FILE NAME: Asbestos Sacks and Bags (ASB)

DATE: 1966 Aug 18

DOC#: ASB099

DOCUMENT DESCRIPTION: Unpublished Report - Discharge of Asbestos in Bags in the London Docks

270

doesn't say how sampling + analysis were done - low nos.

THE DISCHARGE OF ASBESTOS IN BAGS IN THE LONDON DOCKS

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Report

The Ocean Shipowners' Group Joint Committee,
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Attention Mr. Bennett.

August 18th, 1966.

THE DISCHARGE OF ASBESTOS IN BAGS IN THE LONDON DOCKS

INTRODUCTION

At your request we have examined problems associated with the discharge of asbestos in the London Docks.

Asbestos dust has been recognised for a number of years as presenting a health hazard. Prolonged exposure results in a medical condition known as asbestosis, which is generally akin to silicosis. Recently there has been some evidence to suggest that in rare circumstances it may also be a causative agent in bronchial carcinoma.

The purpose of our investigation was to survey the conditions under which asbestos is discharged with a view to determining the dust hazard to stevedores handling this cargo (and any other dock workers suffering significant exposure.) Our report must be based on currently accepted legal and medical recommendations dealing with the problem of exposure to asbestos dust. The purely medical aspects of this problem are outside the scope of the report.

Asbestos is a fibrous mineral of a siliceous type. Its actual composition varies with the type and source. It is basically found in two main forms:

(1) Chrysolite (white) asbestos

This form is made up of fibres which are believed to be hollow and may be as small as 0.02 microns in diameter. The principle sources of this material are Canada, Russia and Rhodesia.

(2) Amphibole asbestos

This form is made up from larger solid fibres of minimum diameter 0.1 microns. The principle sources are South Africa, Australia and Bolivia.

In the United Kingdom the only regulations in force at present covering exposure to asbestos dust are the Asbestos Industry Regulations which are contained in Statutory Rules and Orders 1931, No. 1140, are are in pursuance of Section 79 of the Factory and Workshop Act 1901.

These rules refer only to factories and workshops where asbestos is used or prepared for use in industrial processes.

Two classes of operation are covered. Thus the regulations "apply only to a limited extent" when asbestos is used in sawing, grinding, turning, abrading and polishing, as long as the work is carried out only occasionally and no person is employed for more than eight hours in any week.

Otherwise adequate exhaust and inlet ventilation must be provided so as to prevent the escape of asbestos dust into any room in which persons work. In addition breathing apparatus must be provided for every person employed.

Other provisions in the Act cover the necessity for the provision of special overalls and head coverings for specific applications using asbestos.

It seems from past literature that asbestos is not generally considered a hazard unless there is prolonged exposure over a number of years. There are instances, however, of definite asbestosis where exposure to the dust has been for a period of less than six months. We have found no references to dock workers suffering from asbestosis.

The majority of investigational work covering harmful levels of dust concentration has been performed in the United States, and a number of figures of maximum safe concentration have been issued from various sources.

We have accepted the lowest of these (U.S. Public Health Bulletin 241, 1938) which gives 5,000,000 particles per cubic foot. We believe that this figure is still generally accepted by most medical authorities.

Furthermore, virtually all the available literature states that the harmful fraction of dust is that with fibre lengths between 10 and 50 microns.

Thus, in our investigations we have taken the following factors into account as far as possible.

1. Total exposure time of dock workers.

2. Dust concentrations within any cargo space.

3. Dust particle size.

4. Potential ventilation in ship's holds.

EXPOSURE OF DOCK WORKERS

Abstracting information supplied by yourselves, we find the following pattern of discharge in the London group of docks during the twelve-month period July 1964/June 1965.

Docks	No.vessels discharging	Total Tonnage asbestos discharged.	Source of asbestos.	Type
Royal	37	19,887	Canada	Chrysolite
Royal	8	2,015	S.Africa	Amphibole
West India	21	7,875		Probably Chrysolite
Surrey	27	3,848		" "
Total:	93	33,625		

DUST CONCENTRATIONS WITHIN CARGO SPACE

Measurements of this parameter present some difficulty inasmuch as it is difficult to sample where work is being carried out, and furthermore differing results may be obtained using different techniques.

It is obvious that dust concentration in any particular space will be dependent on the size and geometry of the space, the rate of discharge, to some extent the amount of time during which discharge has been taking place, as well as any ventilation factors and meteorological considerations.

In our examination we studied discharge on three vessels, as follows.

1. "EMEZK"

This was a Russian vessel discharging from No.1 Lower Hold. Conditions were atypical inasmuch as no normal discharge was taking place when we visited the vessel. In order to assist us a gang of stevedores, wearing masks, worked as quickly as possible for a period of 14 minutes during which time they loaded six slings, which were discharged into a barge, i.e., the rate was about 25 slings/hour, as opposed to a normal rate of we understand 35 slings/hour when respirators are not worn.

We endeavoured to take dust samples from the atmosphere adjacent to stevedores and to measure the sedimentation rate on charged plates at various positions in the hold. This had a volume of about 19,250 cubic feet and a hatch opening of 600 square feet. The temperature was 21°C., relative humidity 77%, and air conditions still.

Full results of our measurements are appended. Summarising, however, we found that the concentration of fibres of less than 50 µ. length did not exceed 1.5 mg./cu.ft. Translating this into numerical values, if one assumes an average diameter of 0.1 µ., the total content is approximately 3.6 million per cubic foot. If, however, the average fibre diameter is 0.05 µ. a value of 12.0 million per cubic foot would be obtained.

Sedimentation values for dust varied from 3 to 32 mg./sq.ft./hour in the vessel, and 6 to 34 mg./sq.ft./hour in the barge.

2. "MOOSE JAW"

The second vessel we saw discharging was the "MOOSE JAW" which was discharging Chrysolite asbestos loaded in Canada.

In this particular vessel discharge was occurring in No. 1 Tween Deck, No. 2 Lower Hold and No. 3 Tween Deck. The temperature at the time was 20°C., relative humidity 55%, and there was a strong wind blowing.

Discharge from No. 1 Hatch was virtually at weather deck level, and the strong wind was dissipating what little dust there was present at a rapid rate so that sampling of any form was felt to be impractical.

In No. 2 Lower Hold there was no room in which to put equipment, but it was obvious from visual examination that the dust level was extremely low. The stevedores were not wearing masks and discharge was at the rate of about 36 slings/hour/gang.

In No. 3 Hold again sampling was vitiated due to simultaneous discharge of china clay, which produced copious clouds of dust far denser than any dust clouds which we have ever observed during discharge of asbestos.

3. "CITY OF EASTBOURNE"

The final vessel we saw discharge was the "CITY OF EASTBOURNE" where asbestos from South Africa was stowed in No. 4 Lower Hold and No. 3 Deep Tanks. We studied discharge from No. 3 Deep Tanks. The cross sectional area of each tank was about 500 square feet, and the hatch cover which was located towards one corner was of a total area of about 200 square feet.

At the time of discharge the top of the cargo was 4-6 feet below the deckhead. The air temperature was 20.1°C., relative humidity in the hold 81%, and air conditions still. The stevedores discharging this cargo were all equipped with masks, but some were only wearing them intermittently. The discharge rate was approximately 28 slings/hour.

Full results of our examination are appended, but summarising, we found sedimentation rates of fine fibres varied from 4 to 40 mg./sq.ft./hour.

The fibres were generally coarser, and we found the atmospheric content ranged from 500,000 to 4,000,000 fibres 10-50 μ. length per cubic foot. (Based on an assumption of an average diameter of 0.1 μ).

Referring to all cargoes, we noted that in general the dust concentration was primarily controlled by the packages used, and secondly by the nature of the product, i.e., whether it was asbestos powder, asbestos fibres or compressed asbestos fibres. A secondary factor was the degree of external contamination of the packages.

We therefore arranged for specimen packages to be delivered to this laboratory where we examined the contents to determine the distribution of fibres of different lengths. We also carried out controlled drop tests to produce standard dust clouds which we then examined.

The results which were obtained are summarised below. As these were dependent mainly on the packaging, state of the product (i.e., compressed or slack fill) and external condition of the bags, these details are included.

"EMEZK"

1.

PACKAGING:	Double jute bag, stitched ends.
WEIGHT:	50 lb.
PRODUCT CONDITION:	Loose fill.
EXTERNAL PACKAGE CONDITION:	Heavily contaminated.
DUST CONCENTRATION: (AFTER TEST)	2,000,000 particles/cu.ft.

"MOOSE JAW"

2.

PACKAGING:	Glue laminated paper/hessian bag.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Compressed.
EXTERNAL PACKAGE CONDITION:	Trace of contamination.
DUST CONCENTRATION: (AFTER TEST)	50,000 particles/cu.ft.

3.

PACKAGING:	5-ply gussetted multiwall paper bag.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Compressed.
EXTERNAL PACKAGE CONDITION:	Clean.
DUST CONCENTRATION: (AFTER TEST)	30,000 particles/cu.ft.

4.

PACKAGING:	Bitumen laminated paper/hessian.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Loose fill.
EXTERNAL PACKAGE CONDITION:	Trace of contamination.
DUST CONCENTRATION: (AFTER TEST)	40,000 particles/cu.ft.

5.

PACKAGING:	5-ply multiwall paper sack, valve fill.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Loose.
EXTERNAL PACKAGE CONDITION:	Contaminated.**
DUST CONCENTRATION: (AFTER TEST)	N/A.

6.

PACKAGING:	Double jute.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Compressed.
EXTERNAL PACKAGE CONDITION:	Contaminated.
DUST CONCENTRATION: (AFTER TEST)	200,000 particles/cu.ft.

7.

PACKAGING:	5-ply multiwall paper sack, valve filled, inside hessian bag.
WEIGHT:	100 lb.
PRODUCT CONDITION:	Loose.
EXTERNAL PACKAGE CONDITION:	Inner sack punctured and contaminated.
DUST CONCENTRATION: (AFTER TEST)	N/A.

** Bag had 6-inch long split at gusset not suitable for repair. Test not possible.

"CITY OF EASTBOURNE"

8.

PACKAGING:	Hessian.
WEIGHT:	112 lb.(?)
PRODUCT CONDITION:	Loose.
EXTERNAL PACKAGE CONDITION:	Heavily contaminated.
DUST CONCENTRATION: (AFTER TEST)	750,000 particles/cu.ft.

9.

PACKAGING:	Glue laminated paper/hessian.
WEIGHT:	112 lb.(?)
PRODUCT CONDITION:	Loose.
EXTERNAL PACKAGE CONDITION:	Contaminated.
DUST CONCENTRATION: (AFTER TEST)	150,000 particles/cu.ft.

DUST PARTICLE SIZE

We have carried out particle size distribution analyses to determine how much asbestos dust found in ships' holds falls within the particle size limits which are considered dangerous from the viewpoint of causing asbestosis. These limits are quoted as 10-50 microns length.

Detailed figures are given in our preliminary reports. In general terms it can be stated that at least 80% of the dust particles we have examined from the sources quoted above are within the critical size range.

VENTILATION

In none of the vessels examined was there any positive ventilation. Generally this can only be provided with electrical ventilating systems, the normal type being inoperative when a vessel is not moving.

Even electrical ventilating systems are in our opinion not effective in removing dust, except perhaps when discharge is in progress in close proximity to inlets or outlets. Thus probably the most effective system if special installations are excluded is to open all hatches. Obviously the efficacy of such a system depends on external conditions, the location of holds being discharged, size of hatch opening viz-a-viz hold volume, etc.

COMMENTS

In terms of current legislation it would appear that occasionally dock workers can be exposed to asbestos dust for more than eight hours in any one week, but over the period of a year it is unlikely that any man is subject to more than 100 hours exposure.

From the viewpoint of exposure to harmful concentrations of asbestos dust, i.e., more than 5,000,000 particles per cubic foot, it would appear that men may work under such conditions when discharging certain cargoes, but such occurrences will apparently be fairly rare.

The concentration of dust in the atmosphere is largely governed by the quality of packaging employed. Much higher concentrations are found when plain hessian bags are used, compared with instances when the internal or all the packaging is paper. Where asbestos is packed in undamaged paper sacks, atmospheric contamination is very low.

It has also been shown that compressed asbestos causes far less dust on handling than loose material. In this respect we understand that it is much easier to compress Chrysolite asbestos than Amphibole asbestos.

It is known that the question of exposure to asbestos dust is under active review by the Ministry of Labour and similar bodies overseas, and it has been reported that the regulations will be altered shortly. If such is the case, then it is virtually certain that the limits will be set at lower rather than higher levels.

Anticipating this possibility and also to reduce any slight existing risk to negligible proportions, we would suggest that asbestos should be packaged in sift-proof sacks. At the present stage this means in effect using a paper liner as the inside of the sack.

In our opinion, whilst the employment of hessian as an outer ply probably gives a more robust sack than is obtained in some instances with multiwall paper sacks, it does encourage the use of hooks by the stevedores, which is obviously undesirable.

As a long-term aim, it would obviously be of advantage to handle asbestos in palletised loads.

We do not feel that respirators can be recommended except for handling either loose asbestos in unlined hessian sacks or cargoes where appreciable mechanical damage had occurred, resulting in the rupture of a number of sacks and the possible production of abnormal quantities of dust during discharge.

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Much of the dust produced during discharge of asbestos is mainly in the particle size range considered as harmful if present in sufficiently high concentrations.

The possibilities of ventilation during discharge are generally so vague and uncontrollable that we are of the opinion that atmospheric control by this technique must be discounted.

Thus in the light of existing regulations and officially accepted data covering exposure to asbestos, it would appear that only in very isolated instances are dock workers exposed to asbestos for sufficiently long for them to be considered in the same category as workers covered under Statutory Rules and Orders 1931, No. 1140, Asbestos Industry Regulations 1931.

Furthermore, harmful concentrations of dust, i.e., dust concentrations of more than 5,000,000 particles per cubic foot, are only met with infrequently during discharge of asbestos.

Thus it must be concluded that the risk to dock workers discharging asbestos is minimal.

We should, however, point out that the limits prescribed both for exposure and for dangerous dust concentrations are arbitrary, being based on the best information available at the time when they were fixed.

APPENDIX

(1)

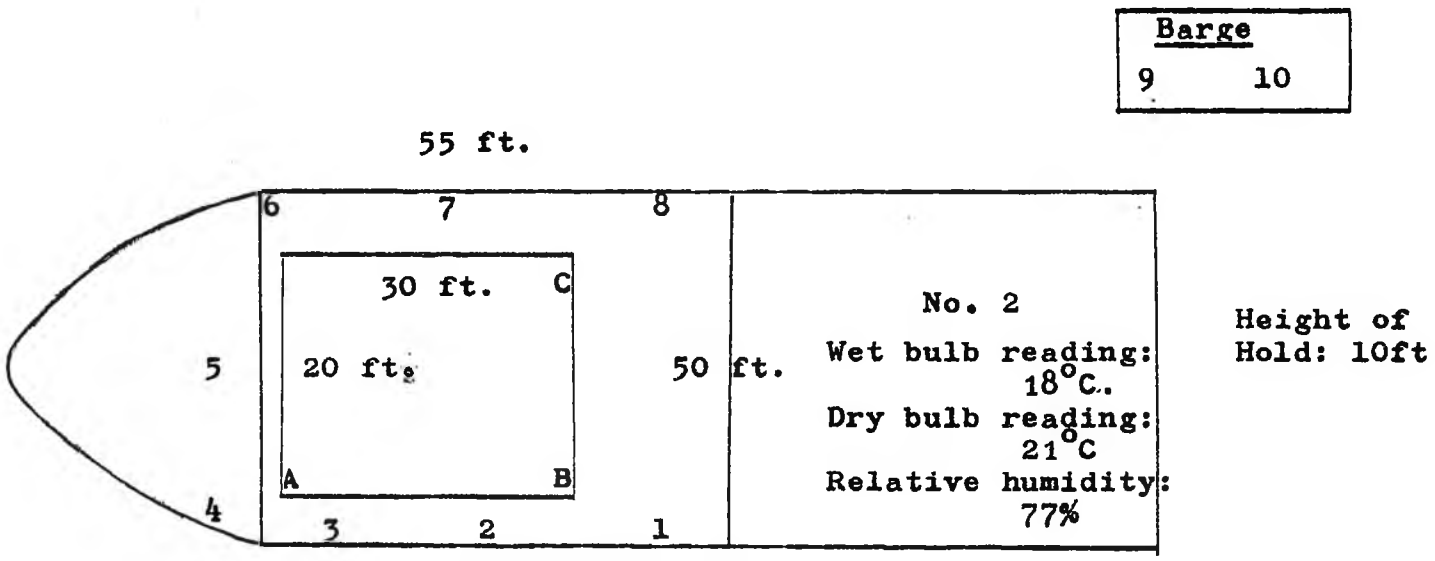
ASBESTOS INVESTIGATION

s.s. "EMEZK" - ASBESTOS IN BAGS.

Investigation carried out on s.s. "Emezk" in Surrey and Commercial Docks, 21.7.65.

ATMOSPHERE SAMPLING

Samples were taken in No. 1 Hold whilst three gangs were working. The position of the samplings were as per diagram.



No. 1 lower hold.

Samples for Particulate Distribution were taken at eight places in the Hold and two places in the barges.

RESULTS

1. CONCENTRATION OF ASBESTOS IN ATMOSPHERE (Particles less than 50 μ. size)

Position A:	1.4 mg/cu.ft.
Position B:	1.3 mg/cu.ft.
Position C:	1.5 mg/cu.ft.

2. ASBESTOS FALLING TO THE DECK

Position	Amount falling per hour
1	32 mg/sq.ft.
2	18 "
3	3 "
4	10 "
5	18 "
6	10 "
7	4 "
8	18 "
9	6 ")
10	34 ") on barge.

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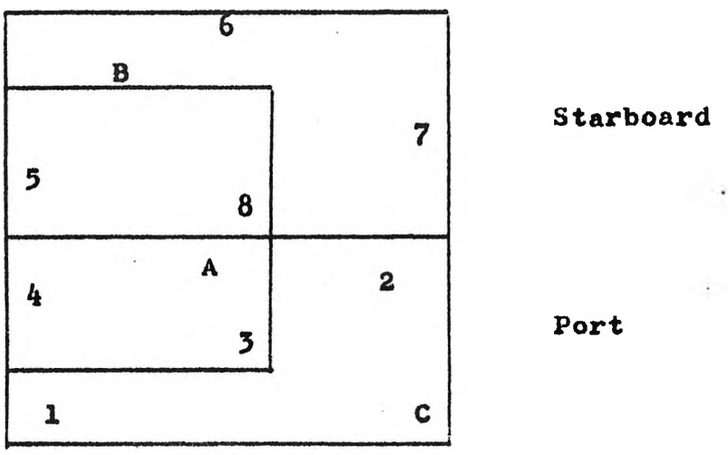
(2)

m.v. "CITY OF EASTBOURNE"

Investigation carried out on m.v. "City of Eastbourne" at Royal Victoria Dock, 15.9.65.

ATMOSPHERE SAMPLING

Samples were taken from No. 3 Port and Starboard Deep Tanks. Sampling positions were as follows :-



RESULTS

1. CONCENTRATION OF ASBESTOS IN ATMOSPHERE. (Particles less than 50 μ. size)

Position A:	2.0 mg/cu.ft.
Position B:	1.1 mg/cu.ft.
Position C:	0.4 mg/cu.ft.

2. ASBESTOS SETTLING ON TO CHARGED PLATES, located at different positions on cargo or ship's frame.

Position	Amount falling per hour.
1	28 mg/sq.ft.
2	38 "
3	40 "
4	40 "
5	32 "
6	4 "
7	16 "
8	39 "