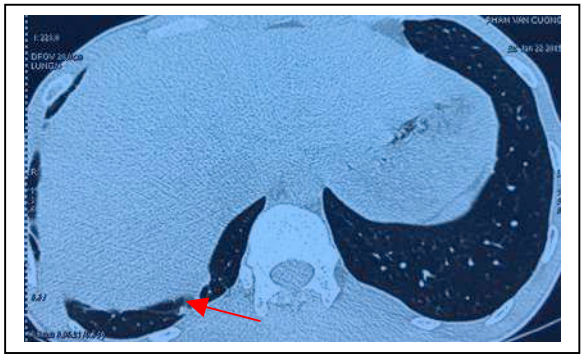
Factories: Tan Thuan Cuong JSC

Diagnosis: Pleural plaque at right costodiaphragmatic angle and behind the base of the right lung

- Keep track on previous lesion.







Case 4:

Full name: Le Thi Nga – Year of birth 1958

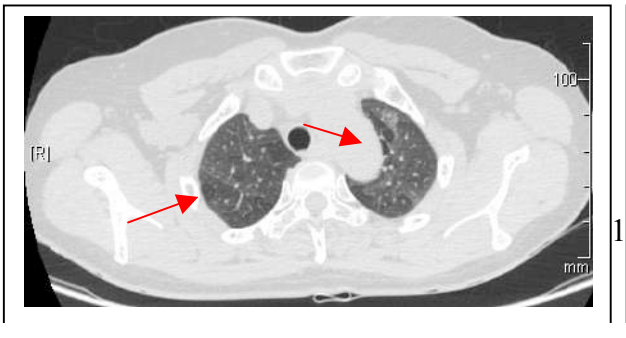
Occupational: Sheet molding (retired)

No of years on the job: 15 years,

Time since the first chrysotile exposure: 25 years

Factory: Thai Nguyen roof sheet JSC

Diagnosis: Bronchiectasis



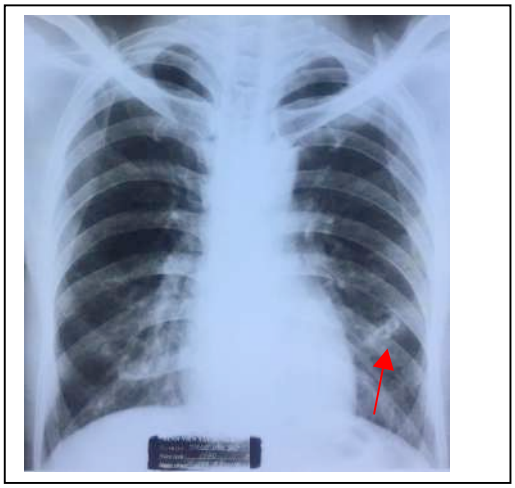
Case 5:

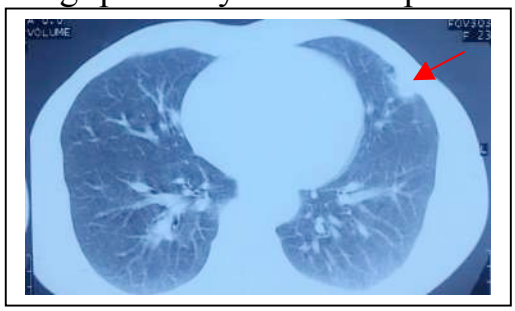
Full name: Hoang Van D. – Year of birth: 1970

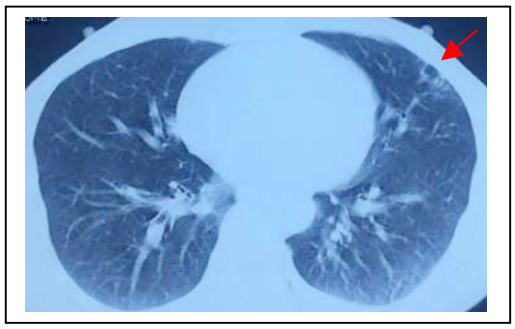
Occupation: Sheet loading – Year of experience: 7

Factory: Phuong Bac JSC

Diagnosis: Pleural thickening, base of the lung parenchyma – Keep track on pneumonia, and previous lesion







Case 6:

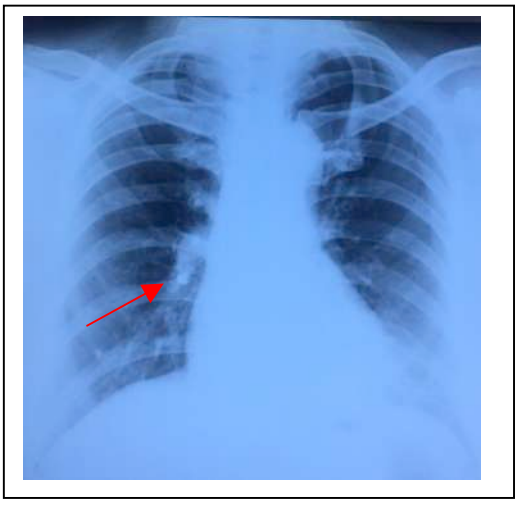
Full name: Tran Thi Mai – Year of birth: 1952

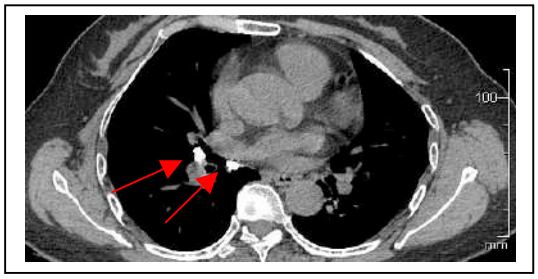
Occupation: Sheet molding – Years of experience: 18 years

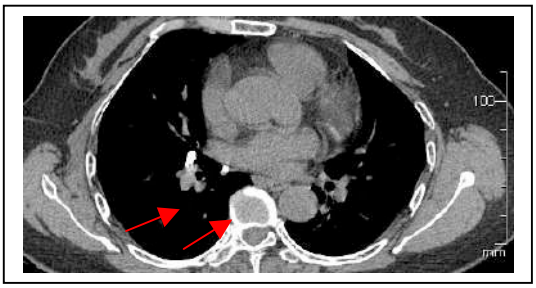
Time since the first exposure to chrysotile: 43 year

Factory: Dong Anh Investment & Construction Materials JSC

Diagnosis: Image of calcifications at mediastinum and right hilar position







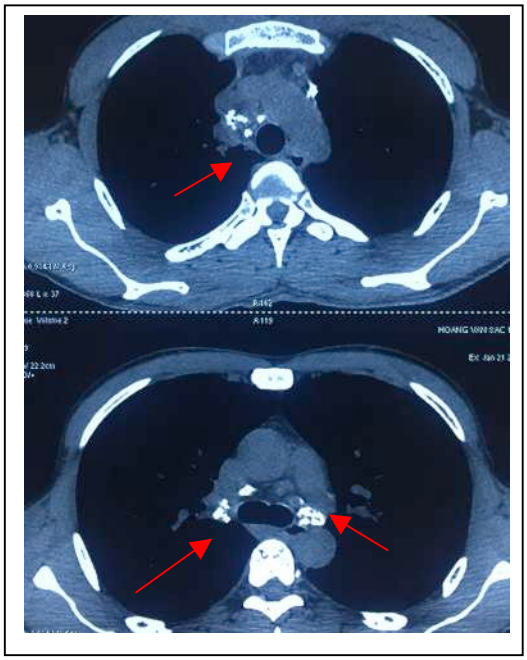
Case 7:

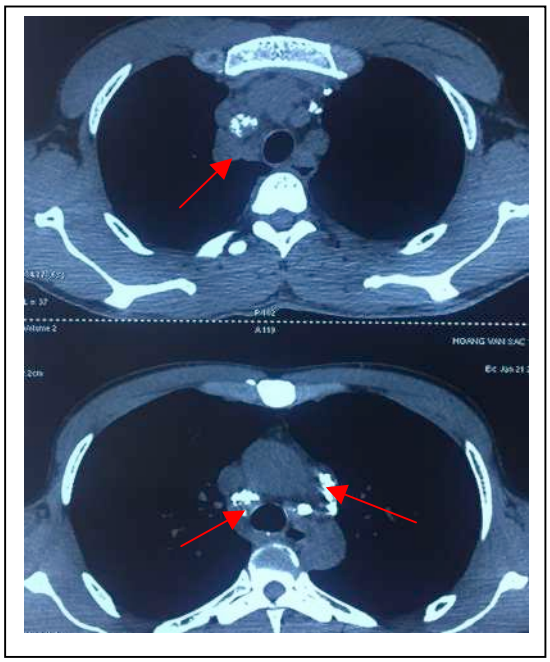
Full name: Hoang Van S – Year of birth: 1979

Occupation: Sheet molding – Year of experience: 4 year

Factory: Hoang Long Ltd

Diagnosis: nodular calcification at mediastinum nodes and hillar at both sides





Case 8:

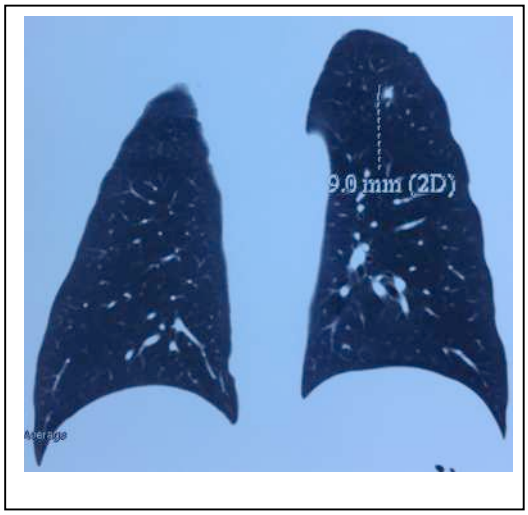
Full name: Nguyen Dinh Q.. – Year of birth 1971

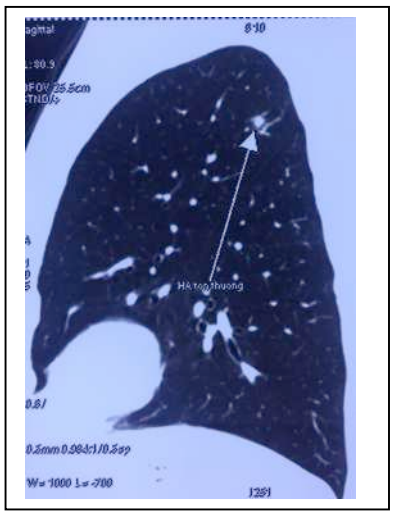
Occupation: Sheet molding and forming – Year of experience: 22 years

Factory: Dong Anh Investment & Construction Materials JSC

Diagnosis: Calcified nodules at left lobe

Check: 9mm due to previous lesion





Case 9:

Full name: Nguyen Thai H. – Year of birth: 1940

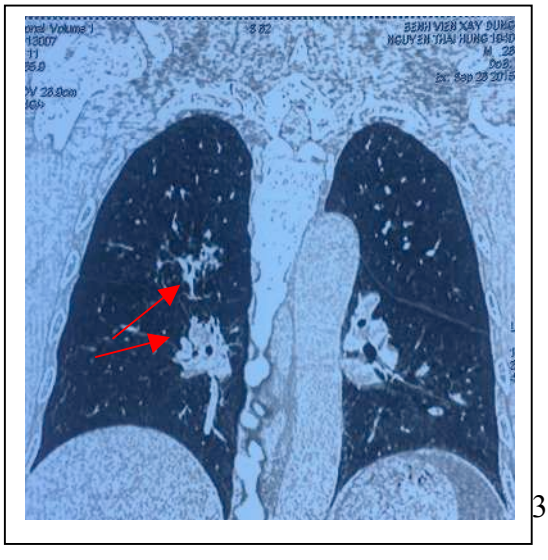
Occupation: Technical staff – Years of experience: 7 Years

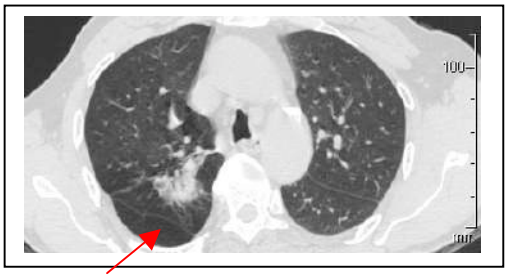
Time since the first exposure to chrysotile: 30 years

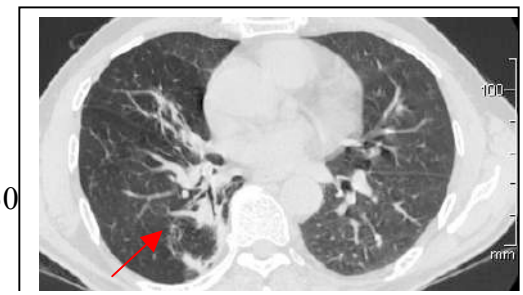
Factory: Thai Nguyen Roof sheet factory

Diagnosis: Fibrosis at middle lobe and base of right lung

Previous tuberculosis







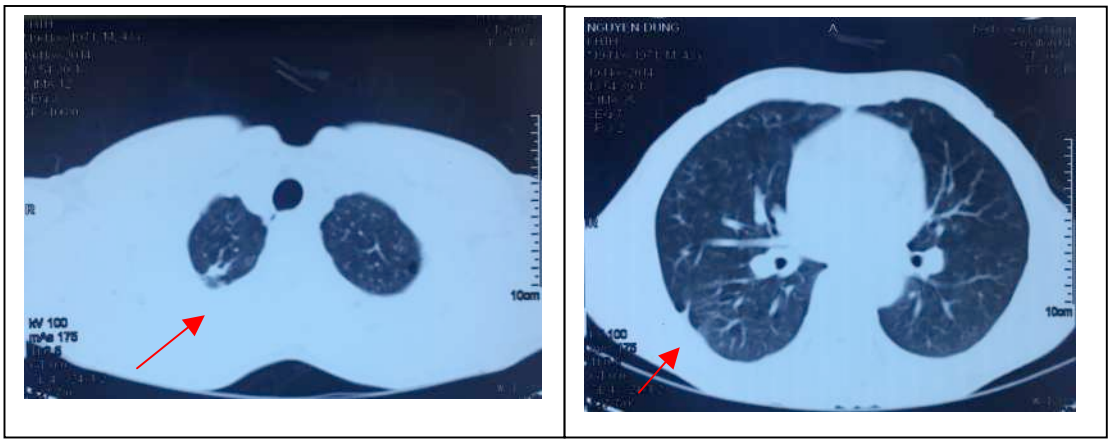
Case 10:

Full name: Nguyen D – Year of birth: 1971

Occupation: Mechanical staff – Years of experience: 10 years,

Factory: Van Long Ltd

Diagnosis: Calcified fibrosis lesion at right lobe, pleural thickening, Alveoli dilatation at bottom lobe – Previous tuberculosis



Appendix 1:

SURVEY FORM

(on the implementation of occupational safety at facility)

1. **Name of factory/facility**

   …….

2. **Address**: ……

3. **Main products:** ……

4. **Number of current employees:**

	Content	Total	Male	Female
1	Number of employees			
2	Number of employees directly involving in production			
3	Number of employees exposing to hazardous factors			
4	Number of employees indirectly involving in production			

5. Hygienic technical measures

HTM / Facility		Ventilation	Vacuum	Toxic gas vacuum	Noise treatment	Others
A	Needed and available					
	Needed but not					

	available					
	Available but out of order					
B	Needed and available					
	Needed and available					
	Available but out of order					
…						

6. Personal protective equipment

	Equipment	**Quantity**		**Equipment**	**Quantity**
1	Clothes		6	Gloves	
2	Helmet		7	Shoes/ boots	
3	Gauze mask		8	Glasses	
4	Half-mask		9	Ear plugs	
5	Protective mask		10	Other (specify)	

7. Healthcare activities

1) Health center at factory: Yes No

2) If there is a health center: The number of health staff is....

The number of doctors i: ...

The number of physicians is:...

3) If there is no healthcare center, is there any contract with other healthcare facility for workers' health examination?

- No contract

- If yes, which facility? (attached contract):

…….

8. The management of occupational hygiene, health of workers and occupational diseases

1) Prepare labor sanitation records? Yes No

If yes, please attach document

2) Prepare hygiene management plan? Yes No

If yes, please attach document

3) Measure and check occupational environment regularly?

Yes No

If yes, please attach document

4) Occupational examination:

- Recruitment examination: Yes No

- Regular examination: Yes No

If yes, how regular is it

- Occupational examination: Yes No

If yes, please attach document

5) Emergency treatment plan for occupational accident: Yes No

If yes, please attach document

6) Hazardous compensation: Yes No

If yes, specify ……

……..

7) Retreat trip for workers: Yes No

8) Are workers with occupational diseases treated?

Yes No If yes, where are patients treated?

……

……

9) The number of employees diagnosed with occupational diseases in the last 3 years:

Diseases			
Pneumoconiosis			
Occupational deafness			
Occupational skin diseases			
Occupational vibration syndrome			
Others ……..			

10) Regular reports on occupational heath to authorized agencies:

Yes No

If yes, please attach document

9. Occupational safety management:

1) Establish occupational safety council: Yes No

If yes, please attach document

2) Occupational safety plan: Yes No

If yes, please attach document

3) There is occupational safety staff: Yes No

If yes, please attach document

4) Network of hygiene staff: Yes No

If yes, please attach document

5) Equipment with strict requirements on occupational safety:

Yes No

If yes, please attach document

6) Occupational safety training: Yes No

If yes, please attach document

7) Regular report on occupational accidents to authorized:

Yes No

If yes, please attach document

8) Occupational accident situation for the last 3 years:

Content			
Number of accidents			
Number of people in accidents			
Number of accidents with death			
Number of death			
The number of people seriously injured			

10. Advantages and disadvantages in health care for workers

Advantages……

……..…

……

……..…

……

Disadvantages……

…

……

……

……

……

11. Recommendation

……...……..

……..

……

……, date ……. month…..year 20….

Person in charge

Appendix 2:

QUESTIONNAIRE FOR EMPLOYEES

A. GENERAL INFORMATION

A1. Name of employer:_____Province_____

A2. Full name: _____ 1. Male 2. Female Age: _____

A4. Occupation:_____Year of experience (<6 months is counted as 0,5 years):_____

A5. Occupational group:

1. *Crushing, bag tearing, material mixing*
2. *Sheet forming, molding, mold removing*
3. *Cement grinding, paper pulp grinding, repair*

B. WORKING CONDITION

B6. Hazardous factors:

1. Dust 2. Noise 3. Vibration 4. Toxic gas 5. Heat 6. Danger

B7. Nature of work

1. Labour-intensive 2. Stressful 3. Unchanged posture 4. Repetitive

5.Other, specify…..

B8. Do you have to work in shift? 1.Yes 2. No

B9. Do you have to work extra hours? 1. Yes 2. No

B10. Do you need to work other jobs for extra income?

1. Yes 2.No

B11. Does workplace have:

1. Ventilation system? 1. Yes 2. No
2. Vacuum system? 1. Yes 2. No
3. Toxic gas ventilation system? 1. Yes 2. No
4. Lighting system? 1. Yes 2. No

B12. Are you provided with personal protective equipment?

1. Yes 2. No.

If yes, they are:

1 Glasses 2. Ear plugs 3 Face cover 4 Mask 5. Clothes 6. Hat 7. Gloves 8. Shoes/Boots 9. Others. specify: …..

B13. How often do you use personal protective equipment?

1. Usually 2. Sometimes 3. Never

Reason for not using:

1.Not suitable 2. Not useful

3.Not necessary 4. Not being provided

B14. Are you trained about occupational safety and occupational diseases?

1. Yes 2. No

B15. Are you aware of the health impact due to occupational factors that you are exposed to and preventative measures?

1. Yes 2.No

If yes, from which source: 1. Health staff; 2. Safety staff; 3. Media channels 4. Self study using books and newspapers 5. Others .....

B16. If not, do you want to know? 1. Yes 2. No

By which way: 1. Direct consultation 2. Reading materials

3. Training class 4. Others.....

C. Recommendations and suggestions on improving working conditions and policy in health care for workers.

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Thank you for taking the time to answer above questions.

Appendix 3:

EMPLOYEE HEALTH EXAMINATION FORM

A. GENERAL INFORMATION

A1. Name of employer:_____Province_____

A2. Full name: _____ 1. Male 2. Female Age: _____

A4. Occupation:_____Number of years on the job (<6 months is counted as 0,5 years):_____

A5. Occupational group:

4. *Crushing, bag tearing, material mixing* *2. Sheet forming, molding, mold removing*
5. *Cement grinding, paper pulp grinding, repair*

B. MEDICAL HISTORY

B6. Occupation diseases: 1. Yes 2. No

If yes: Year of diagnosis: _____.; Diseases/Type:_____;

The rate of labor loss: _____

B7. Other diseases_____

B8. Smoking 1. Yes 2. No *(Continuous smoking duration <6months)*

If yes: 1. Little (<5 cigarettes/day) 2. Medium (5 -10 cigarettes/day) 3. Intense (> 10 cigarettes/day)

C. CLINICAL

C9. Body: *height (cm)*: _____ Weight *(kg)*: _____

C10. Pulse: _____l/ ; C11. Blood pressure: _____mmHg;

C12. Respiratory function symptoms:

1.Dry cough 2. Prolong dry cough 3. Phlegm cough 4. cough with blood 5. Chest pain 6. Fever in the afternoon 7. Regular shortness of breath 8. Shortest of breath in intensive labour jobs

C13. Other functional symptoms:

_____

D. SUBCLINICAL

D14. Pulmonary ventilation function: (there is a written record of pulmonary attached)

1. Normal 2. Limited 3. Obstructive 4. Mix

Detail results:

	Index	**Actual value**	**Theoretical value**	**Rate %**
1	FVC			
2	FEV1			
3	FEV1/FVC			

D15. Lung X-ray: 1. Normal 2. Pathological

Pathological description: _____

D16. Ultrasound abdomen: 1. Normal 2. Pathological

Pathological description: _____

D17. CT Scanner: 1. Normal 2. Pathological

Pathological description: _____

D18. Blood test: 1. Normal 2. Pathological

Pathological description: _____

D19. Other subclinical: 1. Normal 2. Pathological

Pathological description: _____

E. DISEASES

E20	Tuberculosis	1.Yes	2.No
E21	Lung cancer	1.Yes	2.No
E22	Sinusitis, nasopharyngitis, acute laryngitis	1.Yes	2.No
E23	Sinusitis, nasopharyngitis, chronic laryngitis	1.Yes	2.No

E24	Acute bronchitis	1.Yes	2.No
E25	Chronic bronchitis	1.Yes	2.No
E26	Pneumonia	1.Yes	2.No
E27	Bronchial asthma, bronchiectasis, allergies	1.Yes	2.No
E28	Diarrhea, gastroenteritis	1.Yes	2.No
E29	Endocrine diseases	1.Yes	2.No
E30	Mental illness	1.Yes	2.No
E31	Central and peripheral neuropathy	1.Yes	2.No
E32	Eye diseases	1.Yes	2.No
E33	Ear diseases	1.Yes	2.No
E34	Cardiovascular disease, metabolic disorders	1.Yes	2.No
E35	Stomach and duodenal disease	1.Yes	2.No
E36	Liver, bile diseases	1.Yes	2.No
E37	Kidney and urinary diseases	1.Yes	2.No
E38	Gynecological disease	1.Yes	2.No
E39	Miscarriage	1.Yes	2.No
E40	Skin disease	1.Yes	2.No
E41	Muscle, bone and joint disease	1.Yes	2.No
E42	Occupational diseases	1.Yes	2.No
E43	Colitis	1.Yes	2.No
E44	Hemorrhoids	1.Yes	2.No
E45	Oral and maxillofacial diseases	1.Yes	2.No
E46	Surgical diseases	1.Yes	2.No

E47	High blood pressure	1.Yes	2.No
E48	Others	1.Yes	2.No

Description if yes: _____

_____

E49. Classification:

1. Type 1 2. Type 2 3. Type 3 4. Type 4 5. Type 5

Date..... month.....years...

Prepared by

Annex 4: List of equipment for occupational environment measurement

	Name of equipment	Model/ Producer/ Country of origin	Function
1	Microclimate measuring instrument	Testo 435 - Germany	Measuring temperature, humidity, wind speed with digital display
2	Heat radiation measuring instrument	Microtherm–Casella - The United States	Electronic heat radiation measurement
3	Light measuring instrument	Testo 545 - Germany	Electronic light measurement
4	Noise measuring instrument	Rion NL21 - Japan	Noise measurement and frequency analysis using digital display machines
5	Dust measuring instrument	Basic 5 – BUCK - The United States	Collect respiratory dust sample
		LP 12 - BUCK - The United States	Collect dust sample
		Microduck - Casella - The United States	Total dust electronic measurement with digital display
		Kanomax 3521 - The United States	Respiratory dust electronic measurement with digital display

		Asbestos dust analysis system (Hot block, phase contrast optical microscope)	Measure chrysotile fiber concentration in workplace using phase contrast optical microscope and membrane filtration method
		System of other dust analysis equipment in the laboratory	- Weight dust analysis (total, respiration) - Analysis of free silicon content in dust by volume method
6	Gas emission measuring instrument	Kimoto HS 7 - Japan	Gas emission sampling
		RAE - The United States	Measurement of exhaust gases (CO, SO2, NO, NO2) with electronic machines
		Gas analyzing equipment system in the laboratory.	Analysis of concentration of flue gas (CO2, H2S, HCL, H2SO4 ...)

Appendix 5: List of main equipments for regular health examination and occupational health examination

	Name of equipment	Model/ Producer/ Country of Origin
1	System of CT Lightspeed camera 64 ranges	GE Healthcare - The United States
2	X-ray machine for full waves (fixed)	HITACHI – Japan
3	X-ray machine for full waves (mobilizable)	SEMEN – Germany
4	Respiratory function meter PC 10	CHEST – The United States
5	2D ultrasound machine	TOSHIBA – Japan
6	3D ultrasound machine	HITACHI – Japan
7	6 lead electrocardiogram	NIHON KOHDEN – Japan
8	Hematology testing machine with 26 parameters	XT 2000 – SISMEX – Japan
9	Erythrocyte sedimentation rate machine	VES Matic 20 – Italy
10	Automatic biochemistry analyzer	HITACHI 717 – Japan
11	Automatic urine test machine	URIS CREEN 500 – Germany
12	Other specialized equipments	

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