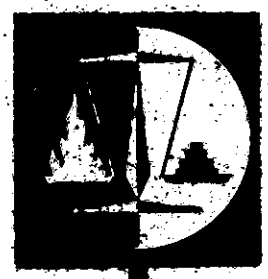

Fire Research Note No. 627

DURABILITY OF FLAME RETARDANT TREATMENTS
Results of some tests on plastics rooflights

by

H. L. MALHOTRA

FIRE RESEARCH STATION

Fire Research Station,
Borehamwood,
Herts.
ELStree 1341

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MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
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INTRODUCTION

The performance of many combustible materials in fire can be improved by the use of flame retardant treatments. These treatments usually consist of either a surface coating or the incorporation of chemicals in the structure of the material which inhibit ignition and combustion. The improvement in the performance of materials can be judged by subjecting them to the appropriate fire tests. Materials are usually tested in a condition when the treatments are new but for continued safety it is necessary to know if their effectiveness is likely to be impaired in service. The durability of flame retardant treatments is currently receiving attention and some investigations are in hand to determine their effectiveness after known exposure in service.

When materials are used inside buildings in reasonably dry and constant temperature conditions, flame retardant treatments are likely to remain effective for a long period of time. On the other hand when materials are used externally they are exposed to a wide range of humidities, variations in temperature and to sunlight. All these factors can have an appreciable effect on the useful life of materials and treatments and there is need for information on how successfully a flame retardant treatment could survive exposure to weather.

PLASTICS ROOFLIGHTS

Roofs in buildings are required under Regulations to act as a barrier against the passage of fire from an external source, and to have exposed surfaces which do not spread fire readily. Their effectiveness is judged by subjecting representative constructions to a standard test called the "External Fire Exposure Roof" test described in B.S. 476 : Part 3. The test is in two parts and determines the time of penetration of fire and the extent of flame spread on the upper surface of a roof specimen. The performance of the specimen constructions is indicated by a grading system consisting of two letters - denoting performance in the two parts of the test respectively.

In industrial and storage buildings it is customary to provide some clear or translucent panels in the roof for purposes of lighting. These may consist of glass or plastics materials and for the latter both thermoplastic and thermosetting products are available. Polyester resin reinforced with a mat of glass fibre, a thermosetting material, has become very popular for this purpose during recent years. In its standard formulation the resin in such rooflights is readily ignitable and burns easily once ignited. Its hazard can be reduced by introducing chemical flame inhibitors either in the composition of the resin or as an additive. On exposure to high temperatures, when the resin commences to decompose, the chemical products inhibit the flaming of the vapours.

In general, two methods are available for this purpose; in one the resin is based on het acid, and in the other phosphates, alone or in combination with antimony oxide, are employed. It has been shown that flame retardant resins do

not possess the same degree of weather resistance as the normal material but no data were available to show whether the fire retardant properties were adversely affected by weathering. In some accelerated weathering tests conducted at the Building Research Station[1] it was found that where comparisons could be made, the laboratory tests did not fully reproduce the same effects as those obtained in specimens subjected to the weather outside. It was felt that the laboratory test did not fully simulate the effects of ultraviolet light and humidity.

To obtain data on the weather resistance of flame retardant polyester resin rooflights it was decided to conduct tests on selected materials by exposing them on a site at the Building Research Station and drawing samples at intervals to determine their fire retardant properties in the tests of B.S. 476 : Part 3.

DESCRIPTION OF PROGRAMME

Five commercially available products were selected each employing a different resin with a known system of flame retardance. The materials are listed in Table 1 below:-

TABLE 1

List of Materials

Material reference	Flame retardant system
1	Resin A with T.C.E.P. (Tricresyl-ethyl-phosphate)
2	Resin B with T.C.E.P. (5 per cent)
3	Resin C with het acid (chlorendic acid)
4	Resin D with het acid
5	Resin E with T.C.E.P. and Antimony Oxide.

Full size sheets in a 3 in corrugated profile were mounted on metal frames at an angle of 45° and left in the open facing South as shown in Figure 1. A set of specimens was tested on the External Fire Exposure Roof test apparatus at the commencement of the weathering cycle to provide a datum for purposes of comparison. In the test two unjointed specimens, each 33 in x 33 in were tested for each part of the test viz. penetration test and flame spread tests. Tests have been conducted on specimens after weather exposure for 6, 12 and 24 months. Further tests are planned after a 5 year exposure and, if considered necessary, enough material is available for a more prolonged exposure.

RESULTS OF TESTS

After 6 months exposure very little change in appearance was noticed and after 12 months some of the materials began to show noticeable deterioration in appearance. In Figure 2 two sheets are shown together, 'A' was stored indoors and 'B' was exposed for 12 months; the latter shows some loss in translucency and the appearance of glass fibre strands on the surface.

The changes in appearance of the specimens are tabulated below and small cut outs are shown photographed together in Figure 3.

TABLE 2

Change in appearance of specimens after 2 year exposure

Specimen Ref.	Colour change	Exposed face	Glass fibre mat
1	none	no obvious change	not visible
2	light yellow	loss of smoothness	just visible
3	yellow	loss of smoothness	not visible
4	slight yellowing	loss of smoothness	fibres visible
5	slight yellowing	no obvious change	just visible

The results of the fire tests at various ages are shown in Table 3 overleaf.

TABLE 3. (Cont'd)

Age	Specimen No.4		Specimen No.5	
	Penetration	Flame spread	Penetration	Flame spread
New	None No flaming	None	None Flaming 33 per cent	7.5 in
6 months	None Flaming 5 per cent	None	None Flaming 100 per cent	16.5 in
12 months	None No flaming	None	None No flaming	2 in
24 months	None No flaming	None	None Flaming 75 per cent	None

CONCLUSIONS

The investigation on the effect of exposure to weather on the fire retardant properties of plastics rooflights is not complete yet and therefore the conclusions are tentative. After exposure to outdoor weathering conditions for 2 years, with one exception the materials have undergone some deterioration of translucency, the exposed surface in three of the materials has lost smoothness and the glass fibre mat has become visible. Although there appears to have been some slight deterioration in fire retardant properties after 6 months none of the materials have shown any sustained deterioration after longer exposures; on the other hand almost all materials have showed a reduction in the extent of flaming on the upper surface. It is possible that the destruction of some resin from the exposed surface may have had a beneficial effect by reducing the quantity of resin available for combustion. There appears to have been no leaching or migration of the flame retardant chemicals.

References

(1) The weathering behaviour of G.F.R.P. Sheeting. Building Research Station Miscellaneous Papers, No.2.

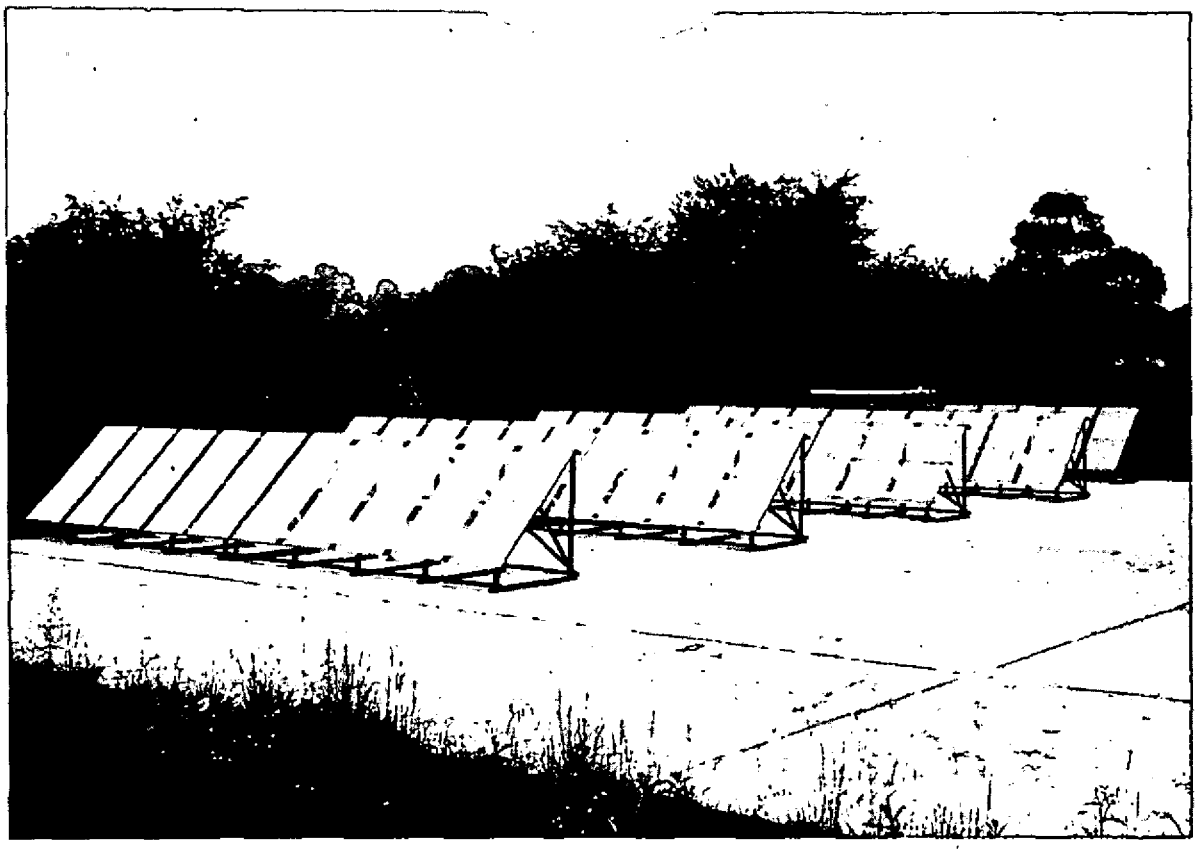

FIG. 1. WEATHERING OF PLASTICS ROOFLIGHTS

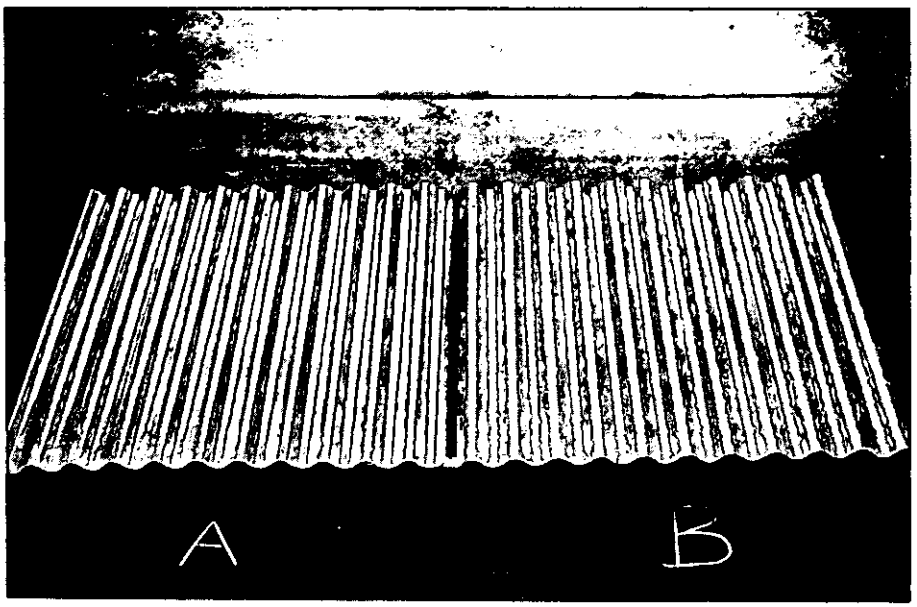

FIG. 2. COMPARISON OF MATERIALS AFTER 12 MONTH EXPOSURE

A - unexposed B - exposed

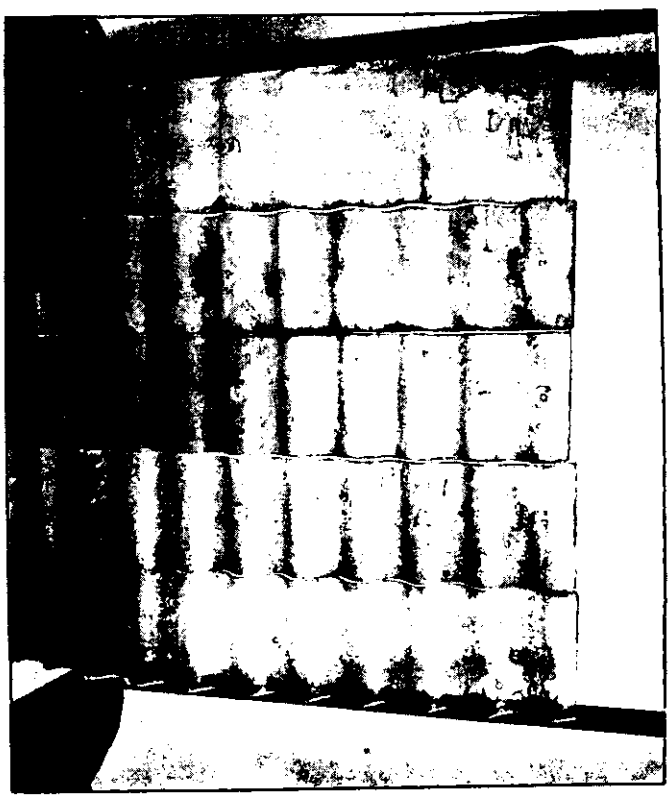

FIG. 3. SAMPLES OF MATERIALS AFTER 24 MONTH EXPOSURE

(Nos 1 to 5 from top to bottom)