# Report of “Pilot Project and Technical Training on Environmental Sound Management of Asbestos Waste”

Basel Convention Coordinating Centre for Asia and the Pacific

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# 1 Background

## 1.1 Introduction of asbestos

The “asbestos” is the term used for a group of naturally minerals that take the form of long thin fibers and fiber bundles. These minerals have extraordinary tensile strength, poor heat conductor and are relatively resistant to chemical attack. It is non-biodegradable.

Asbestos minerals may be broadly divided into two groups, which are amphiboles asbestos and serpentine asbestos. Amphibole asbestos has a chain-like crystalline structure. It comprises of mainly crocidolite, amosite, anthophyllite, actinolite as well as tremolite. Serpentine asbestos has a leafy or layered structure and is represented by chrysotile, the most common serpentine fiber.

| | | |
|---|---|---|
|  |  |  |
| Crocidolite | Amosite | Anthophyllite |
|  |  |  |
| Actinolite | Tremolite | Chrysotile |

**Figure 1.1 Different types of Asbestos minerals**

Asbestos is resistant to heat and most chemicals (most forms are chemically inert). The commercial exploitation of asbestos fiber in modern times occurred in the latter

part of the 19th century, when experiments were successfully carried out in producing asbestos thread. As asbestos thread can be woven to form asbestos cloth, it is important for thermal insulation and protective clothing.

## 1.2 Asbestos-containing material and asbestos waste

Asbestos-containing material is any material, object, product or debris that contains asbestos. Asbestos is commonly used throughout the world. In total, there are over 3,000 recorded uses of asbestos. Chrysotile currently accounts for more than 98% of world asbestos consumption. It is mainly used for asbestos textiles, friction linings and facings, asbestos cement and insulation products. Russia, China, Kazakhstan, Brazil, Canada, and India are main consumption countries in the world[1].

**Table1.1 Top asbestos consuming countries**

| Country | Tones (2006) | Tones (2007) | Global Ranking (2006/2007) |
|---|---|---|---|
| China | 531,190 | 626,099 | 1/1 |
| Russia | 292,541 | 280,019 | 2/3 |
| India | 272,856 | 302,139 | 3/2 |
| Kazakhstan | 151,231 | 108,951 | 4/4 |
| Brazil | 143,123 | 93,780 | 5/5 |
| Thailand | 140,861 | 86,525 | 6/6 |
| Ukraine | 124,130 | 85,602 | 7/8 |
| Uzbekistan | 63,246 | 86,488 | 8/7 |
| Vietnam | 60,657 | 64,429 | 9/9 |
| Indonesia | 40,542 | 46,187 | 10/11 |
| Zimbabwe | 34,409 | 57,329 | 11/10 |
| Kyrgyzstan | 24,056 | 20,862 | 12/12 |

(Source: United States Geological Survey)

China mines approximately 450,000 tons of asbestos each year and 410,000 tons out of which are for domestic uses while the rest are being exported to many other countries.

Asbestos has been found in 18 provinces in China. 90% of asbestos resources are located in Sichuan, Qinghai and Shaanxi Province. Asbestos resource in China is

mainly in the form of chrysotile, accounting for 96.5% of total reserves. Fig. 2.1 is the generation of chrysotile from 1999 to 2007.

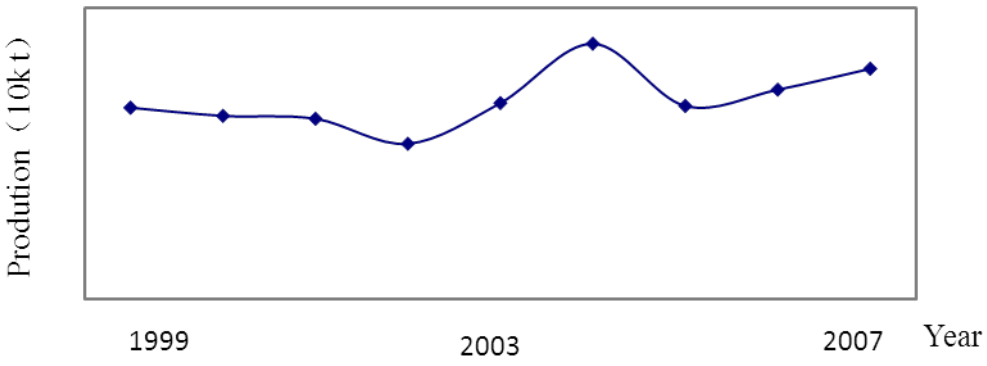


**Fig. 1.1 Chrysotile generation in China from 1999 to 2007**

Asbestos waste means waste asbestos-containing material (ACM) including all removed ACM, as well as disposable items used during asbestos removal work. Indeed, asbestos wastes mainly come from following sources:

(1) Extraction, manufacture and processing of asbestos products;

(2) When asbestos-containing materials reach end of life.

## 1.3 Health threat of asbestos and asbestos waste

Asbestos and ACM may produce asbestos dust during the exploitation, transportation, handling, manufacturing and dismantling process. Asbestos exposure becomes a health concern when high concentrations of asbestos fibers are inhaled over a long time period. People who become ill from inhaling asbestos are often those who are exposed on a day-to-day basis in a job where they worked directly with the material. The most common diseases associated with chronic exposure to asbestos include: asbestosis and pleural abnormalities (mesothelioma, lung cancer).

Amosite and crocidolite are the most hazardous asbestos minerals because of their long persistence in the lungs of exposed people. Tremolite often contaminates chrysotile asbestos, thus creating an additional hazard. Chrysotile asbestos, like all other forms of asbestos, has produced tumors in animals.

The health threat caused by asbestos and asbestos waste has been paid great attention all over the world, especially in industrial countries. 52 countries had banned the use

of asbestos by March 2011. Due to economic and technical considerations, Canada, Brazil, Columbia, Zimbabwe, China, Kazakhstan and Russia remain some of the leading producers of the mineral fiber, with production increasing in Asia and the Middle East.

## 1.4 Significance of implementing the project

In most Asia and the Pacific countries including China, asbestos still have been extracted and ACMs are still used widely. Those countries and districts are facing great challenge to manage asbestos waste in environmentally sound way.

(1) The demolition, collection, transportation and disposal of asbestos have not been paid much attention.

(2) Effective environmentally sound management methods and guidelines are not available.

(3) The relevant technologies and facilities are insufficient, and mining of asbestos is still an important industry in some developing countries. Asbestos is still used widely in building construction.

The earthquake happened in 12$^{th}$ May 2008 in Sichuan province of China destroyed many hospitals, schools, government offices and private homes. The external walls, roofs, window awnings and bathrooms in many of these buildings had been made by using asbestos cement sheets. The asbestos wastes are always mixed up with other construction wastes and posed a significant risk to public health. For examples, the improper treatment methods used during cleaning up operations are increasing the risk breathing asbestos fibers. Therefore it has great significance for promoting environmental sound management and raising public awareness of asbestos wastes in Asia and the Pacific.

For lack of identification tools and methods, treatment facilities of asbestos waste, the safe disposal of asbestos wastes becomes one of the significant problems, and most of the workers do not know the risks of asbestos exposure. Therefore it is urgent and of great significance that the environmental sound management of asbestos wastes is promoted.

In order to promote the environmental sound management of asbestos waste, improve the disposal capacity of asbestos wastes, and raise the public awareness of asbestos waste in Asia and the Pacific, the project titled as “Pilot Project and Technical Training on Environmental Sound Management of Asbestos Waste” was funded by the government of Japan via Basel Convention Technical Trust Fund and implemented by Basel Convention Coordinating Centre for Asia and the Pacific (BCRC China) during April to December 2010.Ministry of Environmental Protection (MEP) of China, local government and local environmental agencies provided much support during its implementation.

# 2 Asbestos waste management in China

China’s rapid industrialization and economic growth have generated unquenchable thirst for asbestos. Although it has remained amongst the world’s top five asbestos producers over the recent decades, domestic output does not satisfy national demand. The majority of asbestos used is chrysotile and it goes into the production of asbestos cement building materials with the remaining being used for friction products such as textile and insulation products.

## 2.1 Generation &consumption

There are two major sources for asbestos waste: one is from the waste rock and tailings through asbestos mining and mineral processing; the other is from asbestos products and ACMs.

### 2.1.1 Mining & processing asbestos waste

Large amount of gangue generated associated with asbestos mining process, by ore grade of 2.6% and dressing rate of 80%, Approximately 2.8, 2.5 and 3.0 million tons of asbestos gangue was generated in Qinghai, Xinjiang and Gansu provinces respectively, in the year of 2009, the quantity accumulated up to about 8.30 million tons. Since the large scale exploitation of asbestos mines during 1950s and 1960s, the conservative estimate of the total stockpile of asbestos gangue could add up to around 0.11 billion tons in China.

### 2.1.2 ACMs waste

In addition to asbestos gangue, the discarded asbestos containing materials (ACMs) is another major source for asbestos waste. At present, China is the world's largest consumer of asbestos products. There are nearly 3,000 kinds of asbestos or asbestos-containing products used by more than 20 industrial sectors, among which asbestos-cement products account for more than 75% of total asbestos consumption. This shows that the vast majority of asbestos is used in the construction industry. It is

estimated that the current construction waste generation by construction and demolition is more than 0.3 billion tons each year, including considerable asbestos and asbestos-containing products waste. In addition, the manufacturing of basic chemical raw materials, automobile manufacturing, and refractory material manufacturing industries all produce a certain amount of asbestos waste. Waste ships and some waste electrical and electronic equipment (microwave oven) also contain a certain amount of asbestos waste. Although the amount of asbestos products and asbestos-containing products waste generated is difficult to estimate, it is with a large number complex type.

## 2.2 Asbestos management regulations in China

Chinese officials are now starting to realize the extent of the health dangers it poses to producers, processors and the public using the material for insulation after decades of heavy reliance on asbestos.

The management of asbestos and asbestos waste is related to different ministries including Ministry of Environmental protection, Ministry of health and State Administration of Work Safety in China.

Since the 1980s, relevant research has been conducted into the use of non-asbestos substitutes. The import and export of crocidolite has been banned in 1994. In 2001, the mining of crocidolite was forbidden and in 2002 the use of crocidolite was prohibited in building materials according to “Catalogue in eliminating outmoded production capacity, technique and products (the third batch)”. From October 2003, the use of all types of asbestos was banned in the production of friction materials for the automotive industry.

Laws to improve occupational health and safety introduced in 2002 include: The Law of the People’s Republic of China on safety in Production; The Law of the People’s Republic of China on Occupational Diseases Prevention and Control.

Detailed regulations for the management of asbestos were made in “Occupational Health Standard of Asbestos Operation (GBZ/T193-2007)”, and in 2008

“Administrative Regulations on the Production, Circulation and Use of Chrysotile”, stated detailed regulations for the management of chrysotile, and waste chrysotile should be sealed and landfilled to reach the environmental sound disposal.

**Table2.1 Laws and regulations on asbestos management in China**

| Laws/Regulations | Issued(Year) |
|---|---|
| The Law of the People’s Republic of China on safety in Production | 2002 |
| The Law of the People’s Republic of China on Occupational Diseases Prevention and Control | 2002 |
| Regulations for Safe Management of Dangerous Chemicals | 2002 |
| Regulations for Protection of Labor in Workplace Using Toxic Substances | 2002 |
| Health standard for asbestos fiber in the air of workplaces | 2007 |
| Occupational Health Management Specification Of Asbestos Operation | 2007 |
| Occupational Exposure Limits for Hazardous Agents in the Workplace Chemical Hazardous Agents | 2007 |
| National Hazardous Waste Catalogue | 2007 |
| Administrative regulations on the production, circulation and use of chrysotile | 2008 |
| guidelines on the clearance and mangement of disaster debris and waste | 2008 |
| Post-Earthquake Restoration and Reconstruction Practical Technical Manual in Yushu, Qinghai Province | 2010 |

## 2.3 Current asbestos waste management in China

According to "National Hazardous Waste Catalogue", asbestos waste is defined as category 36 in the catalogue, mainly including seven types of waste from asbestos mining, manufacturing of basic chemical raw materials, cement, gypsum products, refractories material, automobile, ships and floating equipment, and non-specific industry (Tab. 2.2). Hazard characteristic is toxic. According to "Law on Prevention and Control of Environmental Pollution by Solid Waste”, and the “Measures for the Administration of Permit for Operation of Hazardous Wastes” and other related regulatory requirements, hazardous waste should be managed in the whole process. It

means that storage, transportation, disposal process must meet the relevant requirements.

In China, No specific regulations and technical guidelines of environmental management for asbestos waste have been issued. Only the" Occupational Health Management Specification Of Asbestos Operation" and "Post-Earthquake Restoration and Reconstruction Practical Technical Manual in Yushu, Qinghai Province" involve few contents of the safe disposal of asbestos waste.

**Tab. 2.2 Main industrial sources and code of asbestos waste**

| Industry | Waste code | Hazardous waste | Characteristics |
|---|---|---|---|
| asbestos mining | 109-001-36 | asbestos residue generated from Mining asbestos processing | T |
| manufacturing of basic chemical raw materials | 261-060-36 | asbestos waste generated from removal of electrolysis device during halogens and halogen chemical production process | T |
| manufacturing of cement, gypsum products | 312-001-36 | asbestos dust, waste fiber, waste asbestos fiber generated during the production of asbestos building materials | T |
| manufacturing of refractories material | 316-001-36 | asbestos dust, waste fiber, waste asbestos fiber generated during the production of asbestos products | T |
| manufacturing of, automobile | 372-001-36 | asbestos waste from the production of brake linings for vehicles | T |
| manufacturing of ships and | 375-002-36 | waste asbestos generated from ship recycling | T |

| | | | |
|---|---|---|---|
| floating equipment | | | |
| non-specific industry | 900-030-36 | waste asbestos generated from other production process | T |
| | 900-031-36 | Asbestos-containing waste electrical and electronic equipment, insulation materials, building materials, etc. | T |
| | 900-032-36 | Asbestos waste generated from the maintenance removal of Asbestos diaphragm, thermal insulation, vehicle brake linings and other facilities containing asbestos | T |

## 2.4 Problems and challenges in the asbestos waste management

Chinese official know asbestos hurts human health but research into its ill effects and prevention has been hobbled by lack of money and lack of attention by the authorities setting on rapid economic and industrial development.

The first asbestos mine was found in the 1940s in Jinzhou county near Dalian in the north-east. In the following years, only peasants used the fibre, now and then, to weave cloth and make asbestos gloves to resist heat. Small mills producing asbestos were merged and production was expanded and regularized. China today has five major, state-controlled mines extracting the mineral and numerous processing plants run by local governments. The biggest asbestos mine of Mangai in the western province of Qinghai and the working conditions in this mine are very poor.

Despite the fact that asbestos-related lung cancer and mesothelioma induced by occupational exposure have been recognized as statutory occupational lung diseases in China since 1990, only limited data are available. Based on the limited available

data, it is estimated that annual deaths due to mesothelioma in China were about 1,500 in 1990.

By the end of 2003, 7,907 cases of asbestosis, of which 923 were fatal, had been registered; this represented 1% of all pneumoconiosis cases. The burden of occupational lung cancer in China remains ill-defined.

After May 12 earthquake (2008), Sichuan Province had lots of debris containing asbestos waste. In order to deal with the debris, according to the guidelines promulgated by Ministry of Environmental Protection, the local government organized some training on the collection, demolition, transportation and disposal of debris, and experts from international organizations and developed countries made presentations on the training. Until now Sichuan province has established 9 disposal centres for hazardous waste, and lots of companies have involved in hazardous waste. But for asbestos waste, the local government and authorities did not pay enough attention. It is urgent to raise the awareness of asbestos waste and develop the environmental sound management of asbestos waste in those regions.

# 3 Implementation of the pilot project on environmental sound management of asbestos waste in China

## 3.1 Background of the pilot project

### 3.1.1 Objectives

Main objectives of this pilot project include:

(1) Raising public awareness of the importance of asbestos waste management;

(2) Identification of hazardous asbestos wastes;

(3) Integrated hazardous asbestos wastes management from collection, transportation to storage.

(4) Best available techniques to dispose hazardous asbestos wastes;

(5) Sharing experiences on how to environmental sound management of hazardous asbestos wastes in Asia and the Pacific.

### 3.1.2 Principles in designing the project

The following principles were obeyed during the implementation of the pilot project:

(1) Work safety—Collection, transportation, storage and disposal should keep the staff and people nearby safe. Try to cut off the exposure approaches to the crowd.

(2) Environmental sound management—Aims of clearing and disposal of asbestos are environmentally sound. The asbestos fibers should not be dissipated in the overall process until they are safely and harmlessly disposed.

(3) Economical—Under the premise of safety and environmental sound, the pilot project will try to use economic and reasonable technology and measures to implement the clearing and disposal.

### 3.1.3 Technical framework of the pilot project

Fig. 3.1 shows the technical framework of pilot project. The whole process includes

identification, collection, transportation, storage and disposal. According to management requirements, labor security points, technical points and pollution prevention regulations, the pilot project was implemented.

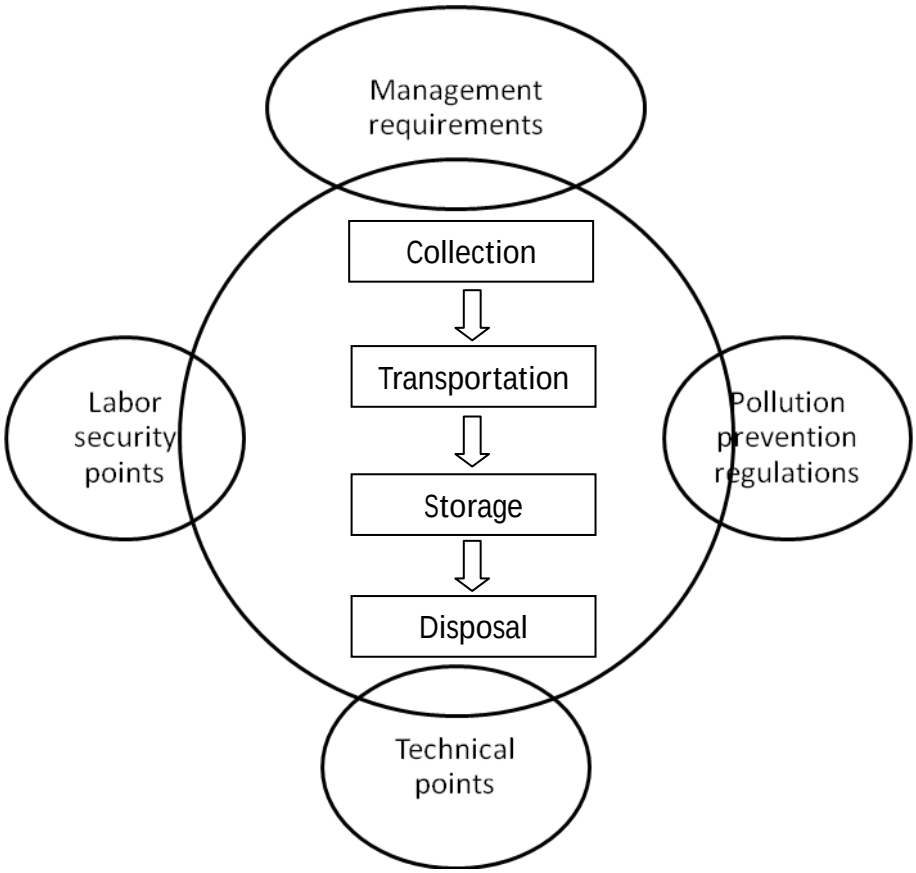


**Fig. 3.1 Technical framework of pilot project**

## 3.2 Selection for the site and disposal techniques

### 3.2.1 Selection for the site

During the preparation, the choice and location of the pilot city was the first step work. Based on the suggestions of national expert and officials from MEP, the Sichuan Province was chosen as the area to implement the project. In Sichuan province, some possible sites (Tab. 3.1) were recommended by the local governmental authorities and environmental protection agency.

**Tab. 3.1 Possible sites recommended in implementing the project**

| Location | Availability in disaster debris | Transportation | Local asbestos waste disposal facilities |
|---|---|---|---|
| Shifang, Deyang city, Sichuan Province | Yes, heavily affected by the earthquake in 2008. The former chemical factories were preserved to commemorate the big earth quake | Not very good, nearly 150 miles from Chengdu city, truck is able to arrive | Yes, a comprehensive hazardous waste construction facility exists which can landfill asbestos waste. |
| Wenchuan, Sichuan province | Not sure, most of the debris were collected after 2 years | Not good. Some roads are blocked. | No, need nearby facilities located in other places |
| Chengdu, Sichuan province | Not sure, most of the debris were collected after 2 years | Good, capital of the province | Yes, hazardous waste disposal facility exist |

After comparison, the Shifang, Deyang city, Sichuan Province (Fig. 3.2) was chosen as the final choice of the site in implementing the project based on following reasons:

(1) Shifang was heavily affected by the earthquake in 2008.

(2) There existed available disaster debris in Shifang. The former chemical factories were preserved to commemorate the big earth quake, and in the debris of the plant, lots of asbestos waste were found.

(3) Transportation is available. Truck is able to arrive.

(4) Most important, a asbestos waste disposal facilities located in capital city (Chengdu), Sichuan Province want to cooperate us to implement the pilot project.

(5) Local environmental protection agency and other authorities expressed positive

attitude to help us to carry out this project.


**Fig. 3.2 Shifang, Deyang city, Sichuan Province, site chosen in the project**

The Shifang Chemical Plant, which was heavily destroyed in the earthquake, was chosen as the site for implementing the project.

**Fig.3.3 The site selected for the pilot project-Sichuan Shifang Chemical Plant**

### 3.2.2 Selection for the asbestos waste disposal company

According to China's laws and regulations on solid waste, companies engaging in hazardous waste collection, treatment and disposal must apply for hazardous waste operation permit from environmental protection authority.

Transposition of hazardous waste must obey the requirement of management method of hazardous waste transfer. If company wants to transfer hazardous waste from one city to another city, they must submit hazardous waste transfer plan and get hazardous waste transfer manifest to relevant environmental protection authority.

According to above requirements, a company which has asbestos hazardous waste operation permit should be selected. Although there are more than 1000 companies which have hazardous waste collection, treatment license, the companies which have the permit to collect and treat asbestos waste are very limited. In Sichuan province, there is only one company (Sichuan Zhongming Environmental Management Co. Ltd.) which has this permit. And this company was selected for implementing the project.

### 3.2.3 Selection of the asbestos waste disposal technique

After the big earthquake of May 12, 2008, lots of debris were left to be disposed, some of which were piled without any treatment. There are several options available for asbestos waste treatment and disposal, such as physical methods, thermal methods and chemical methods. According to literature review, the technical deficiency in dealing with the asbestos waste were analyzed and evaluated, and the situation on collection, transportation and disposal on the asbestos waste and the existing problem on the collection and treatment of asbestos waste, especially on the health and safe aspects were investigated too. It was find out that few projects has been implemented in disposing asbestos waste in China, and little experience has been accumulated.

Considering the technical availability and economic reasons, the landfill was selected as the disposal option.

## 3.3 Implementation progress

### 3.3.1 Desk study

A desk study in investigating and analyzing existing asbestos waste management in the selected city, as well as consultations with relevant experts and field visits to stockpiling sites and disposal facilities were conducted in order to establish good practices of demolition, collection, transportation and disposal of asbestos wastes. Discussion and investigation of the current collection and treatment experiences were undertaken with the local authority and national experts several times, and a lot of

materials in relation to the asbestos waste, especially on developed countries and international organizations were collected.

It has been found out, in the selected site, local people were not aware of the health risk of asbestos waste, so there were neither existed management regulations nor facilities aiming at the management and disposal of asbestos waste.

### 3.3.2 Identification

It's often possible to "suspect" a material containing asbestos by visual determination. In fact, determinations can only be made through instrumental analysis. It's better to suppose every material contains asbestos before it is analyzed by instrument. In the project, the identification followed the procedures shown below:

**(1) Site inspection and primary evaluation**

The professional staffs implemented the site inspection in the debris, collect typical building debris containing asbestos waste, judge the components of debris containing asbestos waste, make timely marks, and set isolation belt and warning labels.

In the site, asbestos were found in the listed components of the debris:

Equipment and structure: Asbestos insulating layers and thermal insulating layers in boilers, fireproof doors and other industrial equipment;

Asbestos textured ceilings: Sealed binding lines and blankets in equipment; Fireproofing, soundproofing and insulation filler in dampers and partitions.

Asbestos-cement and other materials: Asbestos board and asbestos shingles used for roof panels; other architecture structure such as frames and partition walls; flues, ventilation installation, sewers, and garbage gallery; outer walls with cement and mortar mantled.

**Fig.3.4 Site inspection and primary evaluation in Shifang chemical plant**

**(2)Sampling and detecting**

Suspect materials should be gathered enough and delivered to the third party with qualification of specialized examination using phase contrast microscope or electron microscopy-National Research Center for Environmental Analysis and Measurement, using scanning electron microscopy. The method for sampling should comply with Chinese national standard Technical Requirement for Environmental Labeling Products – Asbestos Free Building Materials (HJ/T 206-2005).

**Fig 3.5 Sampling and detecting of suspected materials**

**(3)Training for workers**

The professional staff will train the workers, tell the areas containing asbestos waste, the characteristics of debris containing asbestos waste, the technical points for clearing, self-protection and environmental protection, and prepare typical debris samples for the workers to identify.

The key for asbestos waste identification is to distinguish the typical materials containing asbestos waste. Asbestos are widely used in the construction, and they can be found in any component in the debris, such as equipment, vessels, panels and textiles When the results come out, if the waste is tested containing asbestos, the isolation belt should be set with warning, and then the collection will be scheduled.

### 3.3.3 Collection

Approximately 1ton of asbestos waste was collected during the project following the management, technical, labor protection and pollution control requirements below.

**(1)Management guidelines**

Considering wide use of asbestos in building materials, the process of cleaning building debris should be considered as dangerous activities for asbestos exposure. The process should be conducted under the professional staffs from specialized companies or centers treating hazardous waste. Engaging in this process should submit the scheme to the department which is in charge of environmental protection, and the scheme should contain necessary equipment and materials, measures protecting the safety of workers, regulations preventing asbestos fibers effusion to the environment, procedures for transportation, treatment scheme for collected asbestos waste, and emergency accidents. If entrusted, the cooperation protocol and contract should be offered.

At the same time, the manager of chemical plants filled out the manifests correctly, consigned, kept one copy and delivered rest manifests to transporter from Sichuan Zhongming Environmental Management Co. Ltd.

**(2) Technical key points**

The separate barriers and obvious labels should be set around the debris containing asbestos waste. Minimize the disturbance of asbestos fibers. For the debris unable to implement the cleaning process, it should be covered by tarpaulins.

Take the asbestos waste in insulation pipes collection in this pilot project as an example, the first thing to do is laying a tarpaulins on the ground, and then using the sprayer to wet the surface of the pipes. Then a staff using knife or other sharp devices to cut the surface of the pipe, another staff lifted a plastic bag to catch the asbestos waste. The asbestos waste collected should be sealed in double-layer plastic bags or containers. In the procedure, use sprayer device to keep the surface wet, use the vacuum cleaner to aspire the dust, move away the small ones, put them into the plastic bags and the volume will be no more than 2/3. If the bag is full, put it softly into the steel containers. After collection, make the plastic sheet wet and clean the area, aspire the dust with vacuum cleaner, swap the dirt on the surface of vacuum cleaner, and enclose the dust, dirt to the special packages for asbestos waste, with the protective personal equipment. The plastic bags and sealed containers loading asbestos waste must be marked with obvious labels noticing that asbestos waste are contained.

**Fig 3.6 The collection requirements of the asbestos waste**

**(3) Labor protection**

The workers should wear the whole set of protective clothing, including hair-caring hat, antitoxin non-bleed protective clothes, antitoxin non-bleed gloves, work shoes or

gaiters, goggles, and breathing apparatus with filter covering the whole face, covering the whole body, and insure there is no direct exposure to the asbestos(Fig. 3.6). The workers should be trained by the professional staffs, and can manipulate personal protective and emergency equipment skillfully.

**Fig. 3.7 The equipment of workers**

Before working, the workers would:

- Ø Enter the clean room storing the casual clothes, take off the casual clothes, put them in the chest, and wear respirator.
- Ø Pass the shower room, enter the room storing protective clothes, wear goggles, and the protective clothes (including work shoes, gloves).
- Ø Leave the space storing protective clothes, and enter the working site.

**(4) Pollution control**

The debris containing asbestos waste must be thoroughly wet before clearing.

For the pipes and insulation layers containing asbestos fibers that may produce asbestos dusts and particles, the vacuum cleaner with high efficiency particular air filter must be used in the clearing process.

The asbestos waste cleared should be sealed in plastic bags or containers.

The used personal protective equipment should be put away waiting to be treated.

### 3.3.4 Transportation

**(1) Management Requirements**

Asbestos waste must be packed on site before transportation. The packing should follow the requirements as follows:

Asbestos waste can be packed in plastic bags with double layers thicker than 0.2mm or in other sealed container meeting the standards of landfill. Before transportation or storage, be sure that the packages are undamaged and the surface without any asbestos waste dust or fibers. During packing, the amount of waste loaded should be less than 60% of the bale capacity, the plastic bags should be tied by iron wire, containers should be absolutely sealed and the gases in the packages should be ejected totally. If there were any sharp materials, the containers should be sealed stout barrels rather than plastic bags.


**Fig 3.8 Management requirements of the asbestos waste before transportation**

The packaging bags and sealed containers loading asbestos waste must be marked with obvious labels noticing that asbestos waste are contained. And also the health risk and protective measures of asbestos are printed. Most importantly, the companies in charge of collection, transportation and reception of the packages should be attached.

Transportation of asbestos waste should be agreed by the local authority of environmental protection, approved by company of waste disposal, transportation department, and receiving unit, and managed as hazardous waste. The transportation

plan must be made, the staff must be trained, the anti-leak measurements should be equipped, and the transition process must be recorded.

The vehicle of transporting the asbestos waste must be special-purpose vehicle, rather than compressed vehicle for normal waste transportation, and should be allocated with shovels, brooms, personal apparatus for breath, protective clothes, wetting agent, and enough plastic bags and so on.

**Fig 3.9 Transportation of the asbestos waste collected in the project**

During the identification process, hazardous waste generator (Shifang Chemical Plant) submit transfer plan to local environmental protection bureau in Shifang city. After get approval from Shifang environmental protection bureau, manager of shifang chemical plant applied hazardous waste transfer manifests (5-copys).

During the whole transposition, hazardous waste transfer manifests must be followed with the transport vehicle.

**(2)Technical key points**

The operation for loading asbestos waste must be careful, and keep the package undamaged. Also the package should not be jettisoning or dropped.

If the asbestos waste which are stabilized in the matrix are transported and not loaded in the packages, the waste should be wet enough without effusion.

**(3)Labor protection**

The workers should be trained and be familiar with the personal protective clothes

and emergency equipment. The staff for transportation must wear a whole set of protective clothes including hair-caring hat, antitoxin non-bleed protective clothes, antitoxin non-bleed gloves, work shoes or gaiters, goggles, and breathing apparatus with mask, ensuring no direct exposure to asbestos waste. Personal cleaning items such as water, soaps and towels should be prepared.

After the work, the used protective apparatus should be put away in the packages storing asbestos waste and the workers must take a thorough shower and wash the skin exposed to the asbestos waste carefully.

**(4)Pollution Control**

Personal protective apparatus, packages and cloths contaminated or tainted by asbestos waste should be packaged in clean packaging bags and treated properly. The packages for asbestos waste are one-off materials, and should not be used repeatedly.

The surface of containers and vehicles for transportation must be cleaned up. Keep the vehicles totally sealed, if not, use tarpaulins or other safe ways to cover the vehicles completely. During the transportation, if the bags or containers are damaged leading to the effusion of asbestos waste, the workers should repair or alter the bags or containers or repack the asbestos waste immediately.

In the case of the leakage happens, the workers should adapt proper measurements in the leakage area; for the small amount of leakage, the workers should collect the waste and load them into the packages; for the large amount and most of which are dusts, the workers should wet the dust, cover the dust if possible, and clear the leakage waste. While in the process of clearing, the workers must adopt necessary safely protective measurements such as wearing protective clothes and breathing apparatus.

### 3.3.5 Storage

**(1)Management requirements**

In principle, the asbestos waste gathered from the debris should not be stored at other places rather than hazardous waste disposal site, even temporarily. If stored in the hazardous waste disposal site, it should follow the operation management requirements of hazardous waste.

In case of special reasons for temporary storage, the original place collecting asbestos waste is the first choice. If stored, make sure the dust and fibers would not effuse to the air and the surface runoff. The place for temporary storage should be guarded by special persons, and prepare schemes for emergency incidents.

According to law on pollution prevention caused by solid waste, storage period for hazardous waste cannot exceed 1 year.

**(2)Pollution Control**

For the storage of asbestos waste, the requirements are the same as collection. For example, the staff should lay temporary protective layers on the ground, maintain barriers and warning signs around the storage place, wet the asbestos waste thoroughly, and cover the waste with tarpaulins. Clear the outer place of storage, there should be equipped with shovels, sandy soil, spraying apparatus, washing water with surfactant, brooms, cloths, vacuum cleaners, spare packaging bags and other devices needed.

**Fig 3.10 Storage of the asbestos waste collected in the project**

### 3.3.6 Disposal

**(1)Management requirements**

Asbestos waste is one type of hazardous waste, and the disposal of asbestos waste should meet the requirements for hazardous waste disposal. And it must be disposed by qualified hazardous waste treatment unit. The disposal of asbestos waste is mainly landfill, and the advantages are no exposure of asbestos fiber, and no open fire in the

landfill site.

During the disposal, the special equipment such as mechanics should be prepared, and operated by professional staff. And the treatment unit should have the methods for identifying asbestos waste.

In this pilot project, after the asbestos waste were transported to the storage area, the plastic bags and steel containers filled with asbestos waste and ACMs were put into special facilities sealed with cement in case of fibres and dust effusion, and then transported to the landfill site.

In the loading, deposit, landfill and preliminarily compressing operations, there should be enough area about length of 50m prohibiting other persons get into the site. In the operation, the asbestos waste stored in the area must be covered by materials without asbestos waste thicker than 30cm. The disposal site should apply some methods to control the effusion of asbestos fibers and dust, the erosion of wind and the change of asbestos from fibers to non-fibers.

For all the received asbestos waste, the disposal site should keep the receipt records until the landfill site is close, and mark the location, depth, scope, and amount on the map of the disposal site. All the asbestos waste must be recorded and maintained for more than 2 years. Keep permanent marks or accurate descriptions of the landfill site including the depth, quantity, and volume.

Prepare annual progress or record indicating the quantity and location of asbestos waste, sum up once a year, and represent the time for close. Supply a record for the next land owner indicating that the site is filled by asbestos waste and dangerous to be excavated. Otherwise, the definite location of asbestos waste landfill must be presented on the territory or the contract.

**(2)Technical key points**

Asbestos waste must be located on the bottom of landfill site, the ditch, or the hole. Measurements should be adopted to prevent the leakage of asbestos. In the process of deposit, except the waste with high density, the waste could be covered with the acceptable height (such as 20-25m), and after the daily work, no asbestos waste would be left. Wet waste should be used to cover the dry in the same way, in case of the effusion of asbestos when dried. The wet deep holes are suitable for storing asbestos

waste with high density. At the drier place, measurements should be made to prevent the dust from asbestos waste with high density when the vehicles pass. The best way to treat plastic bags used for packing asbestos waste is melting, leaving the asbestos waste wrapped in the melt plastics.

**(3)Pollution Control**

For asbestos waste is one type of hazardous waste, according to “Standard for Pollution Control on the Security Landfill Site for Hazardous Wastes (GB 18598-2001)”, the pollution control measures for asbestos waste landfill are the following:

**Operation phase:**

- The effusion of asbestos fibers should be prevented by atomization.
- In the operation area, equip with shovels, sandy soil washing water with surfactant and so on.
- The mechanicals must pass the high pressure washing before leaving.

**Coverage and close phase:**

The final mantles should be more than 60cm preventing the excessive erosion or frost, and waste no more than designed landfill volume are dumped. Keep the sloping surface, plants and water supply and drainage structure of the closed landfill site integrity.

On the mantles, enough vegetation should be planted avoiding the exposure of asbestos waste or cover more than 60cm mantles without asbestos waste. Set and maintain warning labels or barriers.

## 3.4 Outputs of the pilot project

The Shifang, Deyang city, Sichuan Province was chosen as the final choice of the site in implementing the project. Based on the principles of work safety, environmentally sound management and economic availability, experts from national center of solid waste management, BCRC China and Sichuan Zhongming Environmental Governance Co.Ltd. drew up detailed procedures for implementation of the pilot project including identification, collection, transportation, storage, and disposal of

asbestos waste. According to the scheme, the pilot project was accomplished successfully and approximately 1 ton asbestos waste was disposed. A video “Pilot Project on Environmental Sound Management of Asbestos Waste” was made by BCRC China at the same time.

The following key points are summarized below.

(1) The identification should follow these procedures: site inspection and primary evaluation, sampling and detecting, training for clearing workers. The key for asbestos waste identification is to distinguish the typical materials containing asbestos waste.

(2) The collection process should be conducted under the professional staffs from specialized companies or centers treating hazardous waste.

(3) Asbestos waste must be packed on site before transportation. Transportation of asbestos waste should be agreed by the local authority of environmental protection, approved by company of waste disposal, transportation department, and receiving unit, and managed as hazardous waste. The vehicle of transporting the asbestos waste must be special-purpose vehicle.

(4) The deposit of asbestos waste should consider rational displaying, and be convenient for the next deposits.

(5) The disposal of asbestos waste should meet the requirements for hazardous waste disposal. In the loading, deposit, landfill and preliminarily compressing operations, there should be enough area about length of 50m prohibiting other persons get into the site. For all the received asbestos waste, the disposal site should keep the receipt records until the landfill site is close, and mark the location, depth, scope, and amount on the map of the disposal site.

## 4. Conclusions

(1) In most Asia and the Pacific countries including China, asbestos are still utilized,

and those countries and districts are facing great challenge to manage asbestos waste in environmentally sound way.

(2) In China, no specific regulations and technical guidelines of environmental management for asbestos waste as well as these wastes in disaster debris have been issued. Fractions of management requirements has been published in some regulations, however, both the governmental authorities and the public are still in lack of adequate consciousness on the environmental sound management of asbestos waste.

(3) The pilot project was accomplished successfully in Shifang, Deyang city, Sichuan Province, and a video named “Pilot Project on Environmental Sound Management of Asbestos Waste” was made.

(4) The technique on disposing asbestos waste is inadequate, and landfill should be proposed as the most appropriate way for disposing asbestos waste especially these which were separated from disaster debris.

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