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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

THE EFFECT OF COATINGS ON THE IGNITION OF FIBRE INSULATING BOARD BY HIGH TEMPERATURE RADIATION

by

Patricia M. Hinkley

Summary

A number of paints of high reflectivity have been exposed to radiation from a high temperature source. A phosphate resin paint was found to be the most effective in preventing ignition but distemper, which is cheap and readily available, was nearly as effective.

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1. Introduction

Unlike the radiation from fires(1), the radiation from an atomic explosion contains an appreciable part of its energy in the visible spectrum and therefore the shade or hue of a protective coating is important. Thus it is important to choose paints which have at least as high a reflectivity as the untreated surface otherwise they might afford little protection and might even increase the possibility of ignition by absorbing more heat.

The usefulness of some paints of high reflectivity is examined in this note. The choice was restricted to those available at the time of testing. The base material was fibre insulating board of density 0.29 g/cm^3, of thickness 1.25 cm.

2. Treatments used

Five treatments were used. Details are given below in Table I.

TABLE I - DETAILS OF MATERIAL AND TREATMENTS

Treatment	No. of coats applied	Weight applied g/cm^2 (lb/ft^2)	Colour	Approximate absorptivity per cent 0.4 - 0.7 μ	Remarks
Untreated fibre insulating board	-	-	Fawn	55	Density 0.29 g/cm^3 (18 lb/ft^3)
Distemper	2	0.03 (0.06)	Yellow	30	Made up to manufacturer's instructions
Silicate paint (A.R.P. type)	1	0.048 (0.1)	Off-white	30	Made up to instructions in B.S. 476 (1953)
Phosphate resin paint	1	0.016 (0.033)	White	20	-
Phosphate resin paint	2	0.03 (0.062)	White	20	-

After treatment, 2 in. square specimens were dried in an oven at 100°C for 24 hours and cooled over phosphorus pentoxide. The reflectivities were measured using the Paint Research Station reflectometer(2) which contains a tungsten filament lamp to illuminate the surface and a photocell with a spectral response similar to that of the human eye to measure the reflected radiation. These measured values of reflectivity may be somewhat low for radiation from a carbon arc source or an atomic explosion(3) but this would not affect significantly the results of Table II.

3. Experimental procedure and results

The specimens were exposed to radiation of various intensities from a carbon arc and ellipsoidal mirror source(3). The ignition time of the specimens was recorded automatically.

The intensity of radiation was measured with a water-cooled thermopile. The results are shown in Fig. 1, each point being the mean of six results.

The lack of adhesion of the double coating of phosphate resin paint caused a large variation in the ignition times and made it useless as a protective paint. The lighter coating appeared to be quite durable and did not flake off. With silicate paint the fibre insulating board sometimes smouldered under the paint layer.

4. Discussion

All the paints and distemper do retard, in varying degrees, the ignition of fibre insulating board. The single coat (0.016 g/cm^2) of phosphate resin paint provides the greatest protection of those tested. This treatment increases the time taken to ignite by a factor of at least five, over the range of radiation intensity used. The silicate paint is as effective as the phosphate resin paint in delaying ignition, but, at the lower intensities of radiation, where smouldering occurs this might spread to neighbouring unprotected combustible material. The distemper reflects less of the radiation incident upon it and has little effect at very high intensities of radiation, but at lower intensities of radiation (> 6 $cal.cm^{-2}s^{-1}$), it is the most effective of those tested. White distemper may be slightly better than the yellow one tested.

5. Application of results to an atomic explosion

The radiation from an atomic bomb falls off with increasing distance and as the visibility is reduced(4) the distance from the explosion at which ignition is just possible will be reduced by these treatments. For a nominal bomb this is shown in Table II.

TABLE II - DISTANCES AT WHICH IGNITION IS JUST POSSIBLE FOR DIFFERENT VISIBILITIES FOR A NOMINAL BOMB

Treatment	Distance (ft x 10^3)				
	Visibility in miles				
	3	6	12	25	50
Untreated	3.4	4.7	5.6	6.6	7.2
Silicate paint	2.6	3.4	4.0	4.4	4.8
Yellow distemper	2.8	3.8	4.4	5.0	5.5
Phosphate resin paint	2.6	3.5	4.0	4.5	4.9

The surrounding area from ground zero in which ignition is likely is thus reduced by a factor of about two.

6. References

(1) SIMMS, D. L. The ignition by radiation of fibre insulation board protected by some fire retardant paints. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization. F.P.E. Note 59/1951.

(2) TILLEARD, D. L., SMITH, N. D. P., and BULLETT, T. R. Measurements of the reflectance of paint films. The Research Association of British Paint, Colour and Varnish Manufacturers. Technical paper No. 141 (M) Vol. 7, No. 1. December 1945.

(3) HINKLEY, P. L. Source of high intensity radiation employing an arc lamp and ellipsoidal mirror. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization F.R. Note 270/1956.

(4) LAWSON, D. I. Fire and the atomic bomb. Fire Research Bulletin No. 1. H.M.S.O. London 1952.

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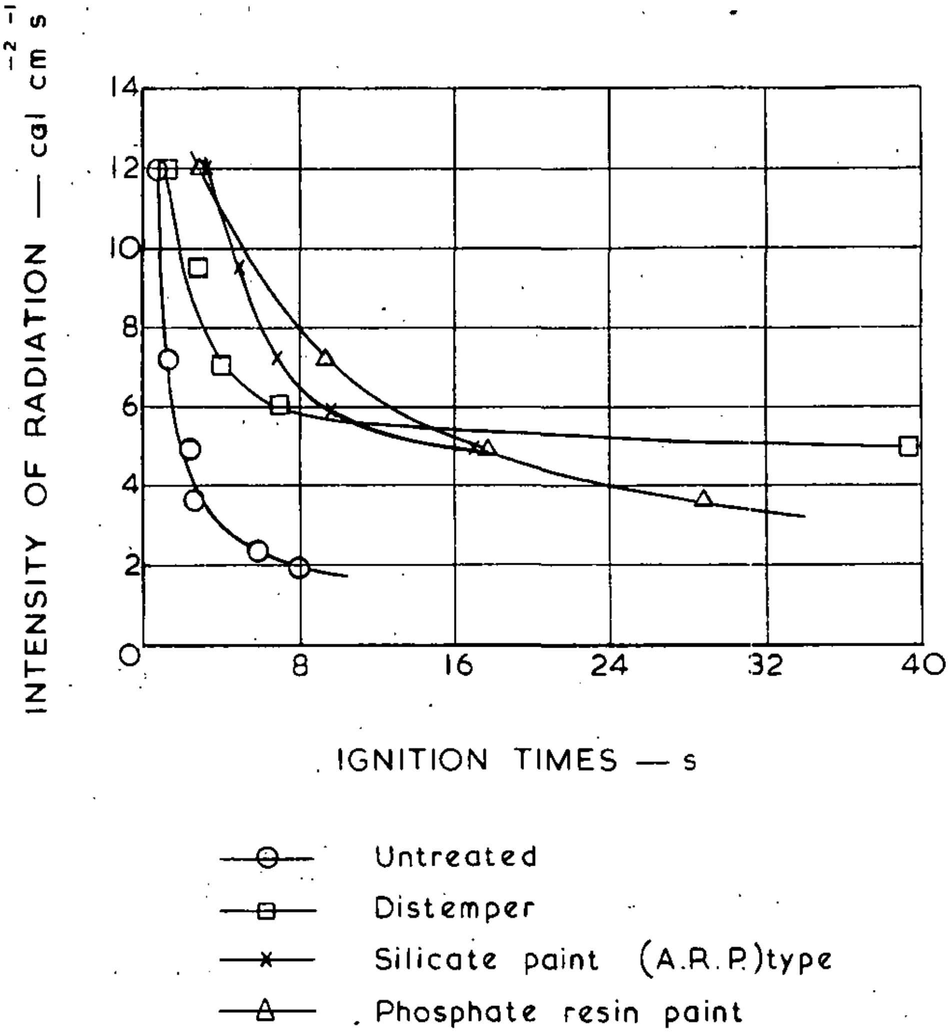

FIG.1. IGNITION TIMES FOR TREATED AND UNTREATED FIBRE INSULATING BOARD

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