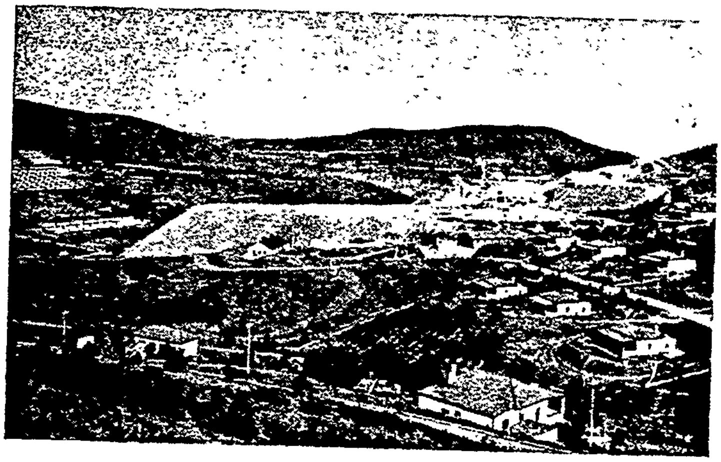
PLAINTIFF'S EXHIBIT
tabbies
JMMC-306

RECOVERY OF RAW ASBESTOS

At The Havelock Mine



By Roland Starkey M. Inst. M. M. Consulting Engineer,
and Staff of African Associated Mines, Limited

Reprinted from May 1947 "ASBESTOS"
Philadelphia, Pa.

RECOVERY OF RAW ASBESTOS

Methods Used at Havelock Mine

By Roland Starkey M. Inst. M. M. Consulting Engineer, and Staff of African Associated Mines, Limited

Production of chrysotile asbestos from the Havelock Mine began in June, 1939 and the milling methods adopted were the result of a considerable amount of experience and research by technicians of Turner & Newall, Ltd., both from their mines in Africa and from their factories in the United Kingdom.

The Havelock Mine is situated in Swaziland a few miles over the Eastern border of the Transvaal. It is owned by New Amianthus Mines, Ltd., a subsidiary company of Turner & Newall, Ltd., of Rochdale, England.

About one quarter of the ore delivered to the mill bins is derived from opencast quarrying operations and the remaining three quarters is broken in underground sub-level caving stopes.

The first operation in the mill is of sizing and hand sorting. The rate of flow from the mill bins is 110 tons per hour and a rotating ring grizzley gives a +4 inch product; the "throughs" pass to trommels clad with steel punched-plate with circular holes of 2½ inch diameter. Fibre bearing rock present in the +4 inch, and —4 inch +2½ inch products, is picked off sorting conveyor belts by hand and the remaining barren waste rock is disposed of forthwith via waste bin and dump haulage. This sorting operation yields a product known as Hand Cobbed Fibre constituting approximately 3% of the original feed; the coarse waste discard to dump amounts to 50%.

The —2½ inch product from trommelling contains moisture varying from 4% to a maximum of 33%, the average content being from 8% to 9%, and before further treatment can take place it is necessary to arrange to dry this material. A type of tower dryer has been evolved, designed to remove excess moisture without subjecting the asbestos to severe overheating or to undue mechanical attrition, both of which would tend to destroy the delicate fibres. The tower dryer is essentially a vertical shell 40 feet high and 6 feet in diameter containing a system of baffles. The moist ore showers down the dryer from top to bottom against the flow of hot furnace gases from a thermostatically-controlled, automatic coal-fired stoker. The contained moisture in the discharge is approximately 2 to 3% and the temperature 180° F.

A further trommelling process now separates the —½ inch element of the dried material, the + ½ inch —2½ inch element being presented in a uniform stream to vacuum air separating nozzles causing the loose fibre to be removed and deposited in a form of cyclone settler. The loose fibre recovered at this stage amounts to 2% of the original feed, while the —½ inch material constitutes 22%. This leaves 23% of the original feed in the form of +½ inch —2½ inch material, which is reduced to a 3 ft. short head Symons cone crusher. The loose fibre just referred to and the hand cobbed fibre previously noted receive separate treatment in order to preserve the long fibres present in the original ore. Drying of these two materials is completed in a steam dryer consisting of successive floors of pivotable steel plates along which steam pipes are conducted. The drying takes place on these floors, the material being passed from one floor to the next below at appropriate intervals of time, a thoro turning over being effected at each transfer.

From this point onwards the fibre recovery process consists essentially of a series of stage crushings followed by screening and vacuum air separation of the released fibre. The initial reduction of the lumps of hand cobbed fibre is by means of a 16" x 10" jaw crusher and subsequent crushings are in pan rolls. This crushing machine

comprises two edge runners revolving in an annular dished pan which rotates in a horizontal plane. The crushing takes place between the edge runners, which together weigh 4000 pounds, and the pan which rotates at 35 r. p. m., the crushed material being discharged by means of a suitably arranged scraper. This type of crusher has been found to be very effective in separating fibre from containing rock without damaging the fibre down to limiting particle sizes of from .05 inch to .10 inch. The screening apparatus consists of inclined trommels of 3 feet diameter and 7′6″ length, clad with wire screening cloth, the clear aperture being reduced at each successive crushing stage. The free fibre in the end discharge of these trommels passes over a reciprocating light sheet metal table to a revolving screen. At an appropriate distance, to effect separation of loose fibre from rock and grit, is located the usual vacuum nozzle thru which the fibre is lifted and subsequently deposited in cyclone settlers of the centrifugal type. Pan rolls crushing, screening, and air separation process is applied also to the —½ inch material and the crushed product from the Symons cone crusher.

As a result of these processes two types of material are segregated, (a) fibrous products from cyclone settlers, known as concentrates, and (b) sized gritty materials from 0.10 inch to 0.03 inch particles size, some of which are sent to waste dump and the remainder have sufficient fibre content to warrant further milling.

Dealing first with the concentrates, which are only roughly classified in respect of average fibre length and which contain a proportion of fine dust, it is necessary to provide a screening (trommelling) plant in which there is a much more searching classification into fibre length groups and a practically complete elimination of fine dust. The result is classified fibre in four grades. The next process has a two-fold object, (a) to eliminate fractures in the individual strands of fibre, and (b) to eliminate the hard bundles or faggots of fibre aggregates. The former purpose ensures that the marketable product shall have true fibre lengths between predetermined limits and the latter secures a product of uniform texture. Previous attempts to achieve these aims were generally incompletely successful because of the difficulty in providing a selective treatment whereby fibres already opened up and free from fractures were not subjected to further treatment tending to destroy the fibre altogether. The principle of the machine now in use involves two elements, first an absolutely uniform feed at a predetermined rate, and secondly, introduction of this uniform layer of fibre into a swiftly moving air stream which passes thru a series of streamlined chambers in each of which revolves a horizontal shaft at high speed. The shafts are provided with a large number of beater arms, ½ inch in diameter, radially thru the shaft and projecting about 4½ inches on each side of the shaft. The direction of rotation of the shaft is opposed to the flow of the fibre-air stream. Fibre particles impinge upon these rods and the force of the blow is naturally proportional to the mass of the fibre aggregate. The light elements of opened fibre pass on unmolested, whereas the more compact bundles receive sharp blows which open them and at the same time break down fractured elements into true unfractured strands of fibre. After passage thru these conditioning machines the asbestos is removed from the air stream in the usual cyclone settler and passes thru trommels clad with the appropriate screening to eliminate short length fibre resulting from the conditioning process just described. The discharge from the trommels (plus product) is bagged in 10 ounce hessian bags containing 125 lbs. net asbestos weight under registered marks HVL/2 (spinning grade), HVL/3, 4 and 5 (shingle grades).

In the preliminary stages noted above, mention was made of gritty elements containing sufficient fibre to justify further treatment. Recovery from these materials is effected in a type of conditioning machine in which the rate of flow is regulated to achieve separation of fibre

from adhering waste rock particles—a concentrate results which is incorporated in the flow in the same way as concentrates from other sources.

Finer elements still—down to 0.03 inch particle size—are subjected to a screening process in which a gyratory action is imparted to the horizontal screening surface giving selective treatment to the fibrous elements, opening them up and enabling the vacuum separating action to become operative. The limit to which the ultimate fibre recovery can be pursued is, of course, an economic one in which factors of cost of crushing and treatment have to be offset against net revenue from the salable product after making allowances for transport charges to the customer.

The rate of marketable asbestos production is approximately 26,000 tons per annum.

This article is a companion (or supplement) to Milling Asbestos by J. C. Kelleher, which was published in "ASBESTOS" during 1945 and is also available in reprint form (at 25c per copy).

Printed in U. S. A.

Price - 15c per copy

COPY FORM	INITIALS	DATE

BOX NUMBER	SEGMENT NO.	REQUESTING PARTY
04-1950		

NOTES

Australian Blue

1964