THE ELIMINATION OF ASBESTOS IN H.M. SHIPS

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Evidence has shown that asbestos of a certain particle size and in certain concentration can be a hazard to health. In recognition of this, the Ministry of Defence (Navy) took stock of all of its uses of asbestos and after consultation with the Medical Director General, determined those usages which would cause a hazard. The most dangerous processes were the spraying and removal of crocidolite asbestos used for environmental and fire insulation. This material has not been applied since 1963 but the hazard remains when it is removed during refits. This will become increasingly rare as the older ships are removed from service. The most troublesome remaining materials are those used in the insulation of steam machinery.

For some years the principal insulating material had been amosite asbestos but some four years ago this had been changed to calcium silicate for technical reasons. However, this latter material contained some 14 per cent of asbestos fibre and clearly presented a hazard. The main insulation is held in place with asbestos cloth and finally over-coated with an asbestos containing harder setting composition.

These materials are applied in the confined, limited ventilated spaces of ships' engine rooms and the first object was to control the amount of cutting and forming that could be allowed until such time as asbestos-free material could be obtained. To the latter end, specialist firms were approched and encouraged to develop asbestos-free materials as a matter of some urgency.

To explore the problem and to evaluate any asbestos-free materials that were available, two ships were selected. These were the frigates H.M.S. *Jupiter* building at Messrs Yarrow & Co, and H.M.S. *Scylla* building at H.M. Dockyard, Devonport. H.M.S. *Jupiter* was about six months ahead of H.M.S. *Scylla* so it was decided to concentrate upon methods of application using available materials which were either asbestos-free or had a lower asbestos content.

It was decided to use a calcium silicate containing only 5 per cent asbestos as the inner layer insulation for pipes and fittings and of such a thickness as would reduce the hot face temperature of 950 degrees F to 600 degrees F. The outer layer of insulation could then be asbestos-free magnesia. In terms of thickness this normally meant that half the thickness was calcium silicate and half was magnesia but, of course, in terms of volume, the amount of asbestos-free magnesia was considerably greater. The sections were buttered and mortared in the appropriate plastic materials which were asbestos-free. The asbestos cloth normally used to secure the sections was changed to a lock weave staple fibre glass cloth and the whole coated with an asbestos-free cement.

Since the greatest hazard would be dust emission consequent upon cutting and fitting operations and because asbestos was still present, an exercise was mounted to prove that bends could be insulated by prefabrication either at the factory or at the dockside. It was found that with most standard bends, quite adequate prefabrication was possible at the factory using such information as was available on construction drawings. It was apparent that most pipe bends are bent on a mandrel and that most of these machines were provided with standard dies of 3 times the diameter of the pipe. For bends which did not conform to this standard, templates were taken and sections prefabricated at the dockside. It was found that these bends fitted more accurately than those cut in place and a bonus in increased efficiency and a decrease in wild heat is confidently expected.

The reduction in cutting within the machinery spaces gave the following figures. Sampling was achieved by the Draeger hand-pump/membrane filter method.

	Observations	*Dust Counts—Fibres per cc*
Boiler Room	2 men. Applying magnesia sections to calcium silicate on pipe above the evaporators	4·5 at source 1·6 general atmosphere
	5 men. Applying calcium silicate sections to steam pipe between port boiler and port stop valve	1·9 at source 1·3 to 1·9 general atmosphere
	2 men. Sewing glass cloth to magnesia on pipe above the evaporators	1·6 at source
	2 men. Applying calcium silicate slabs (radiused and bevelled) to boiler uptakes	6·6 at source
	3 men. Clearing up round evaporators	1·9 at source 1·6 to 2·4 general atmosphere
Engine Room	1 man. Applying glass cloth to magnesia on pipe above machinery control room	2·1 to 2·6 general atmosphere
	2 men. Applying prefabricated bends (composite) to pipe on starboard side of machinery control room	1·5 to 2·3 general atmosphere
	2 men. Applying calcium silicate slabs to gland steam reservoir	2·9 at source
Generator Room	4 men. Removing calcium Silicate slabs from carton and applying to exhaust pipe outboard of starboard generator	10·0 to 20·6 at source 12·3 general atmosphere
	2 men. Applying calcium silicate slabs (radiused and bevelled) to bend on exhaust pipe aft of port generator. Some sawing	29·0 at source 5·7 to 24·1 general atmosphere

Note: Dust count figures above marked 'general atmosphere' are dust levels in parts of the space concerned other than in the immediate area of lagging application. They are generally the result of samples taken at one or more of the agreed fixed points.

These figures may be compared with the following average dust counts taken in controlled conditions using normal asbestos containing materials and cutting in machinery space:

	Dust Counts—Fibres per cc
Boiler Rooms	22·4 general atmosphere 16·8 breathing zone
Engine Rooms	2·1 general atmosphere 7·0 breathing zone
Sawing calcium silicate section	67·9 general atmosphere 54·6 breathing zone

Removing calcium silicate section from carton	30·9 general atmosphere 54·6 breathing zone
Cleaning up	133·7 general atmosphere 154·7 breathing zone

It is readily apparent that a considerable reduction in hazard has been achieved. H.M.S. *Jupiter* is now completed and long term experience of the new materials and methods are awaited.

The delay in starting H.M.S. *Scylla* has enabled us to use materials completely free from asbestos but it has been decided to hold to the discipline finally worked out for *Jupiter* because dust is a machinery hazard if not a health hazard and the better fitting of bends is a bonus regardless of material.

In choosing asbestos-free materials some loss of physical properties has had to be accepted. The limiting temperature has been reduced to 1200 degrees F from 1650 degrees F and while this might be thought quite adequate for a system operating at 950 degrees F it has always been our guiding principal to aim for a limiting temperature of working temperature plus 50 per cent to avoid any possible long term deterioration of the insulant. Only time can tell if we have achieved this. Some compressive strength is lost and this is of importance in the congested machinery spaces of a ship where contact and even standing upon insulation cannot be avoided.

In addition, glass cloth is not as pliable as asbestos cloth. More care is needed and draping of cloth round bends is not so easy. There is also some evidence that the glass cloth relaxes and 'bags'. This, however, is offset by the use of our final coating of cement and provided that this is applied early enough after the glass cloth then 'bagging' is avoided.

To sum up, it is quite clear that the virtual ban on asbestos products for insulation will not prove an insuperable barrier to good insulation practice.