

C: NATURAL FIBRES OF MINERAL ORIGIN

ASBESTOS

Asbestos is one of the strangest of all the naturally occurring fibres. It is a rock which has been subjected to unusual treatment during its formation. Instead of crystallizing in the normal way, it has done so in the form of fibres. These are all packed tightly together alongside each other, giving a grainy structure to the rock, resembling wood. Asbestos is non-inflammable and heat resisting.

Asbestos has been known and used as a textile since the earliest times. The lamps of the vestal virgins are supposed to have had wicks made from asbestos, and a lamp made for Minerva 'had a wick made of Carpasian linen, the only linen which is not consumed by fire'. This linen was made from asbestos mined in Cyprus.

The Chinese used asbestos to make false sleeves which could be cleaned by putting them in the fire. All the dirt was burnt off, leaving the asbestos clean. The Emperor Charlemagne is alleged to have owned a tablecloth of asbestos which he threw on to the fire after a meal, to the consternation and amazement of his guests. When Charlemagne was being threatened by Harun-al-Raschid and his hordes, he put his tablecloth to excellent use by performing his trick before the ambassadors of the fierce Emperor of the East. They were convinced that Charlemagne was a wizard, and recommended to Harun-al-Raschid that the impending war should be called off. So asbestos had an early influence on the history of the world.

In 1684, we hear of an asbestos handkerchief being demonstrated before the Royal Society of London. And after the discovery of asbestos in Russia between 1710 and 1720, a factory was established for the manufacture of asbestos textiles, socks and gloves. This industry continued for half a century.

Benjamin Franklin brought back a purse from Canada in 1724, made from asbestos spun and woven by the Indians. The deposits of asbestos in Canada were discovered in 1860; since then Canada has become a most important source of the fibre.

Today, asbestos is the raw material of an impressive industry, with the fibre serving in many invaluable ways.

PRODUCTION AND PROCESSING

Asbestos is the name given to several natural minerals which occur in a fibrous crystalline form. There are three important minerals of this type:

- (a) Anthophyllite
- (b) Amphibole
- (c) Serpentine

A. Anthophyllite

This is a magnesium-iron silicate which occurs in some districts in the form of thin plates or fibres. It is not of great importance as a source of commercial asbestos.

B. Amphibole

There are several important varieties of this mineral:

(1) *Tremolite* is a calcium magnesium silicate which occurs as greyish masses of brittle, fibrous crystals.

(2) *Actinolite* is an iron calcium magnesium silicate which occurs as greenish masses of fibrous crystals.

(3) *Crocidolite* (Blue Asbestos; Amosite) is a iron sodium silicate which occurs as long flexible fibres of bluish colour, and with a characteristic silky lustre. The fibres are 7.5–10cm (3–4 in). Crocidolite has a higher tensile strength than other asbestos fibres, but is not so resistant to high temperatures as chrysotile.

(4) *Mountain Leather* (Mountain Cork) is found in the form of leathery sheets or masses of matted fibres.

(5) *Amphibole Asbestos* (Horneblende Asbestos) is found as fine fibrous crystals, usually of greenish colour.

C. Serpentine

This is a hydrated silicate of magnesium which occurs in two fibrous forms:

(1) *Chrysotile* is found as narrow veins in serpentine rock. It is of green to brown colour, and is separated easily into fine silky fibres. This material provides the major part of the world's supply of asbestos.

(2) *Picrolite* is found as fibrous masses in serpentine rock. The fibrous crystals may be 33–36cm (13–14 in). They are inflexible and difficult to separate without breaking.

The bulk of the asbestos used today comes from Canada, South Africa, Rhodesia and Russia. Canada produces more than two-thirds of the total supply.

Opening

The compressed mass of fibrous crystals forming raw asbestos is given a preliminary crushing as the first stage of the opening process. A rotating wheel and pan crusher may be used, great care being taken to avoid undue breakage of the brittle fibres.

From the crusher, the asbestos passes through further opening machines, generally of the toothed roller type. Dirt and powdered rock are removed by means of grids. When the fibrous mass has been opened thoroughly, it may be blended with cotton or other fibres before passing to the carding machine.

Carding

Asbestos fibre is carded by combing with rotating brushes covered with steel bristles. Short fibres and impurities are removed, and the longer asbestos fibres are delivered as a loose web or sheet of fibre. As it leaves the carding machine, the sheet is split into narrow ribbons or rovings, which are wound onto spools.

Spinning

Asbestos rovings are spun on conventional spinning frames (ring or flyer). Doubling is commonly used to increase the uniformity of the yarn.

Asbestos may be mixed with other fibres before spinning, and yarns may also be spun round cores of cotton, glass, nylon, metal wire and other materials.

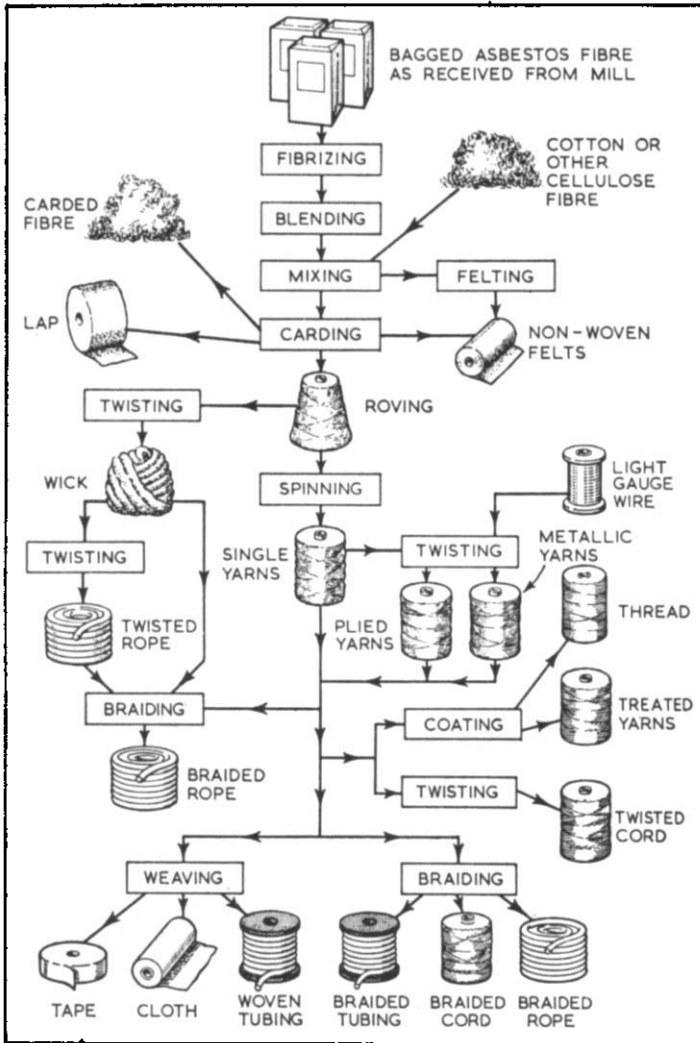
Short asbestos fibres may be spun by first beating them with water, and then feeding the pulp into a paper machine. A thin sheet of asbestos paper is formed, which is dried and cut into strips which are twisted into yarn.

STRUCTURE AND PROPERTIES

Fine Structure and Appearance

The fibrous crystals of commercial asbestos are 12–300mm ($\frac{1}{2}$ –12 in) or more in length. They have a smooth, regular surface resembling that of a glass fibre. They are usually near-circular or polygonal in cross-section.

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Asbestos Fibre Flow Chart - After Asbestos Textile Institute

HANDBOOK OF TEXTILE FIBRES

There is virtually no limit to the fineness of asbestos fibres; the crystals may be subdivided until they are so fine that they cannot be seen through the optical microscope. The molecules of asbestos minerals are arranged in the form of curved sheets which build up into cylindrical structures or tubes. The fibrous crystal of asbestos is made up of many of these tubular structures held together by a mass of crystalline material. The tubes will separate easily one from another, enabling the fibrous crystals to be split into finer and finer fibres.

Other Properties

The outstanding property of all commercial asbestos fibres is their resistance to heat and burning. They are also highly resistant to acids, alkalis and most common chemicals.

Asbestos does not deteriorate in normal use, and it is not attacked by micro-organisms or insects.

ASBESTOS IN USE

Asbestos yarn is durable but has little strength. It is woven into tapes, cloth, brake linings, gaskets and twine. The main applications are those in which its resistance to heat and burning are all-important, such as conveyor belting for hot materials, industrial packings and gaskets, fireproof clothing, theatre curtains and scenery, electrical windings and installation.