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Cross-
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OCCUPATIONAL SAFETY
AND HEALTH
SERIES

SAFETY AND HEALTH IN SHIPBUILDING AND SHIP REPAIRING



INTERNATIONAL LABOUR OFFICE - GENEVA - 1972

Table 4

VARIOUS OPERATIONS WITH INCOMBUSTIBLE BOARDS OR PANELS

Operation	Asbestos dust concentrations (fibres/ml			
	A test room investigation		Other reported cou*	
	without dust extraction	with dust extraction	without dust extraction	with d extra
Hand sawing				
Unveneered	31.4	3.4	13.8 to 44.8	-
Veneered	58.4	1.1	-	-
Power hand saw				
Unveneered	>200	1.6	87	1.5
Veneered	-	-	63 to 109	1.7
Bench saw				
Unveneered	>100	4.5	109 to 186	1.5
Veneered	-	-	-	1.4
Power drill				
Unveneered	1.9	0.9	-	-
Veneered	1.0	0.7	5.4	-

* These counts have been reported by various investigators under varying conditions, but the ARC's membrane sampling method has been used in all cases.

Conclusion

More work must be done in the development of tools which do produce dust or which are equipped with efficient dust extracti devices. There is scope for further improvement in the develop of dust-suppressed materials. Possibly one of the most importa areas for improvement is in the raising of standards of hygiene and in the education of all those concerned - both management a workers - in adhering to the working procedures and safety stan devised for their protection. It will not be easy to maintain consistent level, particularly since neglect produces no immedi penalty. Only by continual vigilance and a sustained educatio effort will the desired standard be achieved.

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INTRODUCTION OF ASBESTOS SUBSTITUTES IN A SWEDISH SHIPYARD

N. Sundstedt*

Abstract

Brief account of successive measures taken since 1958 in a Swedish shipyard, which have resulted in the complete elimination of asbestos as an insulation material, except in the case of fire-proofing board, substitutes for which were under test at the time of writing. The reasons for substitution in various applications and for the policy switch from partial to total elimination made in 1969 (new evidence of extent of hazard, reluctance of workers to work with asbestos) are outlined and the characteristics of substitute materials selected are indicated. It is concluded that, all in all, substitution should involve no economic burden.

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* *

When we had the first serious discussions in Gothenburg in 1958 about the health hazards in work with asbestos, the participants (representatives of the labour inspectorate and the shipyards, physicians, safety technicians, etc.) fully realised that asbestos should be replaced as far as possible by a less dangerous material. The studies made in 1958 brought no acceptable substitute material to light. However, the discussions at the meeting and our search for a substitute resulted in increased interest in finding such a material.

In 1958 the following materials containing asbestos were in use:

1. Board, lags and pipe sections of magnesite for insulation of steam boiler, exhaust receiver and other large pipes.

* Götaverken Shipyard, Gothenburg, Sweden.

2. Magnesia mortar - to plaster the aforementioned insulation. These magnesia products contained between 12-18 per cent asbestos.

3. Cloth, yarn and cardboard containing 97 per cent asbestos.

4. Loose asbestos fibres for filling of insulating mattresses, containing 97 per cent asbestos.

5. Asbestos packings of different kinds.

6. Sprayed asbestos for insulation against fire, sound and condensation, containing 97 per cent asbestos.

7. Board of different makes for accommodation purposes, containing 10-14 per cent asbestos.

The companies producing rock wool and glass wool for insulation purposes realised that there might be a demand for these in the shipyards. Quite soon they succeeded in producing products that could be accepted by the yards and the maritime authorities. After a few years of tests we found in 1965 that we could replace the asbestos insulation of steam boilers and exhaust pipes with wired mats of mineral wool or glass fibre. Moreover, we could replace the loose asbestos fibre in the insulation mattresses with the same material.

This switch reduced the use of asbestos at the shipyard so much that medical experts considered at that time that none of our workers was likely to contract lung asbestosis within a normal lifetime. The remaining work with asbestos material was done sporadically during short periods, and was therefore not considered as dangerous.

In 1969, however, we had to change our minds. Two suspicious cases of asbestosis occurred in which neither of the affected persons had worked either with asbestos itself or in an environment with an "asbestos hazard".

Moreover, at a meeting organised by the Institute for Research on Occupational Diseases we learnt that asbestos was suspected of causing other pathological symptoms in addition to classical asbestosis. Although among medical experts there is substantial doubt about the connection between asbestos and the newly noted pathological changes in the lungs, the suspicion was sufficient to motivate a study aimed at completely eliminating asbestos in work at shipyards. As we had succeeded so well in finding substitutes for asbestos, we now wanted to concentrate on pursuing this effort to its logical conclusion. Another reason for avoiding asbestos was that the discussions about the hazards involved had caused such anxiety among our workers that we could expect difficulty in finding workers willing to undertake such work.

The spraying of asbestos for insulation in engine rooms and in some cases in the equipment of ships is a very dusty operation. A great deal of the sprayed asbestos falls haphazardly on places such as floor plates, platforms, hulls and engine parts, where it remains during the rest of the building time. When dry, it is stirred up by draughts and persons working in these rooms inhale it.

During the last year we have not used asbestos spray in our new building. Now we insulate the latter with rock wool wire mats with a surface coating of plastic cement or sheet-metal. Instead of asbestos spraying we use rock wool board No. 337 which is fastened with welded pins and washers. As a surface coating, plastic cement, cement plaster, glass textile or the like can be used. Turbines, steam drums and other similar engine components that were formerly insulated by asbestos spraying are now insulated with asbestos-free calcium silicate (Newthorn Extra) which is plastered with plastic cement to obtain a hard surface.

Asbestos cloth is replaced by glass textile. We use Mölnlycke Tex No. 9642 or glass textile No. 6245 from "Svenska Sidenväveriet". Tests carried out by Götaverken's laboratory have proved that these glass fibre textiles will withstand higher temperatures than asbestos cloth.

Ordinary asbestos cloths contain between 15-18 per cent cotton and a small percentage of textile glue, and consequently do not endure temperatures above 400° C. Asbestos cardboard has been rejected completely, and we have not tried to find a substitute for it, as the quality of the mineral wool and glass fibre hitherto used in conjunction with it is now so good that the asbestos cardboard must be considered as unnecessary. Pipe lines with temperatures up to 340° C are insulated with rock wool pipe sections or lags and are covered with glass textile. Pipe lines with temperatures between 340-513° C are insulated with asbestos-free calcium silicate and are covered with glass textile or plastic cement.

Tube flanges and valves on pipe lines are insulated with mattresses filled with rock wool and are externally covered with glass fibre textile. Packings for tube flanges and for various engine parts are still made of rubber jointed asbestos or plaited asbestos. However, instructions have been given that "Three Bond" packing pulp or an equivalent material must be used wherever possible.

All this has now been put into practice and the last ship with asbestos in the engine room and pump room was delivered in July 1971. Only the board remains (Marinite, Navilite, Internit and Turner), which we use for the equipment of ships where there is a demand for fire-proof insulation.

It has been more difficult to find a substitute that meets the requirements for screw-retaining ability, possibility of glueing on different kinds of surface coatings, absorption of humidity, etc. We are now testing a board made of plaster and rock wool, called "Fire Guard", which is approved by the Board of Shipping and the classification associations. One disadvantage of this board, however, is that it is rather heavy to handle.

In October 1971 we plan to deliver the last ship with asbestos insulation and asbestos equipment on board.

During the last year, we have not used asbestos in manufacturing stationary steam boilers of different types.

The substitutes of which I have given an account are the materials that we use today. The companies that manufacture rock wool, glass fibre, glass textile, plastics and tapes of different kinds are interested in obtaining their share of the market and they introduce and discuss novelties nearly every week. Recently, one of the companies presented a self-adhesive glass textile which is available in any colour. With this material, the slow and expensive work of sewing the glass textile on the pipe lines and painting is eliminated. In a year or two we shall perhaps have other substitutes which are better, less expensive and more labour-saving.

To sum up, this investigation shows that in many cases one can easily abandon the use of asbestos. The reason why asbestos has been used to so great an extent is probably because of its technical qualities, and also because its use has often been a matter of pure routine, no attempt having been made to find a substitute.

As to the cost of the substitutes, it is early yet to answer this question. In some cases it may be cheaper and in others more expensive. However, taking into consideration the extra protective measures in the form of ventilation, personal protective equipment, careful housekeeping, etc., required in regular work with asbestos, it can be safely said that substitution will impose no economic burdens.

DUST HAZARDS IN THE PROCESSING OF ASBESTOS CEMENT SHEET

H. Förster*

Abstract

There is ample evidence that exposure to dust produced in particular during the cutting and machining of asbestos cement plates can induce lung diseases. New safety rules laying down precautions to be taken in the presence of asbestos dust are accordingly being elaborated in the Federal Republic of Germany. Measurements have shown that the usual exhaust ventilation arrangements still do not suffice, despite constant improvements. Isolation of workplaces and the wearing of respiratory protective equipment is therefore necessary. Despite all precautions, no matter how good, an incalculable health hazard will always subsist. It follows that asbestos cement plates should no longer be machined, above all in cramped conditions such as are found on board ships. Machining may be avoided by recourse to assembly building systems, or by the use of other materials.

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The International Convention on the Safety of Life at Sea (London, 1960) requires, amongst other things, that the partition bulkheads of ships shall be constructed of incombustible materials. Although various materials have been approved for that purpose by the responsible national organisations - in the Federal Republic of Germany, the organisation is the Mutual Accident Insurance Association for the shipping industry - in practice asbestos cement panels are in most widespread use, very possibly because these panels can be worked by joiners in very much the same way as the wooden panels which they replace.

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* Mutual Accident Insurance Association for the north-western iron and steel industry, Hanover, Federal Republic of Germany.

When these panels are drilled, sawn or otherwise machined and even when they are sorted and transported, dust is produced in quantities which are all the greater because the panels are processed in the shipyard in the dry state. The larger dust particles sink to the ground relatively quickly, but the finer respirable particles remain in suspension so that the dust concentration at the level of the respiratory tract increases and workers in the immediate area remain exposed to dust long after the machinery has stopped.

The most important constituents of asbestos cement panels are asbestos (25-30 per cent), silicic acid (25-35 per cent) and cement as a binder (40-50 per cent); it follows that such exposure can lead to silicosis or to asbestos-induced diseases in the thoracic region. I am deliberately not confining the latter to asbestosis, because recent years have brought increasing evidence of the existence of a correlation between bronchial carcinoma and pleural mesothelioma and exposure to asbestos dust. The more confined the working quarters, the quicker a hazardous dust concentration will be reached.

So far, no occupational safety and health regulations have been issued in the Federal Republic of Germany dealing specifically with measures required in the event of exposure to asbestos dust. However, such regulations are at present being drafted under the heading "Protection against mineral dusts which are hazardous to health"; their provisions, based on previous medical and technical experience, will run as follows:

(1) The employer must give notification of any work with materials containing asbestos in which dust is produced.

(2) So long as no value shall have been determined for the maximum allowable atmospheric concentration of asbestos at the workplace, the dust conditions shall be evaluated from the overall concentration of dust in atmospheric suspension and a so-called asbestos rating factor:

$$F = \frac{\text{Total particle concentration } C_t(P/cm^3) \times \text{Asbestos fibre concentration } C_a(P/cm^3)}{100}$$

For an asbestos content of <10 per cent, 10-50 per cent or >50 per cent, the corresponding over-all concentration must not exceed 2.0mg/m^3, 1-5mg/m^3 or 1.0mg/m^3 respectively. The asbestos rating factor must not exceed 10.

(3) The health of workers who may be exposed to the dust of materials containing asbestos must be supervised. This is regardless of whether or not they are actually working with asbestos material. The supervision shall take the shape of pre-employment medical examination to determine fitness for work involving a dust hazard, as well as periodical check-ups, all of which must be performed by a physician especially authorised to conduct these examinations.

Such examinations have already been arranged by our mutual accident insurance association for a number of years. At

present there are some 700 so-called asbestos joiners under supervision, 8 of whom (i.e. about 1.1 per cent), with a maximum of 10 years of exposure to dust, have already been transferred away from work in dusty conditions, on the strength of medical advice.

(4) Young persons under 18 years of age may be employed only in specified circumstances and at workplaces where dust conditions are particularly favourable.

(5) Precautions - including technical dust control measures and the provision of appropriate respiratory protective equipment - must be taken to ensure that the air inhaled by the workers concerned is kept as free as possible from asbestos dust.

The technical dust control measures applied in West German shipyards include:

(a) steps to prevent the accumulation of dust deposits;

(b) separation of workplaces with markedly different dust concentrations;

(c) cleaning of workplaces and machines, using vacuum cleaners fitted with efficient dust filters;

(d) exhaust ventilation of workplaces where asbestos cement panels are machined.

The effectiveness of the exhaust ventilation arrangements is being constantly improved, for example by the total enclosure of asbestos material processing machinery, the provision of exhaust ventilation on both sides of workpieces, the mounting of dust extraction nozzles directly on the workpiece, etc. Regular dust concentration samplings at shipyards indicate, however, that the dust extraction installations now in use do not suffice to reduce the asbestos dust concentration in the workplace atmosphere to insignificant proportions. This is especially true of work done not in the workshops but in the ship hulls, where working spaces are cramped and safety and health conditions are generally less favourable. It follows that the preparation and machining of asbestos cement panels must be restricted to particular premises and areas, which must be identified by warning notices. Persons working inside such places must wear respiratory protective equipment affording adequate protection against fine particulate mineral dusts.

Yet notwithstanding all efforts to minimise the hazards of work with asbestos and to ensure the early detection of asbestos-induced diseases of the thorax, there still remains a definite, albeit incalculable, risk, which is rendered more unpredictable by the perpetual comings and goings in hulls under construction of workers of all kinds, who are moreover left to exercise their own judgment as to the precautions required. In these circumstances, plainly, the only really effective way of eliminating asbestos hazards in shipyards is to abandon the machining of asbestos cement panels altogether!

This may be accomplished either by using asbestos cement panels of standard sizes, or by switching to other materials which do not contain asbestos.

Standard asbestos cement panel units can be installed ready finished in hulls, without machining, by mounting them in a lattice framework. When panels are mounted in a metal frame any odd-shaped filler plates required (e.g. by changes in the hull profile) may be made preferably of metal and welded in position.

Hitherto, the replacement of asbestos cement panels by other approved materials - usually metal panels with extra insulation - has always been opposed on the grounds that hull inner assembly techniques would have to be altered accordingly. However, a new material has recently appeared on the market in Norway. It consists of a mixture of rock wool, plaster and various additives, and contains no asbestos. This material, which has already been tested for incombustibility and for suitability for use in Type B partitioning by the Government Materials Testing Centre in Copenhagen, offers the advantage that it can be machined in the joiner's shops like wood.

From the standpoint of occupational safety and health, the only acceptable long-term solution consists in the use of intrinsically safe materials or working methods.

PRACTICAL METHODS FOR PROTECTION OF MEN WORKING WITH ASBESTOS MATERIALS IN SHIPYARDS

A.A. Cross* et al

Abstract

The Asbestosis Research Council was set up by leading asbestos companies in the United Kingdom in 1957 to carry out and sponsor research into the nature, cause and prevention of disease related to the inhalation of asbestos dust. In addition to its medical and scientific research projects, it has established an Environmental Control Committee to investigate and develop methods of practical control and safety in all those situations where materials containing asbestos could be used in a manner likely to produce potentially harmful quantities of dust. A report is given of the results of a particular study made of those situations where special difficulties occur through the space limitations of the working area. The aim of the study was to identify the type of product and the work patterns and situations where these difficulties mainly occurred, to collect information as to practical methods of control which have been devised, and to check on the effectiveness of such methods in reducing the exposure of operatives to acceptable standards.

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Introduction

The Asbestosis Research Council was formed in 1957 by the three major asbestos companies in the United Kingdom as a co-operative research organisation to prosecute a programme of research into the causation and prevention of asbestosis.

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* Chairman, Environmental Control Committee, Asbestosis Research Council, United Kingdom.





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The Environmental Control Committee of the ARC, through its various Working Groups, attempts to establish and recommend safe working methods appropriate to different types of materials and different areas of use. In the case of ship construction, the circumstances are highly specialised and in some respects exceptional. There is evidence that the incidence of asbestos-related disease among ship workers is higher than in most other areas of use.

We have tried in the first instance to identify the environmental conditions which have given rise to this situation in the United Kingdom. We have then sought out the practical experience of users in this industry in the development of methods of working which have effectively reduced the level of exposure, and we have considered to what extent experience in the asbestos industry itself and of users of asbestos products in other sectors may be applied to the benefit of workers in ship construction and repair. It is hoped in due course to assemble information about these practices in the form of one of the ARC's series of Control and Safety Guides.

Special environmental conditions

Cases of disease reported so far are likely to have had their origin in operating conditions before the early 1950s, and, in the case of mesotheliomas, in even earlier periods - perhaps 40 years ago. It is necessary, therefore, to consider the kind of materials which were being used during those years and the way in which work was carried out.

In early years these materials were, particularly for naval vessels, mainly mattresses made of crocidolite (blue) asbestos cloth filled with crocidolite fibre. Pre-formed sectional insulation containing amosite or chrysotile was increasingly used from the late 1930s until the early 1960s. Sprayed asbestos - mainly crocidolite - was increasingly used from the middle 1940s.

In the past ten years, half of the new cases of asbestosis in the UK have come from the insulation side of the industry. Application of sprayed asbestos and of pre-formed insulation in the very restricted areas of ships' quarters resulted in the build-up of high concentrations of dust, though nothing like the levels experienced in stripping.

The conditions occurring in shipyards, especially naval dockyards, can be seen to have been made exceptionally hazardous by an unfortunate combination of several adverse factors. These are, first, the need to work in often extremely confined and restricted situations where many of the services used in factories for dust reduction or control are not available; second, the prevalence hitherto of particularly friable materials; third, operations, such as stripping, which create excessive dust; fourth, extensive use of a particular type of asbestos - crocidolite - believed to be especially associated with mesothelioma. All of these factors appear to have combined to create an exceptional and persistent hazard even affecting workers not directly involved in the manipulation of asbestos materials.

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The situation today

Non-asbestos materials are now used for thermal insulation, and sprayed asbestos is rarely used, at least in British shipyards, unless predamping is employed. Nevertheless, as long as ships are in service in which these materials have been used in the past, stripping will occur, with its attendant dust problem.

The materials which continue to be used do not pose such difficult problems of control. In the United Kingdom, control by exhaust ventilation or the provision of personal protection is required if the asbestos dust level exceeds 2 fibres/ml (or 0.2 fibres/ml in the case of crocidolite). Many asbestos-containing materials in regular use do not come into this category and are regarded as "non-dusty". Some others, under certain conditions, can give rise to dust above this level; in many of these cases it has been found possible to devise methods of working or to devise equipment which adequately controls the dust level (see table 1).

Control and safety measures

Stripping. The operation presenting the most difficult problem for dust control is stripping off old insulation, whether this consists of sprayed asbestos or pre-formed insulation. Techniques developed in the British naval dockyards and by major users and contractors on industrial installations have relied on three basic methods, namely, enclosure; suppression by wetting; and personal protection.

The effect of wetting has been reported to reduce concentrations in the working area, but this technique has been abandoned in British naval yards as creating too many other problems, except in the control of waste during disposal.

Enclosure of the area, for example with polythene sheeting, combined with a ventilation system creating negative pressure can limit the contaminated area. One manufacturer is hopeful of developing a wet stripping machine incorporating a dust-proof debris receptacle. To date, however, operatives engaged in stripping must be equipped with positive-pressure respirators conforming to British Standard 4275, or air-line breathing apparatus, and with protective clothing completely covering the body from ankle to neck, as well as head covering. A hood incorporating the face-piece of the respirator or breathing apparatus has been found to be comfortable to wear and acceptable for men working in restricted areas over quite long work periods.

Strict standards of hygiene must be observed, particularly in clearing up stripped material during and upon completion of the work, and for disposal of the collected waste in impermeable containers such as heavy plastic bags.

Sprayed asbestos coatings. The application of sprayed asbestos coatings has been classified as an operation producing heavy concentrations, not only in the operator's breathing zone but also in adjacent areas. Concentrations of as much as 1,500 fibres/ml have been reported, though a level of 200-300 fibres/ml is more

SAFETY & HEALTH IN SHIPBUILDING AND SHIPREPAIRING ILO, 1972.

Table 1

USE OF ASBESTOS MATERIALS IN SHIP CONSTRUCTION - DUST LEVELS OBSERVED IN TYPICAL OPERATIONS

Operation	Asbestos dust concentration (fibres/ml)			
	A		B*	C*
	Mean	(1) Max		
Stripping				
Sweeping and bagging debris	353	3 815		
Removal of sprayed coatings	248	1 906		
Adjacent areas	83			
Removal of lagging (100% asbestos)	159		62	
Spraying				
	Range			
Undamped	173 to 322			150-1 500
			Range	
Predamped	-		1.7 to 4.7	1-4
Application of pipe lagging				
15% asbestos	11.2	61	40 60	-
Incombustible board				
Cutting (without exhaust)			100	
Cutting (portable exhaust)	-		1.1 to 4.5	-
Drilling (without exhaust)			1.0 to 1.9	
Drilling (portable exhaust)	-		0.7 to 0.9	-
Asbestos cloth				
Various operations				
Conventional	-		5 to 10	
Dust-suppressed	-		1 to 3	
New process	-		0.2 to 1.5	

* Not necessarily observed in a marine situation.

A. P.G. Harries: (1) 1967, remainder 1971.

B. ARC.

C. Government hygienists.

normal. The development of predamping techniques, whereby the asbestos fibre is wetted before being introduced to the feed tank of the spray-gun, has been demonstrated to reduce the amount of dust dramatically. In the United Kingdom, the Factory Inspectorate see no problem in the application of sprayed asbestos, providing that the fibre is predamped and that only chrysotile or amosite fibre is used (see table 2).

Table 2

APPLICATION OF SPRAYED ASBESTOS COATINGS - COMPARISON OF PREDAMPED WITH DRY FIBRE FEED

Position of sample	Asbestos fibre concentration (fibres/ml)		
	Without predamping	With predamped fibre	
		Official test	ARC test
Spray operative's shoulder	1 500	4	4.2
Feeding machine	150		1.9
Feeding damping drum	-		4.7
1st distance from sprayer	(9m) 19-37	(4.5m) 1	(6m) 3.0
2nd distance from sprayer	(18m) 12	(12m) 1	(10m) 1.9

Asbestos cloth and thermal insulation. The main source of dust from insulation lies in the primary lagging, and therefore, where operating conditions permit, non-asbestos materials such as calcium silicate and mineral wool have been introduced. Although the asbestos cloth covering on pipes and in mattresses has never been considered to contribute other than minimally to the hazard, the asbestos industry has developed improved textile materials to reduce still further the possibility of dust emission. Such improvements have taken the form either of conventionally produced asbestos cloth with a dust suppression treatment, or of a cloth made by an entirely new process and also subject to a dust suppression treatment.

Even with non-asbestos primary lagging, stripping will produce considerable quantities of dust which, although not asbestos, make protection desirable. The amount of dust from the asbestos covering cloth, which is usually painted or treated with a covering compound, is not likely to be significant. Table 3 indicates the effect of the introduction of various measures to reduce the asbestos dust level. It can be seen that, having eliminated asbestos from the primary lagging, with presently available asbestos covering materials the asbestos dust is reduced to a level generally considered to be non-hazardous.

Table 4

VARIOUS OPERATIONS WITH INCOMBUSTIBLE BOARDS OR PANELS

Operation	Asbestos dust concentrations (fibres/ml)			
	A test room investigation		Other reported counts*	
	without dust extraction	with dust extraction	without dust extraction	with dust extraction
Hand sawing				
Unveneered	31.4	3.4	13.8 to 44.8	-
Veneered	58.4	1.1	-	-
Power hand saw				
Unveneered	>200	1.6	87	1.5
Veneered	-	-	63 to 109	1.7
Bench saw				
Unveneered	>100	4.5	109 to 186	1.5
Veneered	-	-	-	1.4
Power drill				
Unveneered	1.9	0.9	-	-
Veneered	1.0	0.7	5.4	-

* These counts have been reported by various investigators under varying conditions, but the ARC's membrane sampling method has been used in all cases.

Conclusion

More work must be done in the development of tools which do not produce dust or which are equipped with efficient dust extraction devices. There is scope for further improvement in the development of dust-suppressed materials. Possibly one of the most important areas for improvement is in the raising of standards of hygiene and in the education of all those concerned - both management and workers - in adhering to the working procedures and safety standards devised for their protection. It will not be easy to maintain a consistent level, particularly since neglect produces no immediate penalty. Only by continual vigilance and a sustained educational effort will the desired standard be achieved.

We believe that the methods of control we have reviewed and recommend are practicable and that time will show these to have been effective, so that the important part played by asbestos materials in ship construction, particularly for the safety of those who go

to sea, may continue to be enjoyed at no risk to those who build the ships.

Acknowledgments

Much valuable help has been given in the preparation of this paper from manufacturers and users of asbestos materials in the United Kingdom. In particular, the assistance is gratefully acknowledged of Surgeon Commander P.G. Harries of the Royal Navy, Mr. Colin Douglas of Swan Hunter Limited, HM Factory Inspectorate, members of the Working Groups of the Environmental Control Committee and member companies of the Asbestosis Research Council.

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