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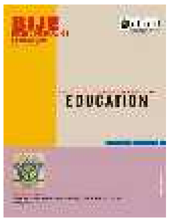

A STUDY OF THE EFFECT OF BORIC ACID AS A FLAME RETARDANT IN WHITE ENAMEL PAINT

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ABSTRACT

Flammability characteristics of enamel white paint were altered with different concentrations of boric acid crystals to determine its effects as a flame retardant in paints. A control and four different concentrations of Boric acid solutions were used. The characteristics investigated were: Flame Velocity, Add-on %. After Glow Time. Cellulose Burnt %. Flame Velocity % and the length of the timber completely burnt. From this research work it was found that Boric acid is a good flame retardant in paints with enhanced effect at increased concentrations. Therefore, boric acid can be used to reduce the devastating effect of fire incidence.

INTRODUCTION

The pioneering works of Wyld in 1735 and Lussac in 1812 revealed how flammability of materials could be controlled and what makes them burn. Estimation shows that, in Africa, over 70% (Nigeria as a case study) of the population are provided with shelte3r by rural housing including furniture and other wooden. This means that about 30% of Nigerian population are living in the urban areas where the use of paints decorations, especially on wooden such as furniture in houses is very common, hence to the high flammability of paints when ignited since most organic substances are combustible i.e. inflame if heated strong enough (Garba and Eboatu 1990). Building codes, specifications and other standards in use throughout united states and many other developed countries set limits of acceptability for the surface flammability of combustible materials used for purposes where protection of life from fire must be considered. One of the largest areas so regulated is the interior finishes including walls and ceiling surface used for houses sand other buildings (Garba and Eboatu, 1990). Paints, often referred to as organic coating can be defined as a fluid with viscosity, drying time, and flowing properties dictated by formulation normally consisting of a vehicle or binder, a pigment, a solvent or thinner, and a drier which may be applied in relatively thin layers and which changes to a solid in time. The change may not be reversible, and may occur by evaporation of the solvent, by chemical reaction (Oxidation or Polymerization) or by combination of the two processes

(Eboatu et al., 1992). A flame retardant (F.R.) can be defined as a compound or mixture of compounds which when added to a polymer, as colccu cellulose, substantially depresses the ease of ignition and/or flame proportion (Garba and Eboatu, 1990).

Qualities of Ideal Flame Retardant

These include the following:

1. Good penetrating power,
2. Substantial stability
3. Positive in action
4. Readily available
5. Not dangerous to the user
6. Colourless
7. Relatively Cheap
8. Odourless

Mechanism of Flame Retardency

The heat of balance at the surface of the burning polymer is of importance as far as the understanding of the role of various flame formulations in use are concerned.

Basically, surfaces of the polymer receive heat from the following sources:

i. An external source (Qe) and
ii. Re-directed heat from the burning mass (Qd)

Likewise, there are two ways through which heat is released, and these are:

i. Classification of the polymer (Qg) and

ii. By the other usual methods of conduction, convention and radiation (Qf).

Qe + Qd must be greater than Qg + Qf in a self-sustained combustion, but when a fire retardant is added, this relationship is reversed. This reversing of the above relationship brought about interfering with combustion at one stage or the other.

Means of Imparting Fire Resistance

In general, all naturally occurring polymers or those produced from them like timbers, textiles, papers etc., can be imparted well and easily with fire retardants by the commonest paddry approach. A solution of slurry of the flame retardant finishing is made and padded or sprayed on to the materials. This is dried, followed by a short time cure at the appropriate temperature in some cases the materials are immersed in a solution of the dope, during which it absorbs the mixture. In the same way, Eboatu (1992) reported reduction in flammability (increased the ignition time) of a local thatch *Andropogon gayyamus* (known-locally as Gamba); whereas the untreated and fertilizer treated materials respectively. It was reported (Garba et al, 1998) that there was reduction in the flammability of four Nigerian timbers when soaked in alum solution for 24 hours. The timbers were: *Chloronphora exesa, Nucea duderichili, Nucea Ceiba, and termmalia superba* locally known as Iroko, Opepe, Ceiba and Afara. Flame retardants area also classified in relation to their durability of fastness to laudry, height, heat chemicals etc. Durability or fastness of fire retardant depends on whether they react chemical or simply from cellular mixture with the materials. On this basis the following is the classification:

i. Non-durable/finishes

ii. Semi-durable finishes

iii. Durable finishes

Experimental

Material: The timber splints were obtained from Sokoto timber market popularly called Kara market. It was found to have moisture content of 30%

Method: All weighted reagents were added into constant gram of while enamel paint brushed on the timber splints using the same method, two timber splints were treated with untreated enamel paints as controls. All were dried in an even at 1030C for 15 minutes. The timber splints were painted up to about two third of their lengths. Some two untreated solutions were used as reference. Add-on (90)% of each sample was calculated using the expression.

Add-on (5) = W2 - Wi x 100

~W

Where: W1 = weight before treatment

W2 = weight after treatment

ii. After glow time: Timed as duration between flameout and visually perceptible glow, and recorded in seconds.

iii. Flame velocity for flame propagation rate: The sample was clamped vertically, ignited with a cigarette lighter and allowed to burn for 60 seconds, after which the flame was set out and the distance traversed by, the char-front was measured. Flame velocity was then calculated as distance covered by the flame (as measured over 60s, the number of seconds allowed for burning, thus flame velocity is recorded in cm/s.

iv. Callulose burnt (%) this was calculated by sing the expression.

Cellulose Burnt (%) = $W4 - W_5$ x 100

Wi

Where: W4 = weight of the treated sample being burnt in grams

W_5 = weight of paint dope applied on the sample in grams

v. Length of the timber being completely burnt. This is the distance covered from the tip of the sample exposed to flame for given time - 60 seconds

vi. Flame velocity change (%): this is calculated by using the

expression FVD (%) = Rvu - FVt x 100

FVu

Where:

FVD (%) = Flame velocity change percent

Fvu (Cm/s) = Flame velocity of the untreated sample

FVt (Cm/s) = Flame velocity of the treated sample

Result and Discussion

Result: The result is summarized in table shown below:

S/NO	Conc. Of Boric Acid (g/dm3)	0.0	12.5	25.0	50.0	75.0
1	Add-ib (%)	1.9	3.0	4.0	5.2	5.6
2	After Glow Time (sec)	3	4	5	7	10
3	Flame Velocity (cm/s)	0.12	0.045	0.031	0.018	0.014
4	Flame Velocity change (%)	0	62.5	74.17	85.0	88.33
5	Cellulose Burnt (%)	35.0	32.0	28.0	23.0	18.0
6	Length of Timer Burnt (cm)	3.28	1.5	1.1	0.6	0.1

Discussion

Add-on % as could be seen from the given table and accompanied graph increases with increase in concentration of the fire retardant (Boric acid). In the same vein, after glow time is shown to be directly proportional to the concentration of the retardant. Flame velocity, as inclicated by this finding increases with an increase in the concentration of this fire retardant likewise its change (flame velocity change %). Both the cellulose burnt (%) and length of the painted timber burnt were found to decrease with increase in the concentration of the fire retardant on analysis i.e. Boric acid.

Conclusion

From the experimental data arrived at after the course of this project, it can be concluded that Boric acid is a good flame retardant in paints. Therefore, Boric acid could be advocated as an additive in paints in our effort to protect both life and properties from very serious challenges of fire out breaks in our homes, offices, institutions and their likes.

Recommendations

The paper recommends as follows:

1. More research work in the area of Flame Retardants Substances so that deep

Knowledge could be driven and used for protection of both human and material resources against fire damages

2. The use of Boric Acid as an additive in the paint Industries.

3. Government provides enable law compelling Paint Manufacturers to use Flame Retardants, such as Boric acid, as Additives in their production.Governments, Non-Governmental Organisations and Professional bodies such as Chemical Society of Nigeria (CSN), Institute of Chartered Chemists of Nigeria (ICCON), Standard Organisation of Nigeria (SON) and so on should rise up to enlightened all people on this new scientific development and its benefits.

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