# Fire Research Note No. 859

## INTUMESCENT MATRICES AS FIRE RESISTANT PARTITIONS

by

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## SUMMARY

The application of intumescent paint to honeycombs provides a lightweight fire resisting partition which may be made of paper and board. The painted honeycomb itself has the property of being perforate under normal conditions and will close once a fire occurs. It may therefore have application in ventilation ducts to stop the spread of fire and for suspended ceilings to prevent fire attacking lighting fitments and services.

KEY WORDS: Columns, doors, partition, ceiling suspended, paint, intumescent.



DEPARTMENT OF THE ENVIRONMENT AND FIRE OFFICES' COMMITTEE

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## INTUMESCENT PAINTS

Intumescent paints have been in use for over 20 years as a means of protecting flammable surfaces from spreading flame in fire. The paint consists essentially of a resin which will soften under the influence of heat, together with a chemical which will decompose releasing volumes of a gas, usually nitrogen or ammonia. The gas aerates the resin, which ultimately sets into a friable meringue-like mass with the application of further heat. (Plate 1). This solid thermally insulating foam will then protect the flammable surface from further attack by fire.

These paints are very successful in preventing the spread of flaming and the question arises as to whether such a well-insulating solid froth might not be used to protect structures from fire. Here, the problem is to produce a thermally insulating coating round a steel column, or even a partition, which will prevent heat being transmitted from the fire to the column or partition causing its temperature to rise to a point at which it will collapse or, in the case of a partition, to transmit enough heat to start fires on the side remote from the original fire.

The difficulty in using paints in this way is that of applying sufficient paint to the surface to get an adequate level of fire resistance and of increasing the mechanical strength of the expanded mass. One way is to include glass fibre in the paint: this allows a greater thickness to be applied. Another method is to include inert fillers in the paint to make a kind of porridge which can be trowelled on to structures or partitions.

## PAINTED MATRICES[1]

An alternative method of increasing the depth of paint is to use a matrix to carry the paint so that the interior surfaces of the matrix are coated. This has a dual advantage: it permits more paint to be carried than would be carried by unit area of plane surface, and also it would provide a relatively strong framework for the paint once it had intumesced. (Plate 2).

Different shapes of matrices are able to carry varying amounts of paint in relation to the plan area they cover. (Table I). The triangle, square and hexagon, having a depth equal to the linear dimension of unit cell, carry respectively 700%, 400% and 230% more paint than a plane surface of the same area coated to the same thickness. The most readily constructed matrix is the hexagon, and this is commercially available in paper and aluminium.

As the honeycomb is protected from fire by the intumescent paint, it is found that paper will give good fire resistance and the choice between paper and aluminium is probably dictated by functional strength, though a paper honeycomb painted with intumescent paint is strong and can be cut with a bandsaw.

PRACTICAL APPLICATIONS

1. Ventilation Dampers

A paper honeycomb coated with intumescent paint will allow the free passage of ventilation air but should a fire occur, the paint will swell shutting off the ventilator. Furnace tests indicate that a 25.4 mm (1 in) thick paper honeycomb coated with 0.2794 mm (0.0011 in) intumescent paint will close in about 1 minute in a furnace test and will give a fire resistance rating of about 40 minutes. On the assumption that fire resistance times are proportional to the square of the thickness, a ventilator having a thickness of 31.75 mm (1¼ in) should give 1 hour's fire resistance. The suggestion would be that an intumescent honeycomb should be placed at the outlet of each ventilation duct into rooms or compartments. Here the velocity of the air is low and the loss of head on the ventilation system would be low by the introduction of such a damper.

2. Fire resisting partitions and doors

A fire resisting partition or door is formed by placing two finishing surfaces on the honeycomb. In the early experiments on ventilators, the indications are that a good deal of paint is lost as a doughy mass from the unexposed side of the specimen in the furnace. This would not occur in a honeycomb bounded by faces. The exposed face would be rapidly destroyed by fire and the expansion away from the fire would be restrained by the back face - expansion would therefore be forward, towards the fire. For this reason it is expected that the figures quoted for ventilators would be conservative for partitions and doors.

3. Suspended ceilings

The idea of using an intumescent honeycomb is attractive for suspended ceilings. The open honeycomb permits the passage of light and forms a decorative finish covering services. Once a fire occurs the honeycomb would close, protecting the services by forming a fire resistant ceiling.

It is expected that a ceiling of this kind would be formed of 609.6 mm x 609.6 mm (2 ft x 2 ft) sections in trays. As yet no experimental work has been carried out but a performance at least as good as that quoted for ventilators is expected, as any overspill of intumescent dough will be retained on the top of the ceiling after expansion.

CONCLUSION

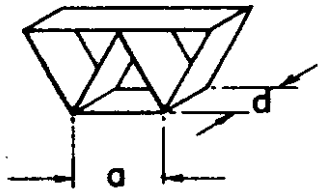
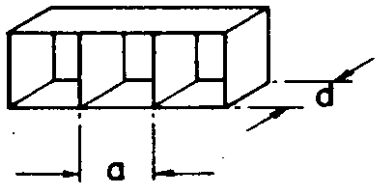
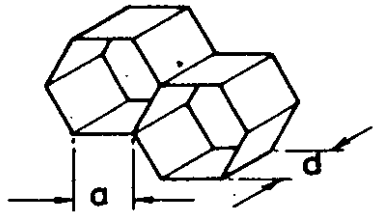
The use of intumescent coated honeycombs may lead to the production of lightweight partitions, doors and ceilings of which the cost could be highly competitive with existing structures having the same fire performance.

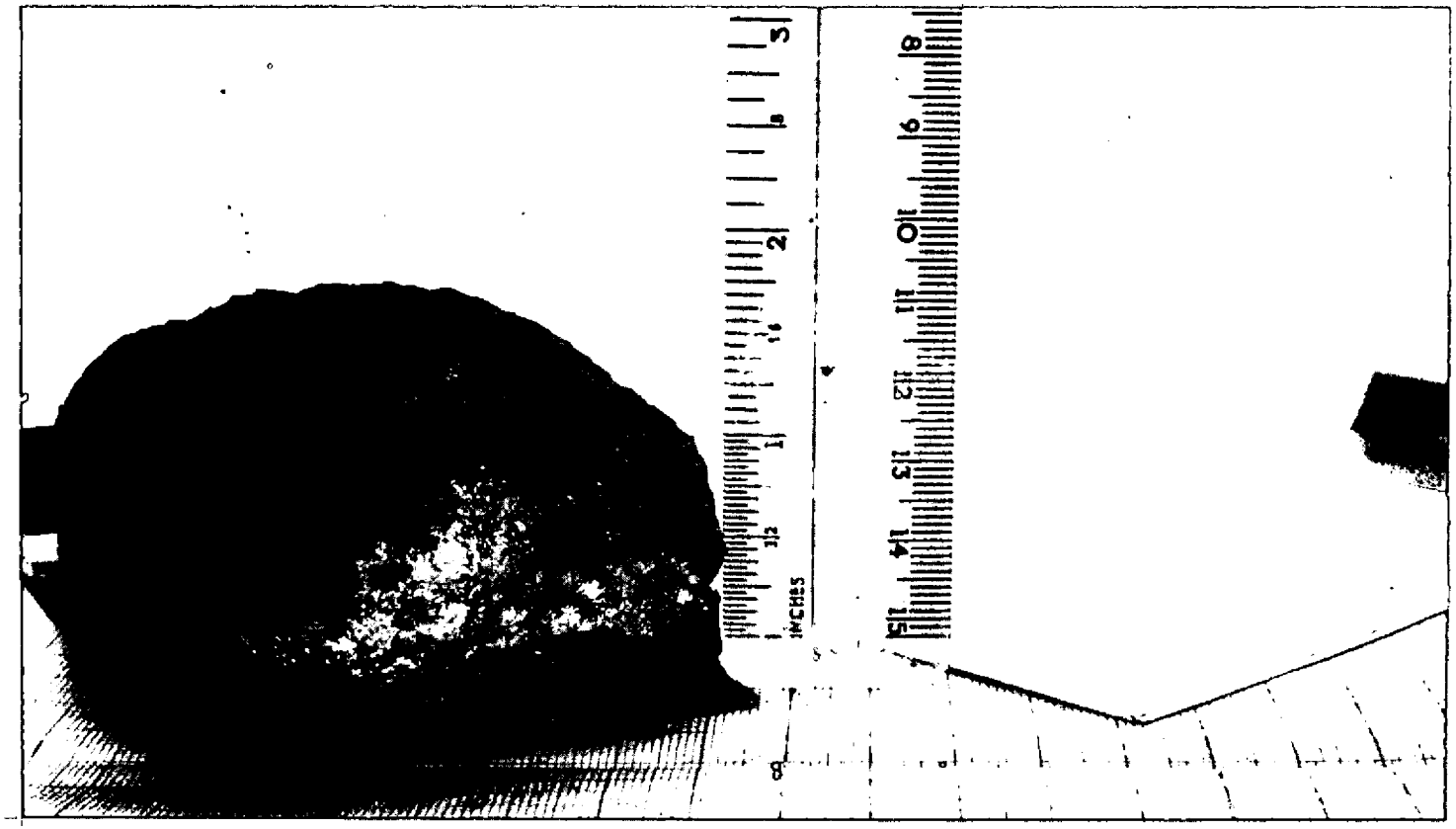
The fact that honeycomb is perforate before a fire occurs means that it can be used for the transmission of air in ventilation systems, or light in the case of ceilings.

REFERENCE

1. U.K. Patent Application No. 43423/70.

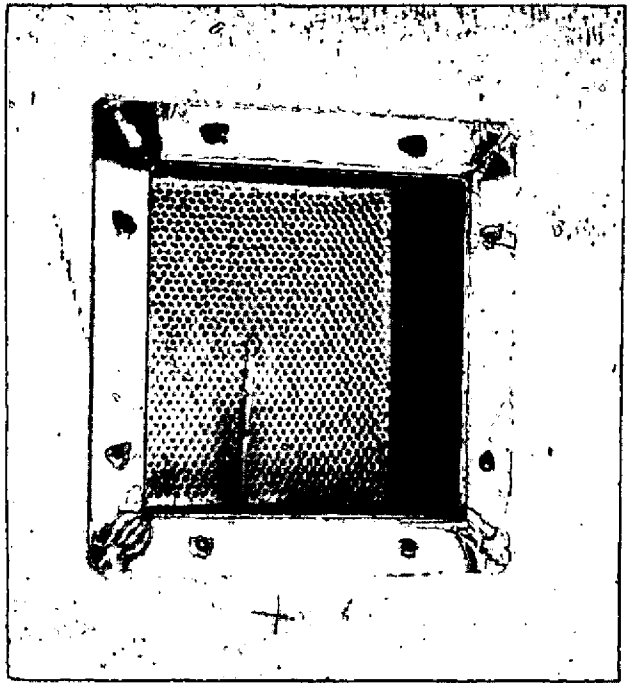
TABLE I

| TRIANGULAR | SQUARE | HEXAGONAL |
|---|---|---|
|   |   |   |
| Area covered by shape: | | |
| $\frac{\sqrt{3}}{4} a^2$ | $a^2$ | $\frac{3\sqrt{3}}{2} a^2$ |
| Area of internal surface: | | |
| $3ad$ | $4ad$ | $6ad$ |
| $\frac{\text{Internal area}}{\text{Area covered}}$ $\frac{12d}{\sqrt{3}a}$ | $\frac{4d}{a}$ | $\frac{4d}{\sqrt{3}a}$ |
| When d = a, percentage increase in paint carrying capacity over flat surface: | | |
| $\approx$ 700% | 400% | $\approx$ 230% |

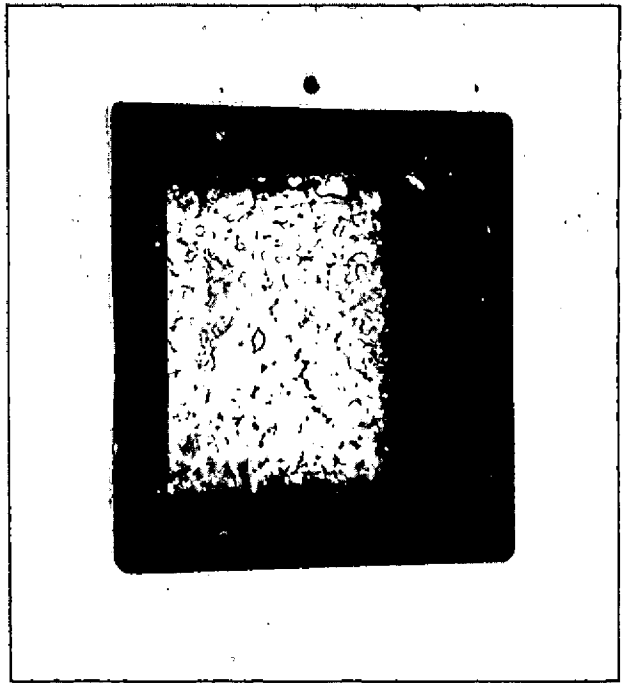



SPECIMEN PAINTED WITH INTUMESCENT PAINT
BEFORE AND AFTER BEING SUBJECTED TO HEAT

PLATE 1



Before



After

VENTILATION DUCT BEFORE AND AFTER BEING SUBJECTED TO FIRE

PLATE 2