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THE USE OF NETS AS BARRIERS FOR RETAINING HIGH EXPANSION FOAM

for

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Summary

Tests have been carried out to define the properties of a net material which could be used to retain high expansion foam. The possible use of this net material is to sub-divide large compartments if these are to be protected by high expansion foam. The tests have indicated that net curtains with a mesh area of 0.1 in^2 are likely to retain foam sufficiently to allow the foam to build up to a height of about 20 ft.

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Introduction

A way of protecting moderately large compartments against fire is to arrange that in the event of fire the whole of a compartment is filled with high expansion foam. There is, however, a practical upper limit of size of compartment which can be protected this way for the following two reasons:-

(a) to be effective the operation must be completed in a short time (say about 10-15 minutes). The outputs of high expansion foam from appliances of the largest reasonable size is about 25,000 - 50,000 cu.ft/min. This gives an upper limit of size of about 0.5 - 1 million cu.ft, if the installation is based on the output of a single appliance;

(b) it would be undesirable to fill the whole of a very large compartment (e.g. a large single-storey undivided factory) with high expansion foam in order to extinguish a fire in one part of the compartment, even if the fire concerned is a fierce one.

A possible way of dealing with this situation is to install in a very large compartment an arrangement of curtains which, if allowed to fall, would sub-divide the compartment. In the event of a fire the curtains in the immediate vicinity of the fire could be made to form a sub-division to which high expansion foam could be fed, the function of the curtains would be to keep most of the high expansion foam inside the sub-division.

To be effective, the curtains must be both light and cheap, and probably also non-flammable. It has been noted in experiments with high expansion foam that the latter does not flow easily through small holes. It was thought that this property could be turned to advantage by making the curtain, as described above, from light net. The object of the tests described below was to define the type of net that would be needed to retain high expansion foam.

Experimental

Four types of material were investigated, two of nylon, one of Terylene and one of asbestos. The shapes and sizes of the holes in the materials are shown diagrammatically in Figure 1.

The tests were carried out by generating high expansion foam from a 6 in generator into the top of a tower 17 ft high and 4 ft x 4 ft cross section. Three of the long sides of the tower were made impermeable, the fourth side was left open. This open side was covered by the material being tested (Plate 1).

In the test the following measurements were made:-

(a) the expansion ratio of the foam

(b) the rate at which the foam was generated

(c) the height of foam retained before leakage took place

(d) the maximum height of the foam retained in the tower

For all the tests the high expansion foam was generated using an aqueous solution containing 1 per cent of ammonium lauryl sulphate.

Results

The results obtained in the tests are summarised in Table 1. All the nets tested allowed a substantial head of foam to build up on one side, varying from 48 in for material No.2 to at least 204 in for material No.1. Owing to the different expansion ratios which occurred in the tests, the build-up of foam before leakage occurred could not be compared directly between the four materials. However, the critical height when divided by the high expansion ratios gave an equivalent head of water which, when plotted against the area of hole in the net, (Figure 2), was found to be inversely proportional to the 0.4 power of this area. There are theoretical reasons which would suggest that the equivalent head should be directly proportional to the length of net material per unit area, but the plot of these two quantities did not give a good correlation.

After the high expansion foam began to leak through the net a substantial increase in the height of the high expansion foam occurred before the rate at which high expansion foam was fed into the enclosure equalled the rate at which the high expansion foam flowed through the net. The limited results on the three materials indicate that the weight of the extra head of foam thus formed was proportional to the square of the total flow of liquid through the net.

Discussion

The results show that a net material with properties within the range of those tested would be adequate for retaining high expansion foam in a protective installation. It is expected that on the large scale, the expansion of the foam will be greater than the expansion which was used in the tests (1,000 - 1,500 instead of 500 - 800) and the flow rate of foam per unit width of net would be higher (40 - 80 cu.ft/min per ft width instead of 18 - 20 cu.ft/min per ft width). Inserting these values into the available correlations shows that if a net is used with the hole size of 0.1 in^2 the high expansion foam would build up to about 10 ft before leakage through the net started, and to about 20 - 30 ft before the flow to the net equalled the flow through the net. This performance would generally be good enough for most practical situations.

There is no evidence from the tests carried out that there is a substantial difference between different materials. The asbestos material was very much simpler in construction than the plastic materials; it was of course also much weaker. The strength of a material, however, is not of overriding importance and if a non-flammable fabric were required, asbestos could be used. Another possibility would be to use an ordinary string net which had been treated with a fire retardant.

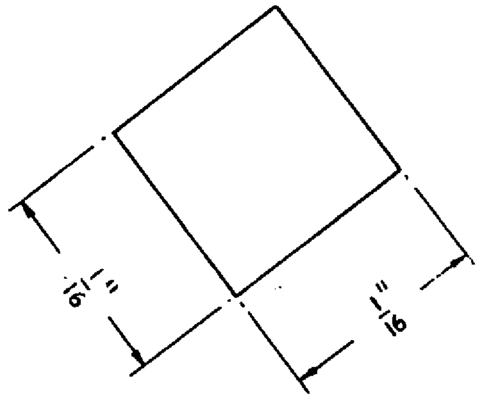
The weight of curtains 20 ft long of materials of the type which have been tested would be about 1 lb/ft run of curtain. This should not give rise to any substantial increase in the loading of buildings, even if the curtains are weighted to allow them to fall more surely into position. It would also be possible to tolerate many obstacles near the floor on to which the curtains fall, since the curtains could drape themselves round the obstacles without leaving too much space for the high expansion foam to flow.

Table 1

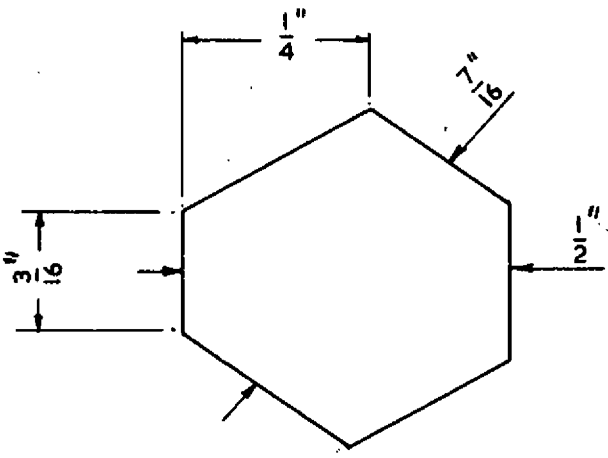
A comparison of the foam retaining properties of four materials of various fibres, weaves and hole sizes

No.	Material	Area of hole in^2	Wt. of material oz/yd^2	Foam Expansion Ratio	Rate of foam generation	Height of foam at which leakage occurred in. (h_o)	Equivalent height in. water	Maximum height of foam column in (h_m)	Maximum additional height caused by flow of foam $h_m - h_o$
1	Nylon 1	0.0031	7.8	500 : 1	80	No leakage at max. height of 204	0.41+	204+	N.D.
2	Nylon 2	0.18	9.3	500 : 1	80	48	0.096	120	72
3	Terylene	0.062	5.4	800 : 1	72	114	0.143	162	48
4	Asbestos	0.42	11.7	770 : 1	80	54	0.070	108	54

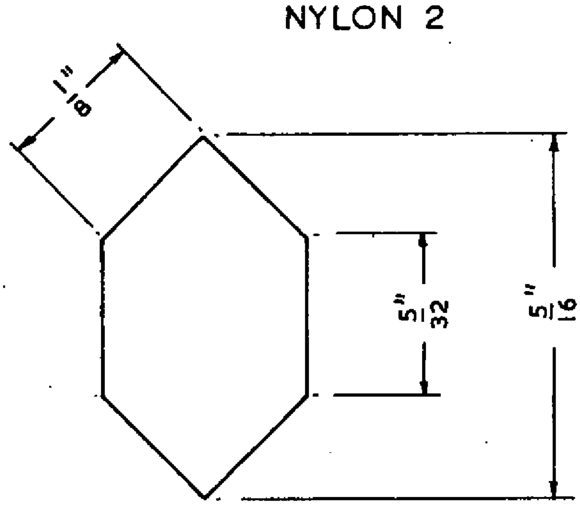
N.D. Not determined



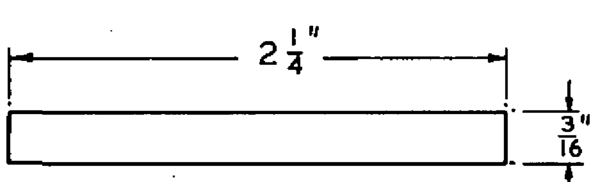
Area of hole – 0·0031 in^2
Ratio of perimeter to area – 8·05 in / in^2
NYLON 1



Area of hole – 0·18 in^2
Ratio of perimeter to area – 10 in / in^2
NYLON 2



Area of hole – 0·062 in^2
Ratio of perimeter to area – 13·1 in / in^2
TERYLENE 1



Area of hole – 0·42 in^2
Ratio of perimeter to area – 11·6 in / in^2
ASBESTOS

Not to scale

FIG.1. SHAPES AND DIMENSIONS OF HOLES IN MATERIALS INVESTIGATED

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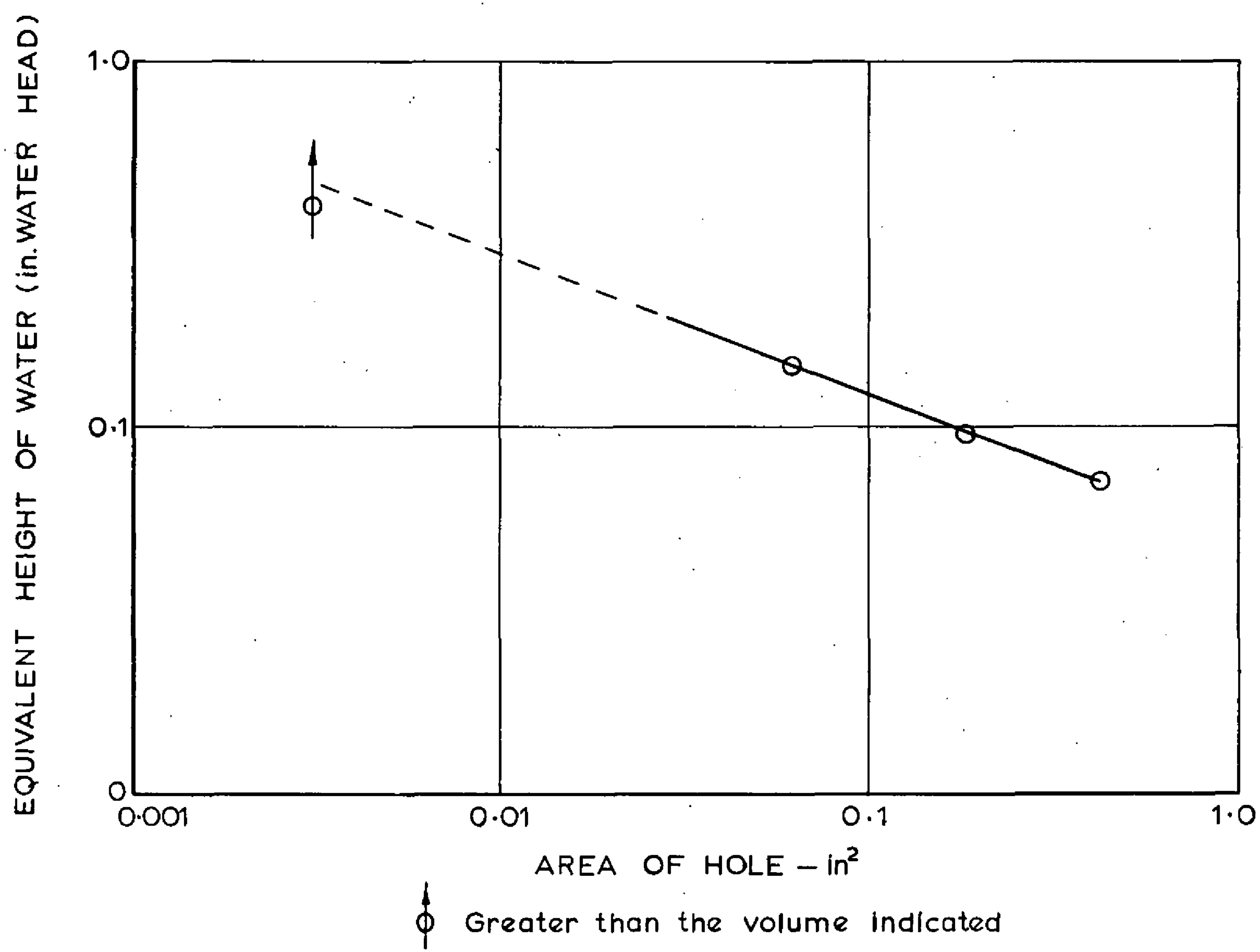

FIG. 2. RELATION BETWEEN EQUIVALENT HEIGHT OF WATER RETAINED AND HOLE AREA

APPARATUS FOR MEASURING THE RETENTION OF FOAM BEHIND A NET

PLATE 1