

Fire Retardant Treatment for Curtain and Carpets

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Curtains and carpets are often used in buildings for decorative purposes. These are cellulosic materials, combustible in nature and catch fire easily. The curtains generally pose great fire hazards because they are always hanged vertically and the surface spread of the flame is quite fast.

To prevent the initiation and growth of fire, a fire retardant chemical formulation consisting of an ammonium salt of phosphoric acid and sodium salt of Boron has been studied. The fire performance of the treated fabric was evaluated following standard methods. The treated fabrics become fire retardant and on exposure to flame show no ignition, no flame spread and remain self-extinguished.

Introduction :

Most of the flame retardants used for cellulosic materials such as curtains, carpets and draperies etc are generally water soluble salts such as ammonium salts of phosphoric, boric and sulfuric acids and chlorides and bromides of aluminium, zinc, tin, chromium and antimony etc. 1-7

Two or more of these salts are generally combined together along with a wetting agent in water in varying concentrations. Although these are efficient flame retardants, they do not resist washings with water.

The present paper reports the results of various tests performed for the evaluation of fire performance and the tensile strength of the treated fabric.

MATERIALS AND METHODS :

(a) (i) Method for the treatment of the curtain cloth :

A 10% aqueous solution of ammonium salt of phosphoric acid and sodium salt of Boron (2:1 wt/wt) was prepared. Samples of curtain cloth were dipped in this solution for about half an hour. The samples were then removed, squeezed well and allowed to dry at room temperature. A chemical retention of 12-16% add on (dry basis) was found adequate for an efficient fire performance.

(ii) Method for the treatment of the carpet :

An area of 30 cm x 30 cm was marked at one corner of the carpet and measured quantity of a 10% aqueous solution of ammonium salt of phosphoric acid and sodium salt of Boron (2:1 wt/wt) was applied till it was completely wet. The amount of the solution required was calculated from the weights of wet and dry carpets.

The whole carpet was then sprayed with

the calculated volume of the above solution and kept for half an hour in the same position so that the solution gets impregnated completely, followed by complete drying. A chemical retention 12-16% add on (dry basis) was found adequate for an efficient fire performance.

(b) Test Methods :

(i) Fire performance test for curtain cloth :

The specimens of the size 31.75 cm x 5 cm were cut and tested according to B.S. 3319² and were mounted vertically. A bunsen burner, 19 mm internal diameter, was used as a source of ignition. Air flow was adjusted to produce a luminous flame of 38 mm length. The burner was kept in such a position so that the base of the flame was 19 mm below the middle of the lower edge of the specimen. The flame was applied for a period of 12 seconds and then withdrawn. The fire performance is reported in 'Result and discussion'.

(ii) Fire performance test for carpet :

Spirit was sprinkled on the treated and untreated carpets and it was then ignited with a match stick. The fire performance is described in 'Result and discussion'.

The treated and untreated carpets were also tested according to B.S. 4790³ for their fire performance. The specimen of the carpet 30 cm x 30 cm size was placed on the floor of the test chamber and the clamping ring was kept horizontally on the top so that it lay completely within the reach of the specimen. A 30 gm hexagonal stainless steel nut was heated to 900°C in a muffle furnace was placed on the centre of the specimen within 3 seconds of its removal from the furnace. The nut was removed after 30 seconds and the flaming time, after glow and the char area were noted.

(c) Tensile strength of untreated and treated curtain cloth :

Tensile strength of the samples of untreated and treated curtain cloth in both the directions (warp and weft) were determined by using

Tensometer Model type W (monsanto London).

Result and discussion :

The results of the fire performance test of curtain cloth are recorded in Table I.

It is evident from the Table I that the samples of the treated curtain cloth did not ignite and no flaming and after glow were observed. The specimen remain self extinguished while the untreated samples burns completely within 20 seconds (Fig. 1,2 and 3).

The spirit which was sprinkled on the treated carpet was ignited with a match stick. The spirit was burnt with the flame and the carpet remained unaffected while the untreated carpet when tested similarly caught fire and was converted into ash completely.

The samples of treated carpet tested according to B.S. 4790 (Hot nut method) showed no flame spread, no after glow and no heat penetration. The char area calculated was 2 cm² which is within the permissible limits while the untreated samples showed flame spread upto 7 seconds and after glow upto 55 seconds. Heat penetration was also observed. The char area was calculated as 4.5 cm².

The tensile strength data (warp and weft) in respect of the untreated and treated samples are presented in Table 2. It is clear from the table that only a slight loss in tensile strength results from the treatment. The reduction in tensile strength along the fibre (warp side) is 7% and across the fibre (weft side) is 5%.

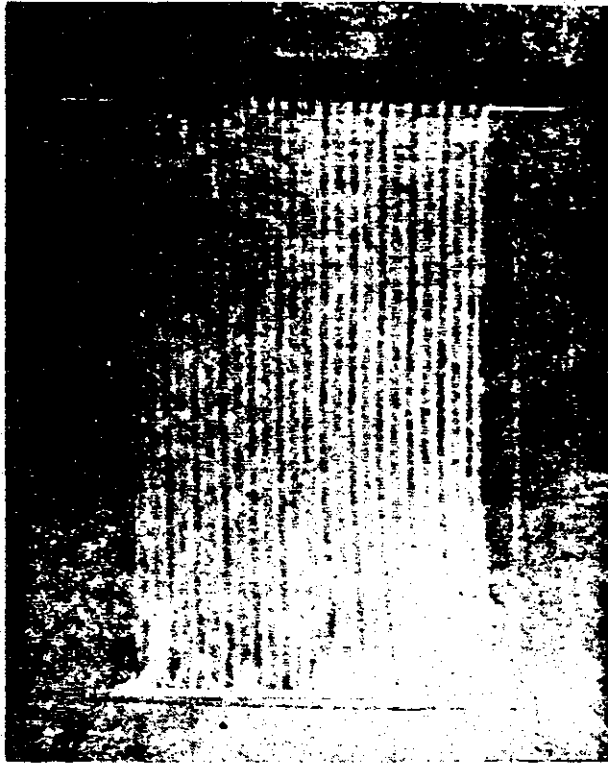
The fire retardants used in the chemical formulation when heated melt relatively at a low temperature and subsequently resolidify in the form of a solid foam stable at pyrolytic temperature produced by the evaluation of decomposition products^{3,4}. The solid foam serves as a barrier between the flame, air and fabric, provides thermal insulation and entraps volatile tars. Retention of the tars encourages their secondary pyrolysis to char, thereby reducing the volume of volatile combustibles¹⁰.

Table 1 Fire Performance Test of Curtain Cloth

<i>Sl. No.</i>	<i>Exposure Time Sec.</i>	<i>Time of flame spread Sec.</i>	<i>Time of after glow Sec.</i>	<i>Char area cm²</i>	<i>Remark</i>
Untreated Curtain					
1.	12 Sec.	Flame spread continued			Burnt entire length.
Treated Curtain					
2.	12 Sec	0 Sec	0 Sec	8 cm ²	Self extinguished.
3.	12 Sec	0 Sec	0 Sec	8 cm ²	"
4.	12 Sec	0 Sec	0 Sec	8 cm ²	"
5.	12 Sec	0 Sec	0 Sec	8 cm ²	"

Table 2. Tensile Strength of Untreated and Treated Curtain Cloth.

<i>Sl. No.</i>	<i>Warp</i>	<i>mean</i>	<i>Weft</i>	<i>mean</i>
Untreated				
1.	28 kg		15 kg	
2.	29 kg	29 kg	16 kg	16.7 kg
3.	29 kg		15 kg	
4.	29 kg		20 kg	
Treated				
1.	28 kg		14 kg	
2.	28 kg	27.5 kg	13.5 kg	15.4 kg
3.	27 kg		14.0 kg	
4.	27 kg	Reduction 5%	20.0 kg	Reduction 7%



**Fig. 1 Left— Untreated (Just Caught Flame)
Right—Treated (Exposed to Flame)**



**Fig. 2 Left—Untreated Curtain burning with flame
Right—Fire Retardant Curtain remain unaffected**



**Fig 3 Left—Untreated Curtain Completely burnt
Right—Fire Retardant Curtain remain unaffected except for the Charred portion**

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