2 HISTORICAL BACKGROUND TO THE USE OF ASBESTOS

2.1 INTRODUCTION

Asbestos is a collective term for a group of naturally occurring fibrous silicates that are incombustible and separable into filaments: chrysotile (white asbestos), amosite (brown asbestos, cummingtonite, grunnerite), crocidolite (blue asbestos), anthophyllite, tremolite and actinolite[1]. Only the first three have widespread commercial use. In its natural state, asbestos occurs throughout much of the planet. It is found in two-thirds of the rocks in the earth's crust.

The ancient Greeks first used chrysotile asbestos over two thousand years ago as wicks for oil-lamps and it was they who gave us the word asbestos, meaning "everlasting" or "non-extinguishable"[2]. There is evidence that it was used even earlier - some four thousand years ago - for strengthening clay pots in Finland. This non-flammable quality led ancient Greeks to manufacture asbestos lamp wicks.

The Romans mined asbestos and left us with both non-flammable cremation cloths and records of an illness among slaves who may have worked with asbestos[3]. During the middle Ages, manuscripts in Europe mentioned diseases common to miners, but there was no mention of asbestos. A small asbestos textile industry developed in Russia during the time of Peter the Great (1675-1725) but asbestos use remained negligible until the time of the Industrial Revolution.

The commercial exploitation of asbestos fibre in modem times occurred in the latter part of the 19th century, when experiments were successfully carried out in producing asbestos thread, which was woven to form asbestos cloth – important for thermal insulation and protective clothing.

At the same time asbestos-cement building materials were being developed, thereby exploiting the reinforcement properties of the fibre in combination with cement. These developments led to the widespread introduction of manufacturing facilities for asbestos-cement corrugated and flat sheets, and high pressure pipes, together with a wide range of associated products. Subsequently other applications of asbestos fibre were developed to include friction materials, jointing and packing and electrical insulation. In total, there are over 3 000 recorded different uses for asbestos.

2.2 ASBESTOS MINERALS

Asbestos minerals may be broadly divided into two groups, namely: amphibole asbestos and serpentine asbestos[1].

2.2.1 Amphibole Asbestos

Amphibole asbestos, which has a chain-like crystalline structure, comprises of mainly crocidolite (or blue asbestos) as well as amosite, tremolite, anthophyllite and actinolite. Because of their chemical structure and straight, needle like fibres, amphiboles are very dusty, as well as highly biopersistent. In some countries, and for some special applications, the amphiboles continue to be used:

- **Crocidolite** is the strongest of the asbestos fibres. It has high tensile strength and acid resistance. Long-fibre crocidolite is woven into fabrics used for boiler lagging, acid-resistant packing and gaskets. Historically the principal use of the shorter crocidolite fibres was in the manufacture of asbestos-cement products, although this is no longer the case.

- **Amosite** is highly resistant to heat and quite flexible, but may be susceptible to strong acids and alkalis. It has less tensile strength than chrysotile or crocidolite and has only fair spinnability. Amosite asbestos has the longest fibre lengths. Its resistance to acids and seawater is greater than that of chrysotile, and it fuses at a much higher temperature than crocidolite. It is, however, somewhat more brittle. It is used in blanket form for felted insulation for high temperature applications. In compacted form it is applied as a covering for marine turbines, jet engines and similar applications.

2.2.2 Serpentine Asbestos

Serpentine asbestos has a leafy or layered structure and is represented by chrysotile (also known as white asbestos), the most common serpentine fibre. Silky in texture, with curly fibres, serpentine asbestos is unlikely to remain suspended in the air.

- **Chrysotile** currently accounts for more than 98% of world asbestos consumption. Its fibres are characterised by high tensile strength, resistance to alkalis, high flexibility and good spinnability. Chrysotile's tensile strength and resistance to heat make it suitable for spinning and weaving and as counteraction to heat and fires. It is mainly used for asbestos textiles, friction linings and facings, asbestos cement and insulation products

2.3 GLOBAL ASBESTOS DEPOSITS

Asbestos is a naturally occurring mineral fibre commercially available in most parts of the world. Supply is fairly diversified. Thus there is no strategic dependency on a single supply. Table 2 reflects worldwide reserves of asbestos[4].

TABLE 2: WORLDWIDE ASBESTOS RESERVES

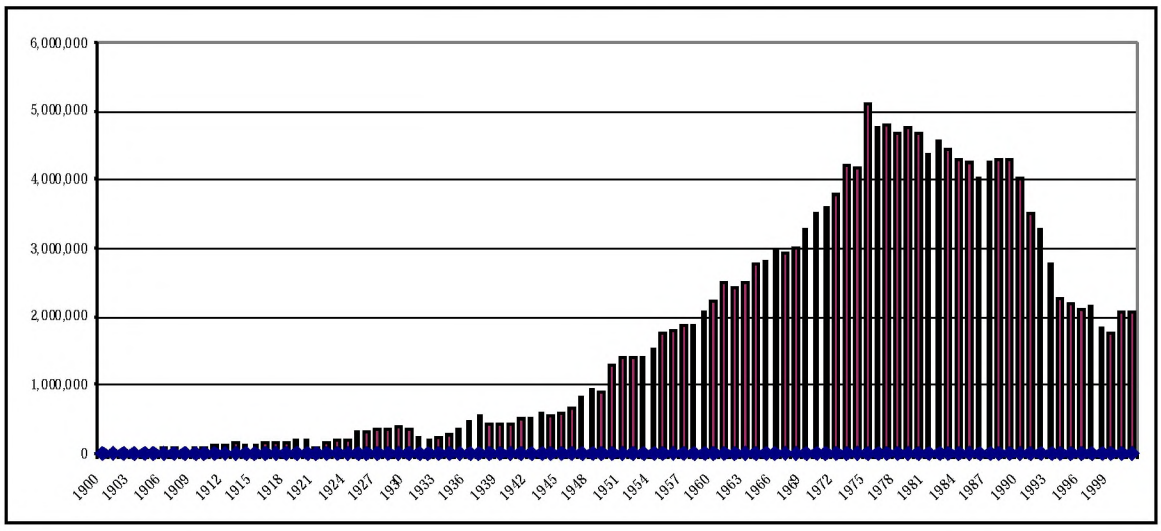
COUNTRY	TYPE OF ASBESTOS	RESERVE BASE
Canada	Chrysotile	47 million tons
South Africa	Chrysotile Amosite Crocidolite	8.2 million tons
USA	Chrysotile	Large
China	Chrysotile	Large
CIS	Chrysotile	Large
Brazil	Chrysotile	Moderate
Zimbabwe	Chrysotile	Moderate
Others	Chrysotile Amosite Anthophllite	Large

Unfortunately, this source does not provide a definition of "large" versus "moderate" deposits, therefore, it is difficult to assess into which category South Africa's deposits fall. However, the fact that South Africa has deposits of all three major types of asbestos confirms that it has been an important international source of asbestos.

2.4 ASBESTOS PRODUCING COUNTRIES

Figure 1 reflects an estimate of world asbestos mining production for the twentieth century[5].

FIGURE 1: WORLD ASBESTOS MINING PRODUCTION – 1900 TO 2001



This figure indicates that asbestos mining production peaked at 5 million tons in 1975 and has steadily declined to the current levels of approximately 2 million tons in 2000 and 2001.

Table 3 reflects a schedule of asbestos producing countries[5], with their production levels for the 1996 to 2000 period.

TABLE 3: ASBESTOS PRODUCING COUNTRIES

	1996	1997	1998	1999	2000	2000 CONTRIBUTION
Argentina	446	400	380	350	350	0.02%
Brazil	170,000	170,000	170,000	170,000	170,000	8.75%
Bulgaria	400	300	300	350	350	0.02%
Canada	506,000	455,000	309,000	337,366	340,000	20.05%
China	293,000	288,000	314,000	247,000	260,000	14.44%
Egypt	1,836	2,000	2,000	2,000	2,000	0.10%
Greece	80,213	80,000	70,000	60,000	50,000	3.50%
India	23,215	25,051	18,751	20,000	21,000	1.11%
Iran	4,500	4,300	2,258	2,000	2,000	0.16%
Japan	18,000	18,000	18,000	18,000	18,000	0.93%
Kazakhstan	128,700	125,000	125,000	125,000	125,000	6.47%
Russia	615,000	710,000	600,000	675,000	750,000	34.50%
Serbia and Montenegro	509	360	633	361	550	0.02%
South Africa	57,120	49,986	27,195	18,700	18,909	1.77%
Swaziland	26,014	25,888	27,693	28,000	25,000	1.37%
Zimbabwe	165,494	144,959	123,295	115,000	110,000	6.78%
TOTAL	**2,090,447**	**2,099,244**	**1,808,505**	**1,819,127**	**1,893,159**	

These figures indicate that Russia, Canada, China, Brazil and Zimbabwe are the worlds largest asbestos mining countries and account for almost 85% of world supply.

2.5 ASBESTOS EXPORTING COUNTRIES

Table 4 reflects a schedule of asbestos exporting countries, ranked according to volume of 1998 exports[4], the latest date for which these statistics are available.

TABLE 4: ASBESTOS EXPORTING COUNTRIES

COUNTRY	1998	% OF PRODUCTION EXPORTED
Canada	295, 000	95%
Zimbabwe	117, 000	95%
USSR /Russia	99, 000	17%
Brazil	63, 000	35%
South Africa	25, 000	95%
China	14, 000	4.5%
Kazakhstan	5, 000	4%

As would be expected, the largest mining countries are also the largest exporting countries.

2.6 ASBESTOS CONSUMING COUNTRIES

Table 5 reflects a schedule of asbestos-consuming countries, ranked according to their 1994 consumption levels, the latest date for which these statistics are available[3].

TABLE 5: WORLDWIDE ASBESTOS CONSUMPTION

	1994	
CIS	700,000	34.6%
China	220,000	10.9%
Japan	195,000	9.6%
Brazil	190,000	9.4%
Thailand	164,000	8.1%
India	123,000	6.1%
South Korea	85,000	4.2%
Iran	65,000	3.2%
France	44,000	2.2%
Indonesia	43,000	2.1%
Mexico	38,000	1.9%
Colombia	30,000	1.5%
Spain	29,000	1.4%
USA	29,000	1.4%
Turkey	25,000	1.2%
Malaysia	21,000	1.0%
South Africa	20,000	1.0%
TOTAL	2,021,000	

These statistics indicate that, even at this relatively recent stage, South Africa was already one of the smallest international consumers of asbestos.

2.7 PROPERTIES OF ASBESTOS

The most important properties exhibited by asbestos, and which account for its widespread use in a broad range of asbestos-containing products include[3]:

- Tensile strength
- Resistance to high and low temperatures
- Fire, friction and acid resistance
- Chemical resistance - particularly to cement alkalinity
- Dielectrical resistance
- Resistance to bacteria, fungi, etc.
- Weather proofing, and
- Compatibility with cement as a binder

The mining and processing of asbestos and its use in manufactured products constitutes a billion dollar industry. Asbestos has been acclaimed for its heat, friction and acid-resistant properties. However, most asbestos is used as a cheap reinforcement agent: more than 70% of asbestos is used for reinforcing asbestos-cement in construction projects[1].

2.8 ASBESTOS CONTAINING MATERIALS

Up until the 1970s, some 3,000 products were made with asbestos fibres of all types. These included toasters, dryers, ironing boards and low-density friable insulation products. Today, some sixty countries still use asbestos, but only the chrysotile variety and primarily in cement building materials such as roofing materials, cladding and pipe.

In a modern context, there are four common applications for asbestos[1]:

- **Asbestos Cement**

  Chrysotile asbestos is used in asbestos cement as it has good reinforcing properties. Products are mainly in the form of profile sheets and slates. 90% of the world production of chrysotile is used in the manufacture of chrysotile-cement, in the form of pipes, sheets and slates. Asbestos-cement is valued principally for its excellent cost effectiveness and durability.

- **Friction Materials**

  Chrysotile asbestos has been used in friction materials because it is durable and resistant to heat and oil. Friction products represent about 7% of the chrysotile fibre used today.

- **Seals and Gaskets**

  The main uses are in:

  - Packing and seals - braided and laminated packing, proofed asbestos cloths and tapes, and moulded gland packing used to seal openings in a variety of industrial applications

- Gaskets - compressed asbestos fibre in a mixture of natural or synthetic rubber compounds that are used to seal joints in a variety of piping and pumps that transport liquids and gasses

- **Insulation Materials**

  The main chrysotile asbestos textiles are woven tapes, welting, cloths and yarns. Composites are generally asbestos fibre or cloth impregnated with resin and then formed into sheets, tubes, rods or shaped mouldings. These are used as insulation materials for temperature control purposes in a variety of industrial applications

2.9 CATEGORIES OF ASBESTOS-CONTAINING PRODUCTS

Table 6 categorises asbestos-containing products according to the density of their asbestos content.

TABLE 6: CATEGORIES OF ASBESTOS-CONTAINING PRODUCTS

	LOW-DENSITY PRODUCTS	HIGH DENSITY PRODUCTS
Density	> 20% asbestos content	< 20% asbestos content
Types of Asbestos	Amphibole (until ± 1980) Serpentine	Amphibole (until ± 1980) Serpentine
Friability	Friable (When dry can be crumbled, pulverised or reduced to powder by hand pressure)	Non friable
Applications	• Insulation • Temperature control • Fire protection • Noise control • Ornamental fittings	• Reinforcement • Friction Resistance
Products	• Textiles • Packings • Braided Packings	• Asbestos-Cement Products: • Profiled sheets • Slates • Pipes • Moulded goods (containers etc.) • Brake Pads • Clutch Plates • Gaskets • Valve Stem Seals

This table indicates that most of the modern applications of asbestos are in high-density products where the risk of exposure to asbestos fibres is lower.