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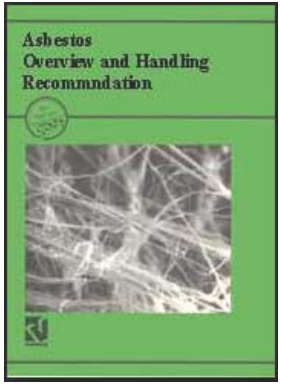

Asbestos Overview and Handling Recommendations (GTZ, 1996)

Asbestos Overview and Handling Recommendations (GTZ, 1996)

Part IV Country analysis

1. Introduction

The worldwide distribution of fiber cement products leads to the suspicion that in developing countries (DC) an elevated Asbestos fiber emission is also to be expected. This could be enhanced by climatic influences, different manufacturing methods for Asbestos containing products, different consumer responses and other orders of preferences, as well as limiting conditions in the availability of substitutes, differing legal norms and other influences. Part IV of this study attempts to illustrate the particular problems of Asbestos in DC. Subsequently, case studies for different countries are detailed. The selection of the countries was made by the contracting party. The collection of data was acquired using a specially conceived questionnaire. The questionnaire was sent to selected organizations in the respective countries. External budgets were provided for gathering the requested information. The varying content of the results of the questionnaire distribution can be traced back to different aspects. For instance, the availability, the state of preparation and the amount of information in the countries are very different.

2 Asbestos in developing countries

In order to focus on the specific problems of the developing countries (DC), it is sensible to review the development in the industrialized countries. In the 1960s Asbestos became a type of "magic word" for superior product properties with good availability, relatively easy production processes and the corresponding cost advantages.

Although at this time the resulting risks had been scientifically proven and the first occupational sicknesses due to Asbestos exposure in different countries had been acknowledged, for a long time the material characteristics were the focal point and were responsible for the many and massive applications of Asbestos and Asbestos containing products. Now this has changed with better availability of substitutes towards to the avoidance of Asbestos use.

Many DC currently see primarily the usefulness of Asbestos, its availability as raw material and its good ability to be processed to marketable products. In addition, some DC belong to the Asbestos producing nations and can and must acquire the necessary foreign currency through Asbestos production.

In 1986 the ILO (International Labour Organisation) passed an agreement on Asbestos at the international labour conference. At this meeting this conflict became apparent:

".. a representative of a developing country stated that many countries have a growing need for Asbestos products and that these products will play a part in

improving the living conditions of many communities around the world "

(ILO, Occupational Safety and Health Series No. 67)

This already "classical dilemma" for DC, that an eventual use poses heavy risks, permits two methods of action:

- **hazardous working substances are not used or only under strong limitations according to the stipulations of industrialized nations and multinational agreements,**

- **a corresponding use of these substances occurs under minimization of the respective risks.**

Substances and goods which are present are not used, only if

- **the application possibilities become limited (orders and prohibitions, legal regulations) and**

- **substitutes are available (general availability and the availability of inexpensive alternatives for Asbestos applications).**

In Part II of the present study the different technically possible Asbestos substitutes were described. According to another questioning of the ILO, Asbestos substitutes are also manufactured in DC. Here it is to be assumed, however, that this is not the case for every application area. More important

than a nearly perfect substitution is the provision of adequate Asbestos substitutes in the construction area, since here the main fraction of Asbestos containing substances is found.

In Chapter 4 the application of substitutes and the relevant legislation on Asbestos for selected countries is discussed further.

The latest developments in Asbestos legislation in South Africa have comparable values to those of European industrialized nations. At the same time, the vital interest in a future use of Asbestos as well as a mistrust against the developments in industrialized nations are apparent.

"Almost all countries in the world, including South Africa, now subscribe Jo the controlled-use approach to the regulation of Asbestos. In South Africa, the statutory limits are 2.0 f/ml for mining and 0.02 f/ml for residential exposure. In the EEC, which recently again rejected calls for a total ban of Asbestos, the occupational exposure limit is 1.5 f/ml. A small number of countries have introduced more restrictive measures calling for a ban or phase-out of Asbestos, including Sweden, Germany, Norway, Denmark, Switerland and Austria Significantly, most of these countries are major producers of substitute products. "

(in: The Asbestos Report, No. 16, November 1991)

3 Use and effects of Asbestos cements in developing countries

In the previous sections it has been illustrated that the quantitatively dominating use of Asbestos fibers occurs in Asbestos cements. The wide distribution of fibrous cement products in DC leads to the suspicion that an elevated Asbestos emission is also to be expected there. In the following, fiber emitting processes for the processing and use of Asbestos cement are discussed.

Asbestos cements are primarily used as construction material in many forms (see Part II, Section 4.1). The processing methods are also manifold. With all of these options, the methods can essentially be divided into two groups, in which differing mechanisms are effective, which can be evaluated differently in regard to potential Asbestos dust emissions.

1. Cutting processes with manual tools and slowly running machines, at which Asbestos cement wastes arise in the form of rough swarf and scraps. With these processes larger attached areas of Asbestos cement structure remain.

2. Grinding and sawing processes using fast operating machines, at which the original material structure is totally destroyed. With this type of processing the structure is beaten to fine dust, and with certainty a change can be expected in the original fiber geometry of the Asbestos in the sense of a distribution into finer and shorter fiber elements.

Consideration of the health and safety measures in handling Asbestos described in Part II, Chapter 5, is important. It is suspected that in DC these are often not applied or only insufficiently applied. Further information on this

is provided in the individual country profiles.

With regard to Asbestos emission through use of Asbestos cement products, erosion and weathering processes particularly play a role. Included here are: flat and corrugated panels as roofing, shingles as facing panels and for roofing, panels as facade elements as well as pipes for water installations.

Chemical and physical weathering mechanisms are in effect on these products, leading in some cases to a destruction of the cement matrix. The result is an exposure of Asbestos cement so that Asbestos fibers can be released to the environment by wind or water erosion. These phenomena are more favorable in areas with extreme climatic stresses, such as high relative humidity, rain periods and high temperatures.

The great amount of roofing and facade panels applied in DC poses the danger of fiber emissions from the weathering of Asbestos cements. The use of Asbestos cements in the area of water main pipes causes the danger of Asbestos contamination of drinking water. However, it must be added that a fiber concentration of up to 20,000 fibers per liter is acceptible from a toxicological standpoint, since the oral intake is judged much less critical in comparison to the inhalative intake. This is not a specific problem of the DC, though, since also in industrialized countries Asbestos cements have been and are used in water mains.

Annex 3 shows the average Asbestos concentrations resulting from different processes.

4 Country profiles

4.1 Australia

4.1.1 General overview

As of 1983 Asbestos is no longer mined in Australia, and currently no Asbestos containing products are manufactured in this country. Therefore, depending on their lifetimes, the Asbestos products have been or are being eliminated from their application areas by substitutes.

4.1.2 Legislation

Australia has extensive legal norms controlling the production, processing and abatement of Asbestos containing materials. The corresponding requirements have meanwhile led to the ceasing of Asbestos mining and Asbestos product manufacturing in Australia. Consequently, these norms are currently applied primarily to abatement and supervisory measures. A general Asbestos prohibition exists only for the use of crocidolite at the workplace, however.

The Workplace Health & Safety Regulations (1990) can be considered. Guidelines and limit values in handling Asbestos containing material are also summarized in the Code of Practice of the National Occupational Health & Safety Commission. These data were determined by the National Consultative

Committee on Occupational Health & Safety (NCCOHS), which was established in 1983.

The Workplace Health & Safety Authority at provincial level is responsible for the authority supervision of the specifications. Workplace measurements and air measurements must be performed by the respective owner.

The import of Asbestos fibers in Australia is forbidden, and there is mandatory abatement for existing materials which can release Asbestos. Asbestos containing material must be specially declared and may only be transported in closed containers. The use of Asbestos is completely forbidden for some applications, as in the case of sprayed Asbestos, for example.

In the guidelines of the Code of Practice, air limits at the workplace during the mining and processing of Asbestos are set at I fiber/ml (chrysotile) and 0.1 fiber/ml (crocidolite, amosite or other Asbestos types as well as mixtures or these). The specification is for the average value over 4 h measured with the membrane filter method. In working with Asbestos, particular safety measures must also be observed (moistening measures, respiratory protection, special clothing, clothes changing rooms, etc.). Furthermore, a medical exam is necessary no later than 90 days after assuming the work and subsequently at least every 3 years and again no later than 30 days after leaving the position. No smoking is allowed at the workplace. Lastly, regular training at the workplace is performed.

There are also regulations on the disposal and abatement of Asbestos

containing materials. Abatement measures may only be performed by officially supervised companies, which require a so-called Class 5 license. For occupational safety, the previously mentioned regulations apply. Asbestos may not be broken off during abatement measures and must be packaged in special sacks. The disposal must be performed at special landfills.

With regard to Asbestos fibers in drinking water, there are currently no legal regulations. Investigations have shown, however, that fiber concentrations in the range of 105 bis 109 fibers per liter drinking water were present.

The Australian federal laws were implemented into corresponding legal norms at the provincial level, which are presented in Table 21.

Table 21: Asbestos - Law / Ordinances / Guidelines of Australian Provinces

Laws, Ordinances, Guidelines	**Year enacted**
New South Wales (NSW)	
- NSW Occupational Health and Welfare Act	1986
- NSW Occupational Health, Safety and Welfare Regulations (Ordinances for the industrial area)	1987
- NSW Occupational Health, Safety and Welfare Regulations (Ordinances for the construction fields)	1987
- NSW Code of Practice for the Safe Removal of Asbestos	

Victoria	
- Victoria Government - Labor & Industry Regulation (Ordinances for the Asbestos processing industries)	1978
- Statutory Rule No. 435	1978
- Statutory Rule No. 201	1979
- Victorian Asbestos Removal Industry Consultative Committees (Different norms for Asbestos abatement of buildings and workplaces)	
Queensland	
- Queensland Workplace Health & Safety Act and Regulations	
Western Australia (WA)	
- WA Occupational Health, Safety and Welfare Regulations	1988
South Australia (SA)	
- SA Occupational Health, Safety and Welfare Act/Regulations (Ordinances/laws for the industrial area)	1986
- SA Occupational Health, Safety and Welfare Regulations (Ordinances for the construction fields)	
- Code of Practice for Safe Removal of Asbestos	
Tasmania	
- Department of Labour and Industry, Tasmania - Safety Guide Toxic/Dangerous Substances No. s 1, 8, 9, 10, 11, 12, 15 -	

Northern Territory	
- Construction Safety Act	1984
- Construction Safety Rules, Division 3, "Spraying and Handling of Asbestos".	
Australian Capital Territory	
- Office of Australian Capital Territory - "Asbestos Removal Manual"	

Source: own compilation

4.1.3 Research and development

Research projects in Australia refer primarily to the control of Asbestos release from existing installations. These research programs are mainly performed by scientific institutes, such as the National Institute for Occupational Safety and Hygiene or the CSIRO in Melbourne.

Currently, for instance, there are on-going research projects on the sealing of Asbestos products (CSIRO) or the behavior of Asbestos fibers in the lungs (National Institute for Occupational Safety and Hygiene).

Furthermore, there are research programs in the area of development of substitutes, such as the research project on silicon carbide -Whiskers (CSIRO) or new brake linings (Australian Railways).

4.1.4 Substitutes

In Australia Asbestos containing products have been replaced by substitutes to a great extent. These are available largely from national production, and examples are listed in the following table.

Table 22: Substitutes for Asbestos Fiber Products in Australia

Application	Asbestos Fiber - Substitutes	Price
Textiles	woven glass fibers	$ 5/m², for 1.8 kg/m² woven textile
Paper products	Kevlar/graphite fibers	varies
Insulation material	glass fiber- (woven textile)	$ 4 50/m² (thickness 50mm)
Cement products	cellulose/glass fiber cement	$ 2300/m³
Roofing	-"-	$ 14/m²
Boards/Tiles, etc.	-"-	$ 20/m²
Brake lining	steel/copper wool strengthened phenolic resin	varies

Source: own compilation

The technical properties and weather resistance of these substitutes are

generally good. However, the processing ability is more difficult in the case of paper products, insulation materials and brake linings.

Furthermore, a number of Asbestos substitutes are in use which are fiber-free. Some of these products are manufactured within the country. Examples are listed in Table 23.

Table 23: Fiber-free Substitutes for Asbestos Products in Australia

Application	Fiber-free Substitutes	Price (approx. value)
Cardboard products	Teflon	Import goods
Insulation material	expanded Polystyrene	$1001m³
Roofing	galvanized steel sheet	$ 18/m² (0.53mm)
Boards/Tiles, etc.	steel sheets	$ 10/m²
	clay sheets	$ 17/m²
	cement sheets	$ 14/m²
Brake linings	cast iron	$ 3-51kg

Source: own compilation

The technical properties, as well as the weather resistance of these substitutes are satisfactory to good. The processing ability is difficult in the case of teflon for cardboard products.

In the typical application areas of Asbestos cements, such as water main pipes or roof coverings, cement strengthened with cellulose fibers is primarily used today. In special cases of application, alkali-resistant glass fibers also come into use. For water mains the following are also applied: (malleable-) cast iron, galvanized steel, PVC and HDPE. For roof coverings, in addition to cement and clay panels (tiles), steel panels or steel pressed panels are applied. Cement sheets are impregnated with bitumen or acrylate protective coatings to make them water-tight. All of these materials are manufactured in Australia.

The technical suitability of these materials is determined on the basis of special Australian norms. Generally, products made of cement fibers are classified somewhat lower in their tensile strength and impact resistance compared to Asbestos cement. Due to climatic conditions, the low UV-resistance of plastics or glass fiber-strengthened plastics must also be considered.

4.1.5 Risk Philosophy

Asbestos is classified in Australia as a material with a high hazard potential. This is reflected in the relevant legislation on Asbestos. In the future, a general Asbestos prohibition is expected.

4.2 Chile

4.2.1 General overview

In Chile Asbestos is not mined, but only processed. Consequently, the import rate of Asbestos is very high, as illustrated in the following figure. Asbestos is mainly imported from Canada.

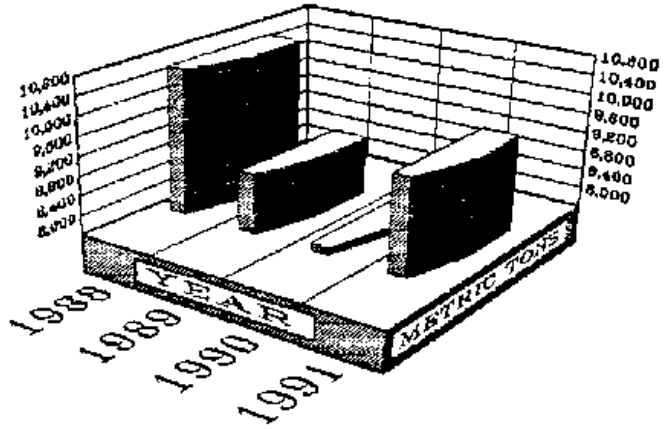

Figure 4: Annual Import of Asbestos in Chile 1988 - 1991 (in tons)

Source: Central Bank / Jan. 1993

Raw materials, such as Asbestos sheets, blocks, powder and fabric, are imported as well as finished products, such as construction and roofing materials and facades. The largest fraction of finished products is comprised of clutch and brake linings.

Only 12 companies are part of the Asbestos industry in Chile, and 8 of them

process Asbestos. Four companies trade with Asbestos and Asbestos containing products. Based on the following figure, it is apparent how high the valued import of Asbestos fibers is (e.g. for 1991: 6,660 t at 660 U. S.$/t).

Asbestos production does not account for a large fraction of the total industry in Chile. Only about 1,500 workers are employed, achieving an interior product of 7 million US $ at a gross national product of 35,700 million US $ in Chile. Accordingly, the percentage lies only around 0.18 %.

From the total products produced, only clutch and friction linings are exported in an amount of about 225 tons/a.

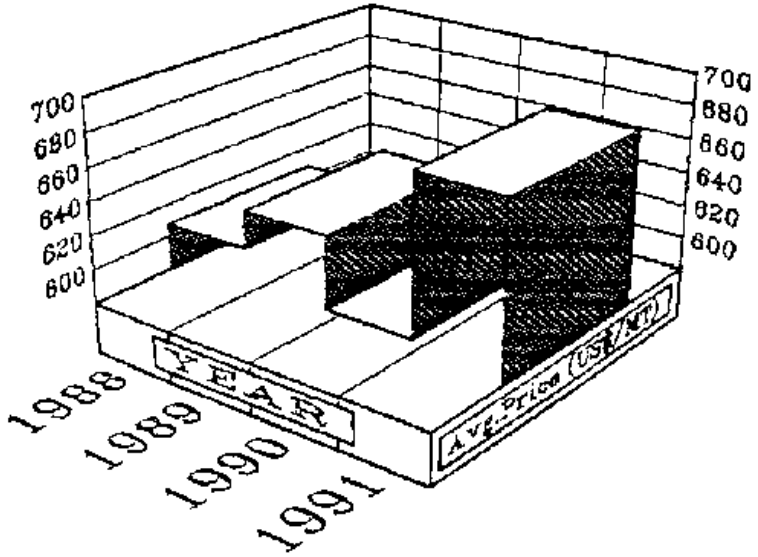

Figure 5: Expenditure on Asbestos Import in Chile
Source: Central sank / Jan. 1993

4.2.2 Legislation

Only two legislative ordinances on the use of Asbestos exist in Chile. In a governmental publication on 7 June 1967, as a result of several appeals by international organizations to the federal health bureau, Asbestos was declared a potentially hazardous substance through inhalation. A legal regulation on improved workplace and environmental conditions was not passed until 1983,

and prescribes a maximum average Asbestos concentration of 2 fibers/ cm³ in air (Paragraph 78). Since 1983, no further tightening of regulations has occurred. The limit of 2 F/cm³ is valid as the maximum workplace concentration as well as the general maximum permissible concentration in air.

The Health Bureau and public independent health institutes are responsible for the maintenance of the Asbestos fiber limits established by this law. Workers at Asbestos workplaces undergo regular medical examinations and must be priorly informed about potential risks. This training serves to prevent risks and high Asbestos concentrations through inproper handling. Depending on the working situation, face masks and protective clothing must be used, and the workplace must be under a continuous water supply. Often ventilation filters are installed or good ventilation is provided by other means. Smoking at the workplace is generally prohibited.

According to in official information, however, the monthly spot checks which have been announced are not regularly performed, and reports are only made in cases of elevated concentrations.

The draft to update Paragraph 78, which has been submitted as a proposal, would include an additional detailed limitation on special Asbestos fibers:

- Crocidolite max. 0.16 fibers / cm³
- Amosite max. 0.4 fibers / cm³
- Chrysotile max. 1.6 fibers / cm³

The prohibition of the use of sprayed Asbestos is not being discussed, though, neither in the import area nor in the area of abatement. Transport or use of Asbestos does not fall under any legal regulations.

4.2.3 Research and Development

Research and development is performed only to a limited extent in Chile. The results of the questionnaire lead to the presumption that at most one or two private companies are involved in research in the area of Asbestos substitutes, however, exact information was not provided.

A few investigations on health hazards through Asbestos are performed by the public health ministry (ISP).

One single air measurement study by Chile's health organization (ACHS) was concerned with the emission of Asbestos in Asbestos processing textile industries. The investigation showed emissions during sewing to average at 0.97f/cm³, during final finishing 0.7 f/cm³ and an emission to the general surroundings of 0.2 f/cm³. Consequently, Asbestos in this industrial area is not considered a health hazard.

There have been no investigations or measurements of the concentration of Asbestos in drinking water.

The majority of the information was taken from international regulations and guidelines (OPS/OMS Panamerican Health Organisation).

4.2.4 Substitutes

The following tabulated fiber containing materials and products are used in Chile as substitutes for Asbestos materials:

All of the named substitutes are available within Chile. Only small amounts need to be imported. The technical suitability of the substitutes is generally considered very high. The weather resistance and the lifetime are generally comparable to those of Asbestos products. Exceptions here are insulation, cement products and fleeces, whose resistance is generally judged poorer.

Table 24: Substitutes for Asbestos Fiber Products in Chile

Application	Asbestos Fiber - Substitute	Price
Textiles	cotton	more expensive
	special synthetic fibers	
Paper Products	Teflon	more expensive
	plant fibers	
	polymers	
Insulation Materials	graphite	more expensive
	plant fibers	
	cotton	

Cement Products	glass fibers	more expensive
	plant fibers	
	synthetic fibers	
Surface Materials	fiber glass	more expensive
	kevlar, teflon, graphite	
Roofing	fiber glass, plant fibers	more expensive
	wood	
Tiles	glass fibers, plant fibers	more expensive
	wood, carbon material, polymers	
Friction Materials	kevlar, teflon	more expensive
	cotton	

Source: own compilation
Note: Since 1969 fiber glass has been bound in the form of glass wool.

The fiber-free substitutes are listed in table 25.

The fiber-free substitutes are all available within the country. The technical suitability is considered adequate, as is the lifetime.

One can generally say that the use of substitutes often means a change in the technology and
machinery. This circumstance frequently prevents manufacturers from using

substitutes, since this would mean a high investment. This is also the reason for the very small amount of research being performed in Chile.

Table 25: Fiber-free Substitutes for Asbestos Fiber Products in Chile

Application	Asbestos Fiber - Substitutes	Preis
Textiles	various synthetic materials	more expensive
Paper Products	clay and venous polymers	more expensive
	Polymers	
Insulation Materials	clay	more expensive
	venous polymers	
Cement Products	clay	more expensive
	concrete	
	synthetic fibers	
Surface Materials	clay, polymers	comparably more expensive
	metal rails	slight difference
Roofing	asphalt with plastic	comparably more expensive
	asphalt with fine gravel	slight difference
Tiles	clay tiles	more expensive
	special polymers	

Friction Materials	clay	more expensive
	special polymers	

Source: own compilation

In the special areas of housing construction and construction of water mains, the following substitutes are applied:

Table 26: Substitutes for Asbestos Fiber Products in Housing Construction and Water Mains in Chile

Application	Fiber-free Substitutes	Fiber Containing Substitutes
Housing Construction	wood (for shingles)	cellulose
	metal rails	fiber glass
	asphalt with fine gravel	ceramic fibers
	asphalt paving	special Polymers
	straw	(kevlar/ teflon)
	plant fibers	
Water Mains	steel	as above
	concrete	
	PVC (predominantly)	
	clay	

Source: own compilation

The substitutes of both areas are much more expensive, although they are largely available within the country. Asbestos products continue to be considered more weather resistant and longer lived and therefore more useful. In summary, one can see that in housing construction the most common substitute is wood shingles, because they have a better optical effect than Asbestos cement sheets and are lighter. However, the higher costs and the required maintenance work are considered disadvantageous. In water mains construction PVC pipes are primarily used, due to their better processing ability, their lower weight and the longer lifetime. In addition, there is only a small difference in price. Although steel pipes have longer lifetimes, they and clay pipes are used less. The reason for this is the higher price, the higher weight and the more difficult processing.

4.2.5 Risk Philosophy

In Chile Asbestos is considered a health risk only under certain conditions and above a specified fiber concentration. The arising problems are treated case by case. For instance, based on measurements in individual factories it is decided how fiber emissions can be reduced. The health authorities in Chile generally have the opinion that Asbestos materials should be avoided. However, even in case of a potential health danger there is no prohibition for use.

In the future, the government intends on making the legislation stricter. However, only particular fiber emission limits are expected to be prescribed and not a complete Asbestos program. In contrast to air contamination, fiber emission into drinking water is not considered hazardous, and consequently there are no limits and no investigations on this matter.

In summary, the impression is that stricter measures in the Asbestos politics in Chile are not going to be imposed, because industry and trade are mainly interested in marketing materials with lower prices and the best possible properties (weather and temperature resistant, stressability). Research is supressed amd the search for substitutes appears too expensive, since the market is not prepared to accept more expensive materials. Consequently, in Chile a purely monetary cost-benefit consideration currently still has superiority over health aspects.

4.3 Republic of China

4.3.1 General overview

Data on Asbestos fiber production in the Republic of China are not currently available, since the Chinese government does not officially keep statistics on this matter. It is known, however, that all important fiber types are produced in China, and that the production amount is very dependent on the respective demand. Mining regions lie in different provinces in China, including in the

Province Hubei.

The processing of fibers proceeds in numerous plants, primarily as manual labor. Asbestos containing products are manufactured in the following cities among others:

Beijing	*Guangdong Province*
Chengdu	*Guizhou Province*
Chongqing	*Hubei Province*
Dalian	*Shannxi Province*
Hunming	*Zheijang Province*
Nanchang	
Qingdao	
Shanghai	
Shannxi	
Tianjin	
Wuhan	
Zhuzhou	

This list is by no means complete, but it shows that in China a large volume of Asbestos products are manufactured and the amount has been estimated at

about 150,000 t/a.

4.3.2 Legislation

In the Republic of China there is no specific legislation on Asbestos. In the area of Asbestos mining, the general safety and hygiene regulations are applied, which refer to supervision of dust emissions in factories, quarries and mines. However, it must be mentioned that occupational safety legislation in China can be described as rather inadequate. A few of these regulations are mentioned below:

- **Rules on Safety and Hygiene in Factories (1956)**
- **Circular Letter on the Improvement of Occupational Safety and Supervision (1983)**
- **Rules on the Improvement of Occupational Safety in Agriculture (1987)**

Some environmental regulations also exist which can be applied to Asbestos. Their content is typically very vague, however, and is hardly imposed. These regulations include restrictions on Asbestos production for development projects in rural areas. It can be assumed, that a minimum of personal safety equipment is used during Asbestos mining (face masks, etc.). The processing of Asbestos fibers is primarily performed manually, and occupational safety measures in this area are not generally common.

4.3.3 Research and Development

In China research projects on Asbestos are being performed in the areas of occupational safety and hygiene, and toxicology. These research projects are focussed mainly on the pathological changes induced by fibers in humans (e.g. Asbestosis und pneumoconiosis) and on the general relevance to health.

In comparison, very little research is concerned with Asbestos substitutes. This is due to the fact that Asbestos products are currently used in great amounts because of their good properties as thermal/acustic insulators and because of their mechanical properties. The development of substitutes does not have any priority or only low priority in China.

4.3.4 Substitutes

The introduction of Asbestos substitutes is limited to particular application areas, and even there they must be considered the exception. Examples are glass fiber reinforced plastic sheets as a substitute for Asbestos containing sheets (roof coverings) and reinforced concrete pipes as a substitute for Asbestos containing pipes. However, the application of Asbestos substitutes must be considered the exception rather than the rule.

4.3.5 Risk Philosophy

The controlling authorities (e.g. the Guangzhou Environmental Protection Agency) and research institutes are generally aware of the hazards of handling Asbestos containing materials. Special control measures are typically lacking,

however. Although guidelines and administrative regulations limit the use of Asbestos (e.g. in newly introduced products), their implementation and any general progress in this field are hardly noticeable.

Consequently, Asbestos containing materials continue to be applied without any special protection measures.

On the other hand, Asbestosis and mesothelioma are recognized in China as occupational illnesses. However, there is no information available on the number of sick people. Apparently, most of the illnesses are attributed to Asbestosis, whereby the groups of peope between 18-40 years old are particularly affected.

4.4 India

4.4.1 General Overview

In India Asbestos fibers are mined mainly in small plants and partly in deep mining. The production cannot cover the national demand, though, particularly for chrysotile fibers, so that a considerable amount of imports are necessary.

The mining activities are concentrated in the Cuddapah District in Andrah Prodesh (chrysotile) and the Districts Ajmer and Udaipur in Rajastahn (tremolite). In 1991 about 66 officially operating mines were located there,

each having an average of about 5-50 workers. The annual production of the mines was between about 30 t/a for the small mines and 1500 t/a for the larger mines. The official total production is presented in Table 27.

In Asbestos mines the official number of workers is currently around 900, and about another 400 in Asbestos processing. The mining of raw Asbestos occurs-primarily with manual procedures, which are described below:

Asbestos containing rock is manually separated from waste rock and ground in edge runner mills. The Asbestos fibers are then separated in a series of shaking screens and freed of dirt. For the final cleaning, manually operated shaking screens are still used in some cases. Finally, the raw Asbestos is packed into polyethylene sacks.

Table 27: Asbestos Fiber Production in India (1 April '90 - 31 March 91)

Asbestos Fiber	Total Production	Underground Mining	Openpit Mining	Export
	(t/a)	(t/a)	(t/a)	(t/a)
Chrysotile	1,293		1,293	
Tremolite	31,728		31,728	
Amosite				
Crocidolite				
Anthophylite	275		275	254

Source: own compilation				

Table 28: Asbestos Processing Companies in India (examples)

Company	Products	Annual Capacity (t/a)
Asbestos & Jointing	Asbestos joints, gaskets	720
Mfg. Co. Ltd., Vapi,		
Bombay		
Asbestos Packing & Mfg, Co.	Asbestos yam, textiles	800
Pvt. Ltd., Andheri, Bombay		
Dutta Bros. & Co.,	coated Asbestos fibers	
Calcutta	Asbestos mortar	
Hindustan Ferodo	brake lining, clutch disks	6,000
Pvt. Ltd. Ghatkopar,	Asbestos textiles, Asbestos mats	1,520
Bombay	pressed links,	2,650
	Asbestos - steel pressed sheets	800
Mechanical Packing	Asbestos yam	500

Industries Ltd		
Andheri, Bombay		
Newkem Products	thermolite high temperature	
Corporations. Bhandup	insulation material (powder)	1,800
Bombay	other Asbestos containing products	5,000
Rane Brake Lining Ltd.	brake lining, clutch disks	3,000
Madras		
Reinz-Talbros Pvt. Ltd.	Asbestos pressed sheets, compounds	2,150
Ghaziabad, (U.P.)		

Source: own compilation

In automatic processes Asbestos containing rock is separated from rock and freed of dirt in a series of two-story rotation-eccentric screens. The raw fibers are pneumatically transported further and then discharged into cyclones.

India has a relatively large Asbestos processing industry. Since the entire capacity of all plants could not be determined, the capacities of just some plants are exemplified in Table 28.

In Table 29 the amounts of Asbestos used in different product areas are presented as well as their import and export. Since many products are produced in small plants, which come under the nonorganized or informal

sector of the economy, these amounts can only be treated as estimations.

Table 29: Asbestos Containing Product Groups in India

Product Group	Type of Asbestos	Production (t/a)	Year (%)	Import
Textiles	Chrysotile	1,923	(1998)	100
Cement Products	Chrysotile	674,000	(1992)	100
Friction Lining	Chrysotile	20,000	(1986)	100

Source: own compilation

In India a total of 1,293 tons of chrysotile, 31,728 tons of tremolite and 275 tons of crocidolite were processed in the period between April 1990 and March 1992. It is apparent that in India the main type of Asbestos used is not chrysotile, which is an exception to the introductory statement.

4.4.2 Legislation

India has legal norms as the basis for particular safety regulations and requirements on the mining and processing of Asbestos. These are, in particular:

- Factories Act, 1948 (last revision 1987)
- Model Rules 123 A and Schedule XIV (under the Factories Act)

- Environmental Protection Act, 1986
- SO-594(E) Hazardous Waste Rules, 1989
- Metalliferous Mines Regulations, 1961 (last revision 1988)
- Mines Rules, 1952 (last revision 1989)

The authority making the laws is the Ministry of Labour or the Indian Government. Implementation and supervision of the laws are the responsibility of the Central Labour Institutes or the Regional Labour Institutes, the Chief Inspectorate of Factories, as well as the central and State Pollution Control Boards, whereby measurements are performed by the individual plants, the Inspectorate of Factories as well as the National Institute of Occupational Health.

In the area of Asbestos mining the Metalliferous Mines Regulations and the Mines Rules are to be followed. These norms stipulate a maximum concentration of Asbestos fibers in the air of 2 fibers/ml.

Average measured values in mines lie around 0.5 fibers/ml and are thus below these upper limits. This is achieved through protection measures, such as vacuum exhausting, water rinsing and encapsulation of facilities. In areas with an exceedance of 2 fibers/ml in the air, additional safety measures are necessary, such as respiratory protection and safety clothing. The measurement of the air concentration of Asbestos is performed as a time average measurement with the membrane filter method and phase contrast microscopy (BIS Standard No. lS-11450-1986). Furthermore, a medical

examination is required upon commencement of employment, and regular examinations are needed at least once every 12 months (x-ray diagnosis, testing of lung functions, blood and urine tests). The workers are informed about the dangers of Asbestos at the workplaces. This is performed within discussion rounds, through audio-visual means, brochures in multiple languages and signs. In most plants there is a general no smoking policy. As long as the air limits at the workplaces are not exceeded, no respiratory protection is prescribed, but is typically available at the plants. This is also true for other protective equipment, such as possibilities for changing clothes, showers and exhaust systems.

In processing Asbestos fibers, as in all areas in which Asbestos fibers are used in any form, a maximum air emission of 4 fibers/ml is required by the Environment (Protection) Rules.

Asbestos products must be labeled with the symbol "a" in India.

There is no mandatory abatement for Asbestos containing building substances in India. Since no friable Asbestos products are manufactured directly in India, it is assumed that no dangers are posed by the other uses to justify abatement.

For transport, packaging and storage of Asbestos containing materials, the relevant rules are in the Standard BIS Standard No. 12079 -1987 "Recommendations for Packaging, Transport and Storage of Asbestos". Since only Asbestos products with high densities are produced in India, however, no special measures are applied in practice. Smaller products are first transported

after packaging, and products like Asbestos cement are transported in open trucks.

In India there are no regulations regarding maximum Asbestos fiber concentrations in drinking water.

4.4.3 Research and Development

In India some research projects are being performed on the health risks of Asbestos.

At the Industrial Toxicology Research Centre experimental studies on animals are performed. Cross sectional exams of industrial workers are performed by the Central Labour Institute, the Regional Labour Institutes and the National Institute of Occupational Health.

As for the development of Asbestos substitutes, some industrial plants conduct research, including the development of roof coverings and friction materials. The Industrial Toxicology Research Centre, Lucknow has also published some some work on the hazardous properties of substitutes. The CBRJ is performing investigations on the coating of Asbestos with chemicals to reduce its toxicity.

4.4.4 Substitutes

In India Asbestos containing products are replaced in part by substitutes, as far as this is possible in spite of the elevated costs. The most important

substitutes are listed in the following table.

Table 30: Substitutes for Asbestos Fiber Production in India

Application	Asbestos Fiber - Substitutes	Price
Textiles	woven glass fibers	relatively expensive
Insulation Materials	mineral-/glass wool	comparable with Asbestos products
Cement Products	cellulose fiber cement	
	(limited use)	
Roofing	glass fiber, cellulose, jute	relatively inexpensive
Friction Products	glass fiber (limited use)	relatively inexpensive

Source: own compilation

The technical properties and the weather resistance of these substitutes are typically judged poorer than those of the comparable Asbestos products. This is true for the processing ability as well. Aside from cement substitutes, all products are manufactured within the country.

Furthermore, a number of Asbestos substitutes are in use which are entirely fiber-free. These products are partly manufactured within the country. The most important classes are listed in Table 31.

Table 31: Fiber-free Substitutes for Asbestos Production in India

Application	Fiber-free Substitutes	Price (approx. value)
Insulation Materials	calcium-silicate insulation	no information
Roofing	jute/asphalt	varies
Cement Products	steel, aluminum, cast iron	expensive
Boards/Clay Tiles, etc.	clay tiles	inexpensive

Source: own compilation

The technical properties and the weather resistance of these substitutes are satisfactory to good. The processing ability is difficult in the case of teflon for paper products.

In typical application areas of Asbestos cement, such as water mains or roofing, cement reinforced with cellulose fiber is mainly used today. In special cases of application, the alkali-resistant glass fibers also come into use. For water pipelines the following are also applied: (malleable-) cast iron, galvanized steel, PVC and HDPE. For roof coverings, steel panels or steel pressed panels are used in addition to cement and clay panels (tiles). Cement sheets are also impregnated with bitumen or acrylate protective coatings to become waterproof All of these materials are manufactured in India directly.

The technical suitability of these materials are judged according to special Indian norms. Generally, cement fiber products are classified somewhat poorer in comparison to Asbestos cement with regard to their tensile strength and

impact resistance. Due to the climatic conditions, the low UV-resistance of plastics or plastic reinforced with glass fiber must be taken into consideration.

4.4.5 Risk Philosophy

Asbestos is clearly recognized in India as an environmental risk with a damaging effect on the health of the population. This was demonstrated on the basis of the Environmental-cum -Medical Study, which was performed in the Asbestos mines and Asbestos mills in Pullivendalla in the Cuddapah District of the state of Andrah Pradesh.

In this study, fiber concentrations in the air in mine operations were found to lie below the limit of 2 fibers/ml when wet processes were used. Asbestosis was still determined in about 3.1 % of the workers. In other areas, where these protection measures have not been applied, the fiber concentration in the air was a factor of 2 to 244 higher than the limit value. Correspondingly, in these areas up to 21.3% of the workers had Asbestosis. In this study, the immunological findings could be directly correlated with the development of Asbestosis through elevated Asbestos concentrations in the air.

In order to stop the further expansion of mining activities, the Indian government ordered the individual governments of provinces not to permit the expansion of Asbestos mines any longer. This has led to an increase in the import rate, though, so that the Indian government is currently reconsidering its decision. Stricter legislation on Asbestos is not presently anticipated, since

the corresponding norms have just been revised in the mid to late 1980s.

The use of Asbestos containing materials is currently judged controversial in India. On the one hand, the hazards in handling are clearly recognized and the government recommends avoiding the use of Asbestos as insulation or sealing material and in cement pipes, as long as substitutes are available. On the other hand, there is an enormous demand for cheap building materials, which can apparently only be covered by Asbestos containing products. Health hazards from non-friable Asbestos are not considered significant.

It must also be mentioned that many social housing construction programs are financially supported by the individual governments of provinces, and that in these projects considerable amounts of Asbestos containing roof coverings are being used. Moreover, federal offices are the main requester of Asbestos cement pipes for water mains and sewer projects.

4.5 Israel

4.5.1 General Overview

There is no mining of Asbestos in Israel, and therefore the country is dependent on imports. Currently, the allowable amount of all raw Asbestos types to be imported is 6000 t/a (1991). This raw Asbestos is primarily processed into Asbestos cement and Asbestos products. Several hundred

people work in the Asbestos processing industry, which produces about 60,000 t/a of Asbestos cement products. The production is concentrated at a relatively large factory in Naharija as well as in several smaller plants in various parts of the country.

Aside from Asbestos cement, Asbestos containing paper products, insulation materials and tiles are also used in Israel Asbestos containing friction materials are not manufactured and are not permitted to be imported any longer. Asbestos textiles are also not in use.

4.5.2 Legislation

In Israel there are regulations on the handling of Asbestos containing materials. For instance, there are requirements on the maximum permissible Asbestos imports annually. The import of Asbestos containing friction materials and the use of friable Asbestos is forbidden. For the handling of Asbestos and Asbestos containing products there are special regulations on occupational safety and hygiene, which are oriented along the lines of the international standards. For Asbestos processing, the fiber concentration at the workplace should not exceed the 8h average value of 0.4 fibers/ml (short-term exposure up to a maximum of 2 fibers/ml). Generally, the environmental ministry recommends entirely avoiding the use of Asbestos, however there are not corresponding legislative guidelines to this effect.

4.5.3 Research and Development

Currently in Israel several research projects in the area of occupational medicine are being performed, but there is little available information on them at present. In the past, however, some work on Asbestos problems in Israel has been published.

In the area of development of substitutes, no information on on-going research projects could be obtained. Due to the relatively high level of the material sciences at several universities in the country, it may be assumed that there is some activity in this area.

4.5.4 Substitutes

Basically, the use of substitutes for Asbestos containing materials is supported in Israel.

Israel has a relatively open economy without special import limits on substitutes. Due to international trade implications and the availability of well qualified employees, it may be assumed that in Israel similar substitutes are used as in industrialized countries.

The costs/benefit situation can be judged similar to that already discussed for industrialized countries.

4.5.5 Risk Philosophy

The governing risk philosophy in Israel is largely the same as the

corresponding standpoints of western industrial nations. Since Israeli scientists have a lively exchange of information with research groups of industrialized nations, it is generally guaranteed that the official risk philosophy of western standards are considered. Due to the social and cultural differences, however, it may be assumed that an identical risk philosophy or corresponding consciousness of the problem is not present among all groups of the population.

4.6 South Africa

4.6.1 General Overview

In South Africa Asbestos fibers are both mined and processed. In the area of fiber mining, there are currently about 2,300 workers employed in the underground mines in the two raw material areas Msouli (chrysotile) and Conetsi (crocidolite).

Asbestos mining is very retrograde in South Africa, and numerous mines have given up production in the past 50 years. (Previously, amosite was also mined.)

A large fraction of the mined Asbestos fibers are exported, as shown by the following numbers from 1995:

Table 32: Asbestos Production and Export in South Africa (1991)

	Production	Export
	t/a	t/a
Chrysotile	110,000	100,000
Crocidolite	25,000	23,000

Source: own compilation

The total turnover in this area lies at US $ 43,000,000 per year (1991).

About 7,000 people are employed in the area of fiber processing. Asbestos cement and friction linings are manufactured. Five companies participate in the production of construction materials, pipes and clutch and brake linings. These are situated in Kliprivier, Jacobs, Johannesburg, Rosslyn, Bloemfontein and Brackenfell. About 27,000 tons of fibrous raw material are processed annually, of which 15,000 tons are imported.

The total generated Asbestos cement and friction lining products are used in South Africa itself. An import or export of Asbestos products does not occur.

4.6.2 Legislation

Legal regulations on Asbestos in South Africa have existed in the form of a law stipulating allowable Asbestos concentrations in Asbestos mines since 1956.

(Act 27 of 1956).

As of 1956 a maximum fiber emission of 2 fiber/ml has not been allowed to be exceeded in Asbestos mines in an average 8 hour period. Control measurements show, however, that only 20% of all mines tested had Asbestos fiber concentrations of about 2 fibers/ml and 80% of the mines had below 1 fiber/ml.

To reduce fiber emissions, vacuum systems are applied for grinding work, and moistening techniques are used in underground mining. Additionally, filter units are installed and personal protection (face masks) are used in hazardous situations.

The legal regulations for Asbestos processing prescribe a maximum emission rate of I fiber/ml, which must be achieved through various measures (e.g. wet production, air filtration and vacuum cleaning of production wastes). This is anchored in the law of 1983 (Machinery and Occupational Safety Act (Act 6 of 1983)) and in the Asbestos stipulations of 1987.

If the fiber concentration exceeds the limit of I F/ml, the legislation orders the permanent use of respiratory protection (face masks). Measurements in the plants show, however, that this limit is not reached by far. The fiber concentration lies under 0.3 F/ml for 95% of all companies.

In 1985 the Asbestos industry pleaded with the government for legally prescribed controls, so that every mine and plant would be tested monthly. A

specially developed spot sampling system reduces this to an average of I control per year.

The workers are also specially instructed and must receive particular safety training. The mine workers receive medical exams every 9 months, which is not yet true for factory workers. Smoking continues to be allowed at the workplace, while eating is generally forbidden.

Import of Asbestos products is not subjected to any legal regulations. Further, there is no law forcing abatement in particular cases; only some provisions in the Asbestos regulations govern this area. They order abatement of defect insulation made of sprayed Asbestos in factories or buildings, which has been performed several years ago. The use of sprayed Asbestos is no longer permitted in South Africa.

During transport of Asbestos products, particular handling regulations must be followed, and the product must be labelled appropriately.

In the future, a tightening of the law should occur, which, for instance, would aim at prescribing medical exams for factory workers and a recognition of particular Asbestos-caused illnesses as occupational illnesses.

4.6.3 Research and Development

In South Africa relatively many research projects have been (are being) performed, which either investigate the health impact of Asbestos or are

concerned with the development of substitute substances.

The first type of projects have been performed in the mining sector by the national office for occupational illnesses and in the processing sector by the national health agency. They are concerned primarily with the occurring illness symptoms and the death rates. Ten cases of mesothelioma were reported for 1990 and about 1980 cases of mesothelioma were reported for the period between 1956 and 1990. Around 190 patients were suffering from Asbestosis. The research results showed that mainly people over 30 years old were endangered or became ill, which is due to the relatively long latent period.

The increase of the death rate in the past years was 20% for Asbestosis and 100% for mesothelioma, which could have been induced statistically by the increased supervision. It has not been considered necessary to perform drinking water investigations in South Africa, since no health hazard is considered to be posed by the oral intake of Asbestos fibers.

4.6.4 Substitutes

As already mentioned, the Asbestos industry induced numerous projects concerning research on fiber-containing substitutes. For instance, in the cement area cellulose fibers were used in thin fleeces, and although these fibers are available in the country, they are about 25% more expensive to acquire. The production is more complicated than that of Asbestos cement products, but the processing of the new materials is easier. The technical

properties and the weather resistance or long lifetimes are classified as comparable to those of Asbestos cement products, according to the research results. In the area of friction lining, materials such as steel, fiber glass, Kevlar and polyacrylnitrile replace Asbestos. These materials are generally more expensive than Asbestos, and because of their technical suitability, they are used only for light vehicles.

In the area of roofing in South Africa, fiber-free substitutes are applied which are much more expensive, such as steel, concrete and glass reinforced plastic, depending on the particular building structure. Straw is still the traditional roofing material, but is not a real rival for Asbestos material.

In drinking water mains and pipelines, the same fiber-free materials and plastic pipes are used, which are also locally available, but more expensive than Asbestos cement products.

Table 33 illustrates the advantages and disadvantages of the fiber-free substitutes used in water mains construction.

Table 33: Fiber-free Substitutes in Water Mains in South Africa

Material	**Advantages/Disadvantages**
Steel	corroded complicated to move, more expensive
PVC/ HDPE	questionable life span, more expensive
Concrete	difficult to transport and to move more expensive

Source: own compilation

The use of the above-listed materials is often considered, however, Asbestos cement products are the less expensive products with regards to installation, maintenance and price.

In housing construction, the fiber-free substitutes listed in Table 34 are used, which have the following advantages and disadvantages.

Table 34: Fiber-free Substitutes in Housing Construction in South Africa

Material	Advantages/Disadvantages
Steel Rails	locally produced easy to process
Concrete Boards	simple technology easy to process

Source: own compilation

In this area as well, Asbestos cement products are considered the longest lived materials, which are not locally available, but are very often needed to be used for technical reasons.

4.6.5 Risk Philosophy

The main future goal regarding the Asbestos problem is to reduce the health risk of Asbestos and to reinstate production at closed Asbestos mines.

Eventually, one wants to further reduce the limits for the release of Asbestos fibers, but not in the area of Asbestos mining, where the values are already very low.

Individual protest groups are demanding a total prohibition of Asbestos. This demand is not in accordance with the future plans. The use of Asbestos should also be further reduced, as has already happened in the past few years. The government is not going to stop the typical use of Asbestos materials in public buildings, such as school, etc..

Asbestos fiber release into drinking water from Asbestos pipes is not considered dangerous in South Africa.

4.7 Tunisia

4.7.1 General Overview

Information on Asbestos in Tunesia is relatively hard to obtain. This is partly because different official positions are responsible for this matter, and their cooperation with eachother is currently limited.

Another reason is that the topic of Asbestos is not given special attention. In Tunesia Asbestos is classified as every other building material, without consideration of its potential dangers.

Asbestos is not produced in Tunesia. In 1991 about 7,000 t Asbestos were imported - primarily crocidolite and chrysotile. The imported fibers are processed into products such as Asbestos cement, insulation material or brake linings in 20 plants, which employ around 650 workers. The plants are between 5 and 30 years old and generally use out-dated production methods, compared to the western state of technology.

4.7.2 Legislation

In Tunesia there is currently no legal regulations on the use of Asbestos.

The National Institute for Norms and Private Possession (INNOPRI) has only developed an industrial norm which refers to the health problems in handling Asbestos (NT 36.11). In 13 other industrial norms Asbestos is treated as a conventional building material (NT 21.12, NT 21.20, NT 21.47 through NT 21.49, NT 21.51 through NT 21.55). Furthermore, Tunesia has a general Occupational Protection Ordinance (Ordinance N=68.328 from 22 October, 1968), under which the Asbestos subject could perhaps be (indirectly) addressed.

Due to the lack of legal norms, there are neither limits for the handling of Asbestos nor corresponding federal supervision in this area.

4.7.3 Research and Development

One study on the health risks of handling Asbestos was recently performed in

Tunesia by the uppermost health authority (Institut Superieure de Sante et Travaille, lSST) as commissioned by the Social Ministry. This study was due to be completed in January 1994, and will be published by ISST.

ISST has also initiated the founding of a "continual Asbestos committee." The members of this committee meet monthly to discuss and coordinate the research activities of ISST.

No information could be received on the private initiatives concerning research and development in the area of Asbestos substitutes. It is presumed that there are currently no such activities in this sector.

4.7.4 Substitutes

There are no activities in Tunesia on the direct substitution of Asbestos products due to their health risks. Asbestos substitutes are therefore only used, if they have corresponding cost advantages in manufacturing or application. For example, plastic pipes or simple cement pipes for water mains and bitumen sheets for roof coverings could be named. These substitutes can largely be manufactured within the country.

4.7.5 Risk Philosophy

In Tunesia neither the authorities nor private industries have a special awareness of the problems related to Asbestos.

Neither Asbestosis nor mesothelioma are recognized as occupational illnesses. Correspondingly, no worker's compensation is paid.

The only exception is the intiative of the ISST. According to this institute, after the conclusion of their study study, the following measures should be instigated: an import prohibition for crocidolite; the performance of air measurements; and the ratification of ILO Guideline No. 162 by the parliament. These should also be accompanied by measures such as medical supervision programs and employee training.

How such measures are to be performed is still largely unclear. They fall under the responsibility of the Health Ministry, the Social Ministry and the Economics Ministry.

In Tunesia there are currently no laboratory capacities for Asbestos air measurements. It is expected that corresponding measuring programs will be performed by the Social Ministry.

4.8 USA

The national consumption and production of Asbestos fibers have drastically dropped in the USA over the past few years. In 1991 about 34,000 tons were processed, compared to 84,000 tons in 1987. Asbestos fibers are mined in different mines in the USA. Among the largest are KCAC Inc. San Benito County, California and Vermont Asbestos Group, Vermont. The national production currently lies around 15,500 tons/a (1992). The main production is of

chrysotile, which is mined in underground mines. About 70 people (in 1992) currently work in the area of Asbestos mines and mills. The total turnover was around 6.1 million U.S.$ in 1991. The USA imported about 34,000 tons of raw Asbestos from Canada and South Africa in 1991. The main application areas for Asbestos fibers are shown in Table 35.

In 1991 the USA exported about 25,600 tons of Asbestos fibers and exported Asbestos containing products with a total value of 116 million U.S. $. Among the top purchasing countries are Canada, Japan, Mexico and Great Britain. In Table 36 the export gains are shown according to product group.

Table 35: Use of Asbestos Fibers in the USA

Area of Use	Chrysotile Fibers	Crocidolite (consumption, 1991 (tons))
Asbestos cement pipes	3,400	300
Asbestos cement boards	1,600	-
Coatings	800	-
Friction materials	9,500	-
Packaging materials		
Gaskets	2,900	-
Paper products	<<1,000	-
Synthetic materials	<<1,000	-

Roofing	15,100	-
venous	600	-
_ (Chrysotile + Crocidolite)	34,000	

Source: own compilation

Table 36: US - Export Gains from Asbestos Containing Products (1991)

Product Groups	**Export Gains (US$)**
Asbestos fibers (special fibers)	772,000
Brake lining and disks	86,980,000
Clutch lining and disks	6,637,000
Textiles. woven materials, yam	724,000
Gaskets and packaging	6,841,000
Sheets, coverings, pipes (Asbestos cement as well as cellulose fiber cement)	4,651,000
Paper products etc.	1,155,000
Various	8,254,000
Total	116,015,000

Source: own compilation

4.8.2 Legislation

The legislation in the USA has already been discussed in Chapter 2.3, Part II and in Annex 4. There are strict regulations regarding Asbestos uses, abatement and disposal. Asbestos is recognized as a hazardous substance in the air and water, as proven by numerous research results. There are prescribed limits, which are listed in Part 11, Chapter 2.3 for air contamination. In the water the limit according to the current state of knowledge is 7 million fibers/l. Numerous states and cities have implaced even stricter guidelines.

The Asbestos legislation of the USA is mainly determined by two federal agencies: "Environmental Protection Agency (EPA)" and "Occupational Safety and Health Administration (OSHA)." The EPA is the federal environmental agency; OSHA formulates and implements occupational protection measures.

- **EPA**

The regulations of the EPA refer to

- **Use and removal of (Asbestos containing material) Asbestos material in new buildings or remodeled buildings**
- **Identification of Asbestos in public buildings (schools) and control of fiber emission**
- **Industrial Asbestos fiber emissions**

The first regulations of the EPA on Asbestos originate from 1973. They were passed in the frame of the NESHAP-Program (National Emission Standards for Hazardous Air Pollutants), which was directly addressed to the Asbestos processing industry and forbade the use of sprayed Asbestos in new buildings. Furthermore, measures in handling Asbestos during abatement were formulated. This legislation has been updated several times and modified (1975,1978, 1990). Currently the use of sprayed Asbestos is also forbidden in connection with renovation and remodeling, and rules and limits exist for the disposal of Asbestos containing materials.

The second legal regulation of the EPA falls under the "Toxic Substances Control Act (TSCA)", which can be compared to the German Hazardous Substances Ordinance and is the main legal reference source for the control of Asbestos in the USA. The Ordinance 40 CFR, Part 763 or AHERA 1987, "Final rules and notice (Friable Asbestos Containing Materials in School)" refer to Asbestos in schools and implaced very restrictive rules. They include in particular the regular supervision and analysis of friable Asbestos fibers, the documentation of all suspected ACM and results and the information of the affected public.

The maximum permitted Asbestos fiber concentration in the air, according to the AHERA-Ordinance, is dependent on the size of the critical area:

(1) For an area of the target area of less than 160 ft^2 or with a length of less than 260 ft, the limit is 0.01 F/cm^3 (F=fibers). The analysis must be performed

according to NIOSH 7400. At least 5 samples must be analyzed.

(2) The documentation of successful abatement using removal of ACM proceeds in 3 steps: visual inspection, renewed sampling of the air in the problem area and the ambient air, and microscopic determination of the fiber concentrations.

- **OSHA**

The OSHA-Laws apply to occupational safety in all workplaces which have contact with hazardous substances. Hence, they also apply to Asbestos. Their application is limited to only the industrial area. The goal of the formulation of the OSHA-rules on Asbestos was health protection, particularly against the already known risks Asbestosis, mesotholioma and cancer primarily due to inhalation of Asbestos fibers into the lungs.

The first regulations under OSHA were implemented in 1972 and were modified in 1976 and 1986. They specified limits for fiber concentrations in the air at workplaces for the employees in the Asbestos industry, in addition to control mechanisms, medical exams (preventive care), workplace practices and necessary protective clothing for workers.

OSHA refers to the so-called TWA (= time weighted average), meaning that the allowable concentrations depend on the period of exposure. Different time periods were referenced in the legislature, whereby the 8-hour cycle is the most important, since it matches the length of shifts.

The most important rules and limits are as follows:

(1) PEL = permissible exposure limit 0.2 F/cm³ for a weighted average over 8 hours

This value of 0.2 F/cm³ for a fiber length of > 5 ym was fixed in 1986 by the amendment 29 CFR 1926.58 and represents a significant reduction of the former limits.

(2) Above 0.1 F/cm³ for a weighted average over 8 hours there are specific health and safety measures to be undertaken.

These include primarily particular protective clothing, but also obligatory instructions and training measures as well as medical exams.

A summary of the development in the U.S. federal legislation on Asbestos is presented in Annex 4.

4.8.3 Research and Development

In the USA numerous research projects have been performed in the past few years in all areas of the Asbestos subject. Corresponding reports and review articles are continually being published, so that technical literature can be referred to at this point.

Regarding the research situation in the area of medicine and occupational

medicine, it can generally be stated that in the past years a particular polarization of the main opinions has resulted and thereby also a polarization of the research contents. On the one hand, the opinion is supported that primarily amphibole Asbestos represents a health danger, while no special danger for the health is posed by chrysotile, which is currently nearly the only used form. Another group near the Mt. Sinai Hospital considers the intake of any kind of Asbestos fibers as health damaging, and judges Asbestos to be a hazard for the well-being of the general public.

Since a large fraction of all research programs in the USA are financed by private institutes, including lobby groups, economic interests also play a role in the evaluation of the research.

The US-environmental authorities recently presented a 4 million-U.S.$-study, which summarized the current state of knowledge in the form of a literature review of all important research results (Asbestos in Public and Commercial Buildingss: A Literature Review and Synthesis of Current Knowledge). This study is being controversially discussed in specialized circles.

In the area of development of substitutes, a great number of research programs are being performed, which are spurred by the increasingly strict regulations in handling Asbestos. These research studies are financed by both the public sector and private enterprises.

4.8.4 Substitutes

Due to the legal requirements, considerable efforts have been undertaken by the American industry in the past few years to substitute Asbestos containing products with environmentally safer alternatives. The most typical substitutes are listed in Table 37.

The substitutes for Asbestos containing materials listed in Table 37 are available from national production. Regarding the processing ability and the technical properties, the evaluations presented in Part 111 are applicable.

Table 37: Substitutes for Asbestos Containing Materials in the USA

Area of Application	Substitutes	Price in Comparison to Asbestos Containing Materials
Textiles	glass fibers, ceramic fibers,carbon	expensive
	fibers, aramide fibers, PBI-fibers	expensive
Paper. cardboard	fiber glass, ceramic fibers,	expensive
Insulation materials	calcium silicate, cement	inexpensive
Packaging	fiber glass, plant fibers	expensive
Gasket materials	carbon fibers, aramide fibers,	expensive
	PBI fibers, PTFE-fibers	expensive
	graphite	comparable
	cellulose	varies

	mica	inexpensive
Cement products	calcium silicate	inexpensive
	cellulose	varies
	mineral wool, fiber glass	expensive
	ceramic fibers	expensive
	wrought iron piping	expensive
	PVC piping	varies
	Vinyl or aluminum reinforcements	no information
Facade coverings	calcium silicate,	inexpensive
	cellulose,	varies
	fiber glass, mineral wool,	expensive
	ceramic fibers	expensive
	PVC corrugated board	varies
	vinyl or aluminum sheets	no information
Paints,	cellulose	no information
Coating materials	PE, PP fibers	no information
	fiber glass, ceramic fibers	expensive
	clay, french chalk, silicious calcite	inexpensive
	calcium carbonate	inexpensive
	silica gel	varies

Roofing	fiber glass, slate fibers, metal sheets	expensive
	cellulose	varies
	wooden shingles, plain tiles	no information
Friction materials	aramide fibers, ceramic fibers,	expensive
	franklinite fibers	
	fiber glass	expensive
	cellulose	varies
	all metal (disk brakes)	no information
Tiles, floors, etc.	french chalk, clay, mica	inexpensive
	silicious calcite	comparable

PE - Polythene, PP - Polypropylene, PBI - Polybenzimidazol, PTFE - Polytetrafluoro ethylene

Source: own compilation

4.8.5 Risk Philosophy

The potential hazard of Asbestos containing material has been clearly recognized in the USA. This is evident from the relevant laws, ordinances and industrial norms, as well as from the number of research projects and studies.

The risk philosophy in the USA concerning Asbestos can currently be considered exemplary and has the best and most advanced state worldwide. The authorities pay attention to the obeyance of the safety regulations through extensive control measurements.

In the future a further strictening of the Asbestos laws is expected at federal level. Already, corresponding norms exist in part at state or municipal level.

5 Summary

5.1 Economic Implication

As already mentioned in the introduction, the Asbestos subject is not a specific problem of the developing countries. As can be seen in Figure 6, however, in 1991 more than 75% of the world production of Asbestos was mined in developing or verging countries or especially in the states of the former Soviet Union. Therefore, Asbestos production represents a significant source of income at least for some developing countries.

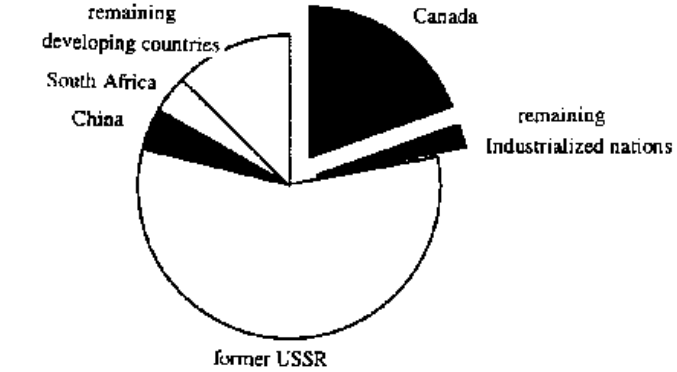

Figure 6: Worldwide Asbestos Production 1991

Source Asbestos - 1991, USA

From a political perspective on employment, however, Asbestos mining should not be an important factor either in the developing countries or in the industrialized countries, because of the low number of workers in this sector.

As for the processing of Asbestos, it may be presumed that in the industrialized countries Asbestos will soon be pushed out of its areas of application. In contrast, it is expected that in the developing and verging countries, particularly China and the countries formed from the former USSR, the trend to use Asbestos will continue for a long time. This is due to the fact that the necessary financial means to apply substitutes are not available, and the positive product characteristics of Asbestos are of primary importance. Since the processing of Asbestos products in developing countries is largely

performed in small operations, which are often active in the informal sector of the economy, it may be assumed, that safety measures are only used to a very small extent. Another dilemma is the insufficient accessibility of statistical data, which hardly allows the country's own government to properly evaluate the Asbestos problem.

5.2 Legislation

The legislation relevant to Asbestos is more developed in the industrialized countries than in the developing countries. With the example of Tunis, it was shown that in developing countries in some cases no legal norms of any kind exist. Furthermore, it is to be expected that such legal norms, where they exist, are not always obeyed to the desirable extent in developing countries.

5.3 Research and Development

The different interests of industrialized nations and developing countries in the Asbestos matter are documented in the corresponding number of research and development studies. In the industrialized countries, numerous projects are currently being performed, which are concerned both with the health hazards of Asbestos and with the development of substitutes.

5.4 Substitutes

For almost all areas of application of Asbestos, substitutes are currently available. Since in industrial nations an average of 15 years are necessary to

develop a product from laboratory scale to the marketing stage, it can be assumed that Asbestos will be pushed out of all areas by substitutes in a few years.

In developing countries product introduction cycles are much longer and hard to predict. The currently only limited use of substitutes will therefore continue in the near future. This is especially to be expected, because substitutes are almost without exception developed in industrialized countries, and consequently the need for imports would exist at least temporarily. The know-how transfer to self-sufficient production of substitutes in the developing countries is very difficult and hindered by rivaling interests.

5.5 Risk philosophy

The inhalative intake of Asbestos fibers is now viewed worldwide as a grave health risk. In many countries there are limits for the maximum permissible fiber exposures, as a consequence of the experiences made with Asbestos. For particular types of Asbestos, particularly amphibole Asbestos (with crocidolite and amosite as the most hazardous forms), there is a general prohibition of manufacturing and use. In some countries these limitations on manufacturing and use are expected to be applied to all Asbestos forms, whereby some countries like the USA play an exemplary role.

With regard to the oral intake of Asbestos fibers and the resulting hazard, there is no clarity at present. Limits are implaced only in a few countries.

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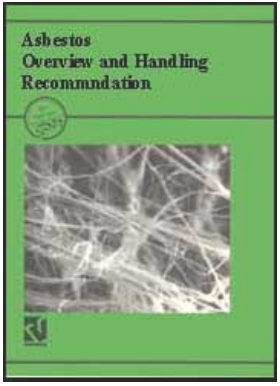

Asbestos Overview and Handling Recommendations (GTZ, 1996)

Part V Development of handling recommendations

- 1. Introduction.
- 2 Overview of rules of other donor organizations and financial institutions on the management of Asbestos problems
  - *(introduction...)*
  - 2.1 World bank
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  - 2.3 European bank for reconstruction and development (EBRD), London
  - 2.4 European investment bank (EIB)
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  - 2.6 Asian development bank Bangkok (ADB) - no guidelines
  - 2.7 African development bank, Nairobi

Asbestos Overview and Handling Recommendations (GTZ, 1996)

Part V Development of handling recommendations

1. Introduction.

Since Asbestos has repeatedly been the focus of discussion over the past few years because of its significantly high health risk, it is of particular importance for donor organizations and financial institutions to develop stringent work instructions and handling principles on the managing of the Asbestos matter, e.g. in the frame of development projects.

2 Overview of rules of other donor organizations and financial institutions on the management of Asbestos problems

In the first subsection below, the rules and procedures of other national and international donor organizations are presented and summarized. The information obtained is based on a specially conceived questionnaire, which was sent to the respective institutions.

2.1 World bank

The guidelines of the World Bank refer mainly to occupational protection in the manufacturing and processing of Asbestos, and contain recommendations on the quantitative determination of the concentration of Asbestos fibers in air.

In 1983 the Office for Environmental Affairs of the World Bank issued health and safety guidelines for mining and milling of Asbestos (Asbestos - Mining and Milling - Occupational Health and Safety Guidelines.)

These guidelines include:

a) control of emissions during mining of Asbestos,
b) control of emissions during the manufacturing of Asbestos;
c) exposure limits:
maximum of 2 x 10(6) Asbestos fibers over 5 ym in length per m^3, 8 hour average value (referral is also made to the OSHA (US Occupational Health and Safety Agency) limit of 10^5 Asbestos fibers per m^3 over 5 km in length),
d) administrative measures;
e) protective clothing and respiratory protection equipment;
f) occupational medical examinations;
g) regular training;
h) data on accidents and cases of illness.

The guidelines and recommendations of the World Bank on the handling of Asbestos in the processing industry, issued in 1984, include:

a) limits at the workplace for Asbestos fibers in the air: maximum of 2 fibers per cm^3 > 5 μm;
b) training, in particular recommendation for a prohibition of smoking;
c) handling with protective clothing;
d) regular medical examinations.

For the determination of Asbestos fiber concentrations in the air, the guidelines of the World Bank from 1983 recommend contrast microscopy methods, which should be supplemented with electron microscopic investigations to identify and quantify the Asbestos fibers.

According to the presented results, projects on mining of Asbestos have not been financed in the past. Due to the generally recognized health hazards, the World Bank currently does not support the processing or use of Asbestos materials. This handling recommendation is compared with a risk estimation in individual cases, however. This means that projects are judged very reservedly, if Asbestos will be used under the hazard of fiber release.

In the end, however, the individual case is considered and judged on the basis of the danger estimation (single case decision). If there are deviations from general rules, the respective project manager has the jurisdiction to make a decision on financing based on criteria such as the availability of alternatives and the extent of the expected health hazard. The burden of proof lies with the applicant, who must prove that no economically sensible alternatives are possible.

If risk analyses are available, which are based on consideration of toxicity and emissions enabling the development of an investment portfolio, the additional costs for alternatives can also be calculated. The project managers are generally obligated to use such studies or to check their availability.

The Bank does not force the demolition of existing Asbestos containing building materials. This is particularly true when friable Asbestos is present. This is due to the extensive health hazards associated with Asbestos abatement in developing countries, which generally have a low standard of occupational protection measures. The Bank does not support the renewal of existing Asbestos cement drinking water pipes, since the risk of oral intake is considered low compared to the inhalative intake.

The World Bank supports the financing of projects in the following areas:

- Control and avoidance of health hazards from Asbestos
- Risk minimizing measures in existing Asbestos containing buildings, including their maintenance
- Safe disposal of Asbestos containing products
- Education and training with regard to safety measures.

2.2 International Asbestos association (IAA), Paris

According to the IAA, the existing IAA guidelines on Asbestos are only for internal use. There is no information which is available to the general public.

2.3 European bank for reconstruction and development (EBRD), London

The European Bank for Reconstruction and Development (EBRD) does not have any special guidelines on Asbestos. This refers to the handling of Asbestos containing products and the use in building construction. Consequently, corresponding financing questions are individually judged. The procedure of the Bank can be described as follows:

In the frame of environmental audits, Asbestos is judged to be a special risk factor. Environmental audits serve to determine the environmental situation of a room (e.g. of an industrial facility) and an evaluation of facilities with regard to the applicable environmental regulations, as well as to estimate environmentally relevant consequences of the planned investments. Environmental audits are demanded by the EBRD as the basic prerequisite for project financing. For these audits there is an EBRD check list which covers Asbestos explicitly, in addition to other subjects.

For example, with building projects it is tested whether non-friable or friable Asbestos is present. Subsequently, the use of alternative materials is discussed in consideration of the costs.

Due to its young age, the EBRD has apparently not had any special experience with financing projects involving Asbestos. If such a case would arise, a strategic decision would immediately be made based on the special case. Here the single case decision is also emphasized.

2.4 European investment bank (EIB)

The health hazards from inhalation of Asbestos fibers and the oral intake of Asbestos are considered by the EIB as a risk potential present worldwide. On the other hand, the Bank judges the existing scientific investigations on the causal relationship between a particular pathological symptom and measured Asbestos exposure with great reserve. However, it is assumed that in the foreseeable future detailed studies will exist, upon which the handling guidelines can be developed.

On the part of the EIB, particular developments in the area of health protection are criticized, which have led to market distortions due to different evaluation of the Asbestos topic in different countries. It is therefore recommended as top priority to develop evaluation criteria under consideration of the required time and the financing power of the respective countries and industries.

The current financing politics of the EIB can be outlined as follows:

It is aimed to not support the growth of future Asbestos markets, but rather to reduce these markets. Therefore, in the future no financing should be provided to projects in Asbestos mining or processing of Asbestos containing materials. Every use of Asbestos should be operated under strictly controlled conditions, and, as a prerequisite, no blue Asbestos (crocidolite) should be used.

Furthermore, the Bank supports research in the area of the development of substitutes. The goal is to soon promote the use of alternative products. With

all environmental problems, the Bank follows the respective European and national legal norms.

2.5 International bank for reconstruction and development (IBRD)

Here, too, there are no direct guidelines for the handling of Asbestos. However, organizational structures exist, which consider the environmental risk estimation, comparable to that described above for EBRD.

The IBRD expects the project applicant to perform the necessary environmental studies. In special cases, financial and technical support is provided for the performance of these studies. Based on the check list of the IBRD, a detailed account of the environmental situation is performed. Asbestos is not explicitly listed in this check list, however.

2.6 Asian development bank Bangkok (ADB) - no guidelines

The ADB does not currently finance any large projects involving Asbestos. There are no corresponding guidelines. Therefore, a single case decision may be anticipated here as well.

2.7 African development bank, Nairobi

There are no guidelines.

2.8 UNEP - United Notions Environmental Program, Washington

Here there are no explicit regulations on the handling of Asbestos. However, UNEP is mainly concerned with the coordination and supervision of environmental projections of the United Nations. Consequently, the UNEP directs more through program related impulses than through project work. No formal procedures for environmental compatability are required for UNEP projects.

3 Risk philosophy

From the previous section, it is apparent that formal elements of risk limitation from the use of Asbestos are either not present or only partly present for other organizations.

Generally, Asbestos is viewed as a hazardous and health impairing substance. Consequently, further use of Asbestos and Asbestos containing materials should not be supported, nor their mining or production. The development of substitutes should be given greater attention.

A risk estimation and resulting strategic guidelines in questions of project financing are only present in cases of exception. Concrete statements and strategic guidelines for handling Asbestos could not be obtained for questions of project financing and performance. Instead, the individual institutes emphasize a case-related risk evaluation, upon which single case decisions are based.

In questions of risk estimation, the potential release and inhalative intake of

Asbestos fibers is generally judged to be very critical. The oral intake is only considered by the World Bank to represent a health risk.

4 Design of a catalogue of recommendations on the management of Asbestos in plans for joint developmental/political projects

A catalogue of recommendations for the handling and management of the Asbestos problem by donor organizations cannot be built upon the experiences of others, but rather it must be derived on the basis of the necessities in handling Asbestos containing substances.

A general recommendation is:

Avoidance of use of Asbestos containing products, in particular of amphibole Asbestos friable Asbestos materials

This general principle can be further specified through criteria:

It is recommended to generally forbid the mining and further processing of the particularly hazardous Asbestos types, namely crocidolite and amosite. In some cases, however, economic restrictions can be derived from this policy for specific countries (e.g. for southern Africa, the most important mining region for crocidolite and amosite). Furthermore, only non-friable Asbestos products should be allowed to be produced.

For each application area, specific substitution possibilities should be

examined, and the use of Asbestos and Asbestos containing products should only appear justifiable in cases in which a suitable substitution is not feasible (insufficient technical properties, lack of availability, uneconomic use of substitutes, etc.), and in which the resulting health hazards can be calculated. This must be determined on a single case basis using estimations of the hazards. However, general recommendations can be given, such as: Asbestos containing materials should not be used in clinics, schools and kindergartens; mechanical wear or subsequent machining of the surfaces of Asbestos containing products should be avoided. Further limitations for application are presented below.

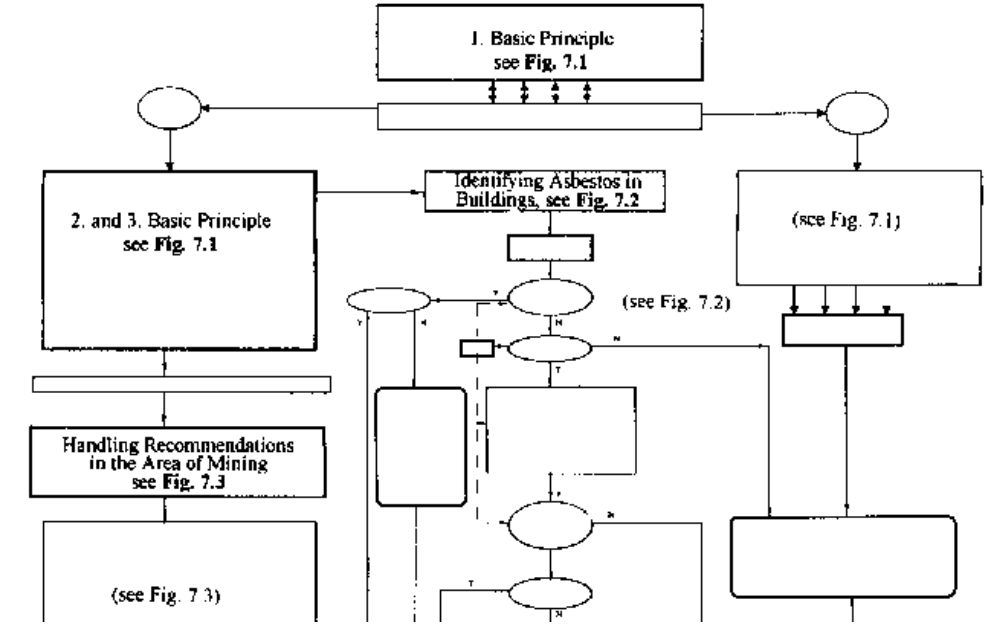
Since it is typically to be assumed that in DC Asbestos containing materials will be or have been processed, the next recommendation is to minimize the health hazards associated with contact of Asbestos containing products. Included here are e.g. measures to reduce fiber release, as described in detail in Part 11, Chapter 5, and personal occupational protection equipment. The attainment of the limit for Asbestos fiber concentrations of < 2 fibers/ml must be required. A correct labelling of Asbestos containing materials with "a" should be prescribed worldwide.

There is a worldwide consensus concerning the grave hazard resulting from inhalative intake of Asbestos fibers over a long period.

The health hazards from exposure to Asbestos fibers must be monitored. The affected groups of people must be informed about the dangers, and regular

medical exams should be performed. Eating and smoking should generally be forbidden at the workplace.

In the following section more elements are presented for risk minimization or handling alternatives through restrictions in the implementation of the basic principle. The individual steps of the life cycle of Asbestos containing products are considered, and limitations for application are presented as well as recommendations in case of use.



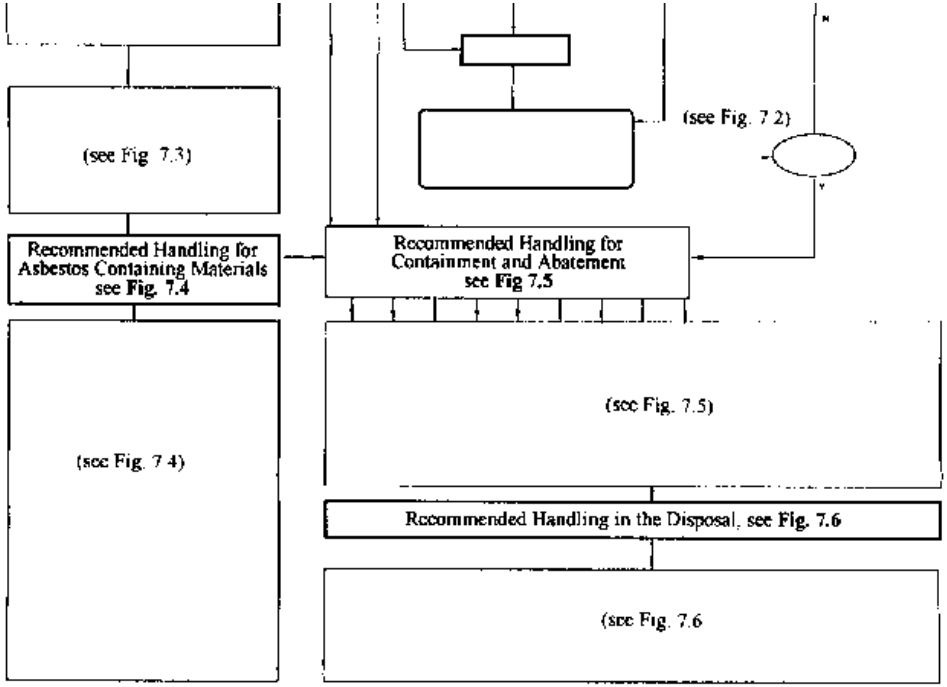


Figure 7: Catalogue on Recommendations for Dealing with Asbestos (overview)

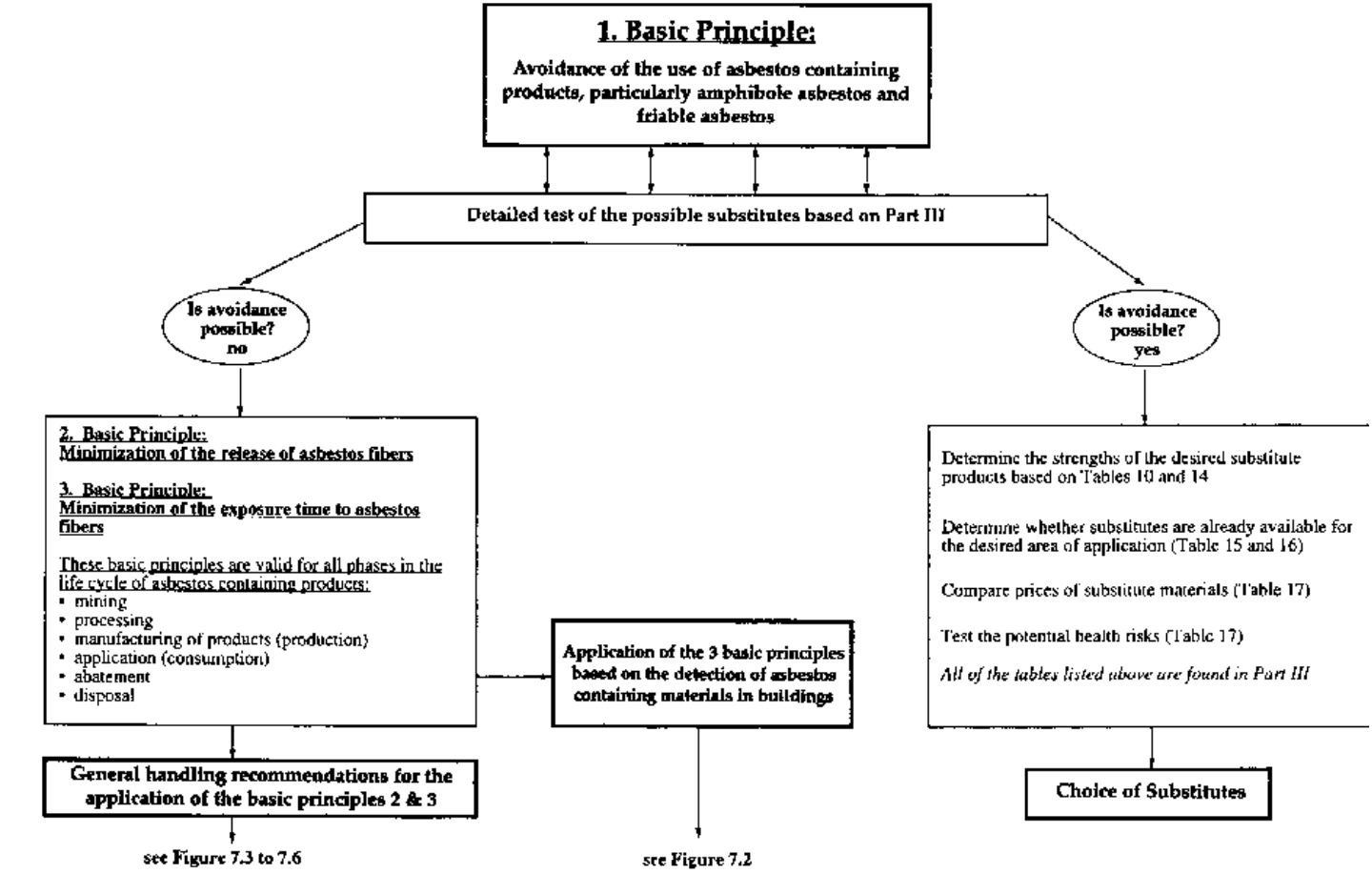
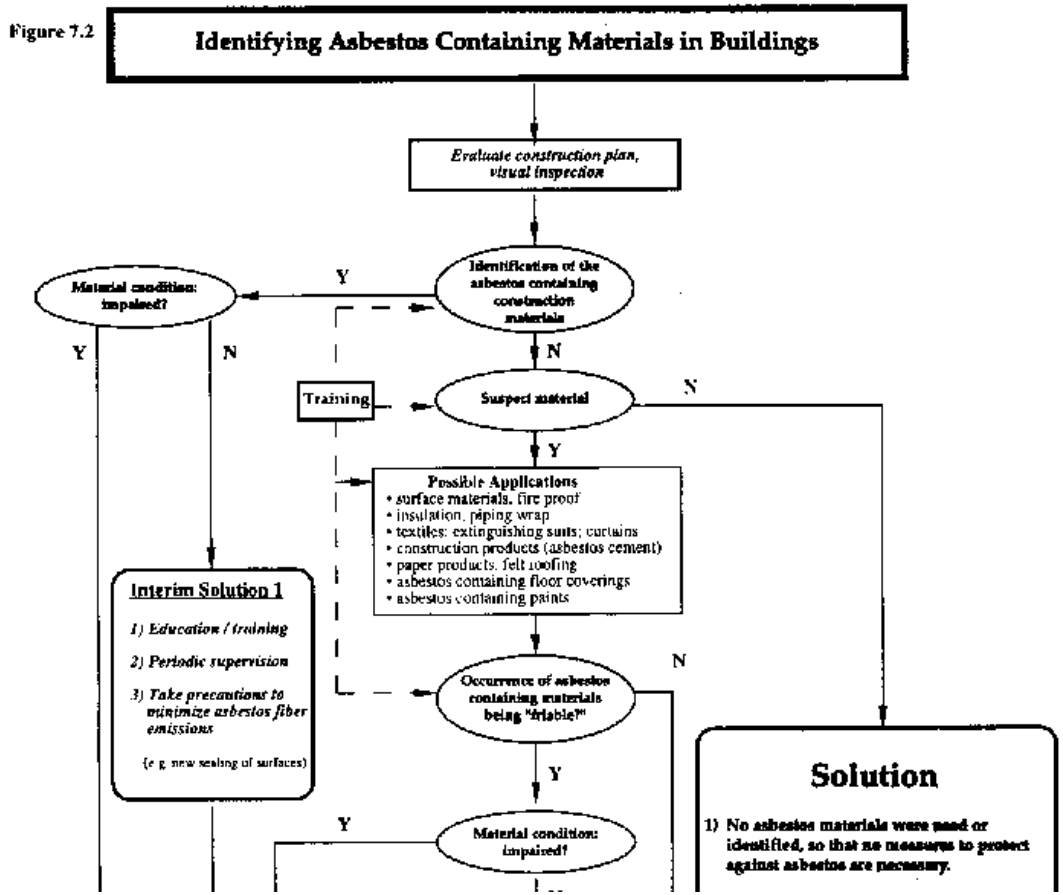

1. Basic Principle:
Avoidance of the use of asbestos containing products, particularly amphibole asbestos and friable asbestos
Detailed test of the possible substitutes based on Part III
Is avoidance possible? no
Is avoidance possible? yes
2. Basic Principle:
Minimization of the release of asbestos fibers
3. Basic Principle:
Minimization of the exposure time to asbestos fibers
These basic principles are valid for all phases in the life cycle of asbestos containing products:
• mining
• processing
• manufacturing of products (production)
• application (consumption)
• abatement
• disposal
Application of the 3 basic principles based on the detection of asbestos containing materials in buildings
Determine the strengths of the desired substitute products based on Tables 10 and 14
Determine whether substitutes are already available for the desired area of application (Table 15 and 16)
Compare prices of substitute materials (Table 17)
Test the potential health risks (Table 17)
All of the tables listed above are found in Part III
General handling recommendations for the application of the basic principles 2 & 3
Choice of Substitutes
see Figure 7.3 to 7.6
see Figure 7.2

Figure 7.1: Illustration of the 3 Basic Principles



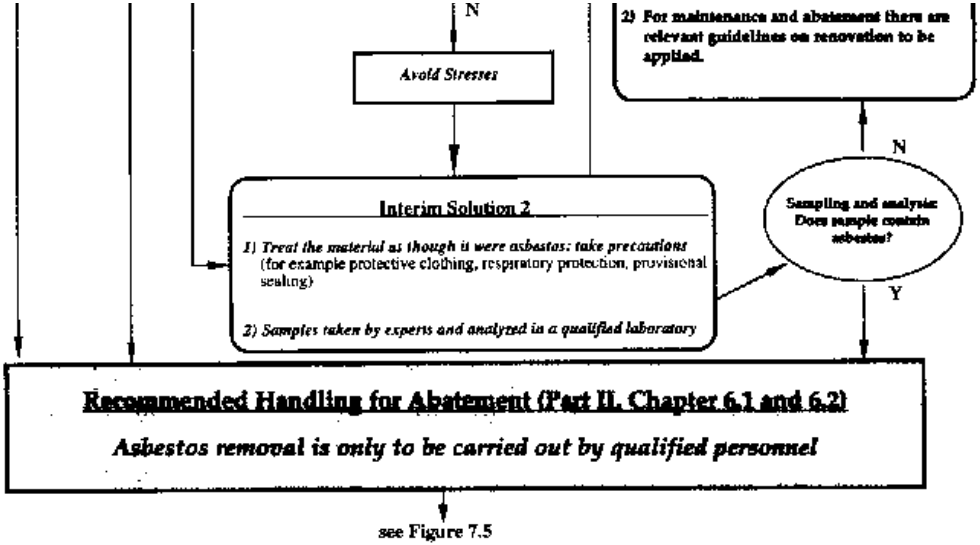


Figure 7.2

Recommended Handling for the Use of Asbestos Containing Materials end products

Control of the use of Asbestos containing products in regard to:
- **state (e.g. condition of surface) and**
- **resulting emission response / fiber releases**

(for control: training / education required)

Generally valid:

1) All Asbestos containing materials to be used must be labelled and the possible health risks pointed out.

2) During the installation of Asbestos containing materials it must be ensured that no subsequent mechanical processing on site will be necessary.

Application Recommendations / Application Limitations:

The use of Asbestos containing materials could result in health effects and is therefore not recommended. Based on the particular situation of the developing countries (availability of minerals, material properties of Asbestos, limited financial resources, etc.), an evaluation could justify the use of Asbestos containing materials in some limited cases.

Examples of controlled risks are:

1) Pre-fabricated and pre-drilled nonfriable erosion resistant Asbestos cement products for building exteriors (facades, roofs) (depending on climate conditions);

2) Asbestos cement products for drinking water mains / wastewater sewers;

3) Pre-fabricated and pre-drilled nonfriable Asbestos cement products for interior coverings (surface sealing and supervision of the fiber concentration

needed, use in schools, kindergartens and clinics is problematic);

4) Asbestos textiles for selected uses and not for long-term application (in particular for fire protection & fire fighting) necessary to control health risks;

5) Asbestos fiber containing sealed floor coverings (not in clinics, schools, and kindergartens);

6) Pre-fabricated and pre-drilled nonfriable covering for insulating purposes (particulary in schools, kindergartens, etc., further surface sealing are necessary), e.g. heat insulation boards;

7) Asbestos containing products within closed insulated components (e.g. disk brake lining and clutches); (special danger for maintenance work).

Recommended Handling for Containment and Abatement of Asbestos

General Basis Principle:

Asbestos removal and securement measures are only to be carried out by qualified personnel following the available measures for guaranteeing a minimal Asbestos release.

Implementation of the Necessary Measures for Asbestos Abatement

Changes and repairs are to be carried out with the best possible locally

available dismantling & removal techniques based on the following recommended guidelines:

1) With large Asbestos abatement projects no other measures are allowed to be carried out in the area;

2) During abatement, detected loosely bound fiber materials are to be handled like Asbestos containing material, until a corresponding analysis disproves that assumption;

3) The planning and execution of the work is to be contracted to licensed and qualified firms;

4) Various securement and abatement techniques could be applied for nonfriable Asbestos containing materials (see Part II, Chapter. 6);

-a- separation / enclosure of the contaminated zone;
-b- encapsulate, as far as technically possible;
-c- removal of the Asbestos containing materials, provided -a- and/or -b- are inadequate;

5) Also smaller projects of Asbestos removal should only be tackled, when it is guaranteed, that no release of Asbestos fibers in other areas will result;

6) Keeping the surface area moist for the minimization of the release of Asbestos fibers;

7) Protective clothing and respiratory protection with special filters are required;

8) General smoking and eating prohibition in the securement and abatement zone;

9) Disposal of the Asbestos containing materials following relevant guidelines.

(Detailed explanations to these points are found in Part 11, Chapter 6.1)

Recommended Handling for the Disposal of Asbestos and Asbestos Containing Materials

General Basic Principle:

Asbestos and Asbestos containing materials and products are only to be deposited at licensed landfills.

Recommended Minimal Disposal Guidelines for Asbestos Containing Dismantled Products and Waste Products

In general, for the disposal of Asbestos the emissions of dust and fibers should approach zero. Special attention should be given to the fact that transportation containers (such as sacks, etc.) can be damaged through rips.

Further minimal requirements should comprise the following:

1) Wastes or dismantled products should always be transported in appropriate containers;

2) The containers should be properly sealed to minimize the dust and fiber emissions arising while being handled;

3) Preferably, the containers should be disposed of at the base of a landfill, in holes or trenches;

4) In the course of disposal, Asbestos containing wastes (nonfriable Asbestos) should not be broken down or pressed;

5) At the end of each workday at the landfill, Asbestos containing wastes should never be left uncovered, and the minimal cover should be 2 meters.

(Detailed explanations to these points are found in Part 11, Chapter 6.2)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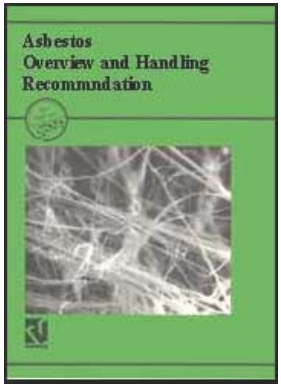
Asbestos Overview and Handling Recommendations (GTZ, 1996)

(introduction...)

Acknowledgments

Preface



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