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Overview On Fire Retardant Of Jute Fibers And Its Mechanical Behaviour Using Boric Acid

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Abstract

Reinforcement usually comes in the shape of particles or fibers. The study physical characteristics of jute fibre are distinctive, including its strong toughness, bulkiness, poor thermal conductivity, capacity to insulate sound and heat, and antistatic properties etc. Due to these characteristics, jute fiber is more appropriate for use in the creation for composite materials in certain particular circumstances. Properties of the flame retardant of jute fibers were examined. In order to create the experimental panels, boric acid (BA), which was combined with jute fibres, was assessed as a flame retardant chemical. In order to create the experimental panels, four fire retardant concentrations (0, 1, 2, and 3%) and 20% jute fibre were combined with resin. Tensile testing and impact testing were done mechanically. Tensile and impact strength were shown to decrease when Boric acid was added to epoxy resins, while the amount of flame retardant increased. The fire retardant was improved more than with lesser concentrations of Boric acid.

Fillers are often referred to as extenders. Boric acid is used to stop flammable gasses from escaping while burning products made of plastic, such as paper goods, cotton, and wood.

Keywords- *Jute fibre, Tenacity, Boric acid (BA), Flame Retardancy.*

Introduction

The term "composite" refers to mixtures of two materials, one of which is referred to as the reinforcing phase and is embedded in the other material, which is referred to as the matrix phase. The goal is to maximize the advantages of both materials' exceptional qualities without sacrificing each one's shortcomings. The size, shape, volume proportion of the reinforcement, and response at the interface matrix material all affect the mechanical characteristics of composite. Separate components among the composites retain their properties while being integrated into the material in a way that only benefits from their positive qualities and not from their negative ones, making them compound materials that differ from alloys. Composite materials can be divided into two categories: matrix and reinforcement. [1] The reinforcement materials are held in place relative to one another by the matrix material, which also surrounds and supports them. The reinforcements provide the matrix their unique mechanical and physical characteristics. Reinforcement usually comes in the form of particles or fibers. In India is second in jute production and known as golden fibre of India. The[1] physical characteristics of jute fibre are distinctive, including its strong toughness, bulkiness, poor thermal conductivity, capacity to insulate sound and heat,

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and antistatic properties etc. [2, 4]. These characteristics make jute fibre more suitable for some specialized applications, such as the production of composite materials. From the Indian Jute Research Center, jute fibre is bought. The tensile strength will be greatly increased with the use of jute fibre. Extenders are a common term used to describe fillers. When exposed to boric acid, burning polymeric materials such as cotton, wood, and paper-based products does not release combustible vapours. [3]
Boric acid suppresses smoldering, glowing, and smoke in addition to increasing char formation and inhibiting flame combustion in a variety of methods. Unalkaline borates like boric acid react to extinguish smoldering fires as well as prevent them from starting. However, because of its boron content, boric acid causes char to form on the cellulose's surface while simultaneously releasing water to aid in putting out the fire. A flame was used to start each sample, which burned its way down into the unheated substance. The lowest oxygen concentrations needed to sustain combustion for each sample were then calculated as a percentage [8]. It is well acknowledged that the physical mechanism of boric acid's fire retardant effect is achieved by the creation of a protective layer or coating on the surface at high temperatures.

Methodology of composite preparation

Based on that selecting Constituents of a Composite Material as Matrix is the material which surrounds the reinforcement. Epoxy resin is a thermoset Plastic. Epoxy resins fall under the category of thermoset polymers and are characteristics when manufacturing pressure requirements, small cure shrinkage, and minimum residual stresses. When the appropriate curing agent is chosen, they can be utilized in a broad temperature range to modify the degree of cross-links. Epoxy resins are sold in the market as powders (solids) and as low-viscosity liquids. **[5**] Reinforcement usually comes in the form of particles or fibers. In India is second in jute production and known as golden fibre of India. Jute fibre has some distinct physical characteristics like strong toughness, bulkiness, poor thermal conductivity, capacity to insulate sound and heat, and antistatic qualities etc. Jute fiber is better suitable for the creation of composites in some particular sectors because of these characteristics. Jute Fibre is purchased from Jute Research Centre, India. Addition of jute fibre will increase the tensile strength significant. Fillers are often referred to as extenders. Burning polymeric materials like cotton, wood, and items based on paper prevents the release of combustible gasses, which is inhibited by boric acid. [6, 8]
Boric acid catalyses the dehydration and other oxygen-eliminating reactions of composite at a relatively low temperature. Dehydration catalysis causes the water to break down at a faster rate, causing a faster decrease in temperature.

- Assemble the mould and evenly spray Silicon mold releasing agent.
- Pour the Epoxy mix into the mould and let it uniform, and add filler into it.
- Then add fibers to the mixture and mix it completely.
- Place the top plate on the mould and apply 80 pressure.
- Then allow it to set at room temperature for 5 hours.

Fig.1 Sample (80 Epoxy resin-20 jute fiber-0 Boric acid)

Fig.2 Sample (79 Epoxy resin-20 jute fiber-1 Boric acid)

Fig.3 Sample (78 Epoxy resin- 20 jute fiber- 2 Boric acid)

Fig.4 Sample (77 Epoxy resin- 20 jute fiber- 3 Boric acid)

Result and Discussion

1. Tensile Test

Numerous things used on a day to day contain resin elements. Due to their strength and low weight, plastics have just begun to be employed as structural elements in transportation apparatus like cars and aeroplanes. Understanding these plastics' mechanical strength characteristics is crucial for various applications. The ASTM D638 standard specifies procedures for finding the mechanical characteristics of resin-based products such as plastics, as well as precision standards for the test frames and accessories utilized. Comparable standards from JIS and ISO, JIS K 7161and ISO 527, and ASTM D638 differ differently from each. For more details regarding JIS K 7161 and ISO 527 [11]. It is observed from graph in Fig. 5 that when the tensile strength increases with increasing the percentage of Boric acid with respect to jute and epoxy resins.

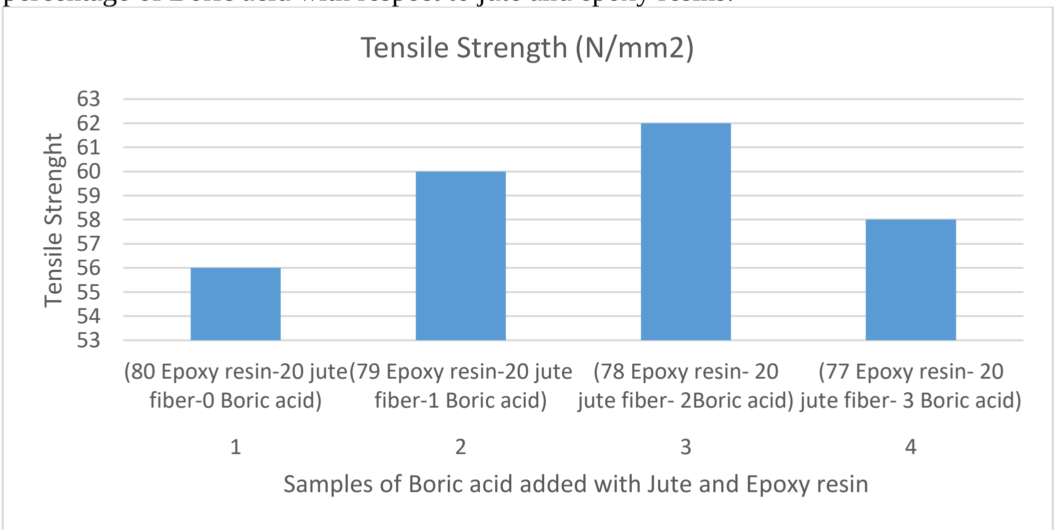


Fig. 5 Result of Boric acid tensile test analysis

2. Impact Test

Impact testing equipment is frequently used to assess an object's ability to sustain high-rate loading and to estimate a material's or part's service life. Impact resistance is one of the hardest characteristics to quantify. There are two standard kinds of impact test, Charpy and IZOD. A material's toughness is examined by impact testing. Toughness is determined by a substance's ability to absorb energy through plastic deformation. [16, 20] Brittle materials are poor toughness because they can only tolerate a specific amount of plastic deformation. The impact value of a substance can also be influenced by temperature. In general, a material's impact energy decreases at very low temperatures. The size of the specimen may also affect the outcomes of the Izod impact test since a larger specimen might have more material imperfections that could act as stress risers and lower impact energy It is observed from graph in Fig.6 that using the increasing percentages of boric acid with respect to jute and epoxy resins increases there impact test result as shown in Izard test result analysis.

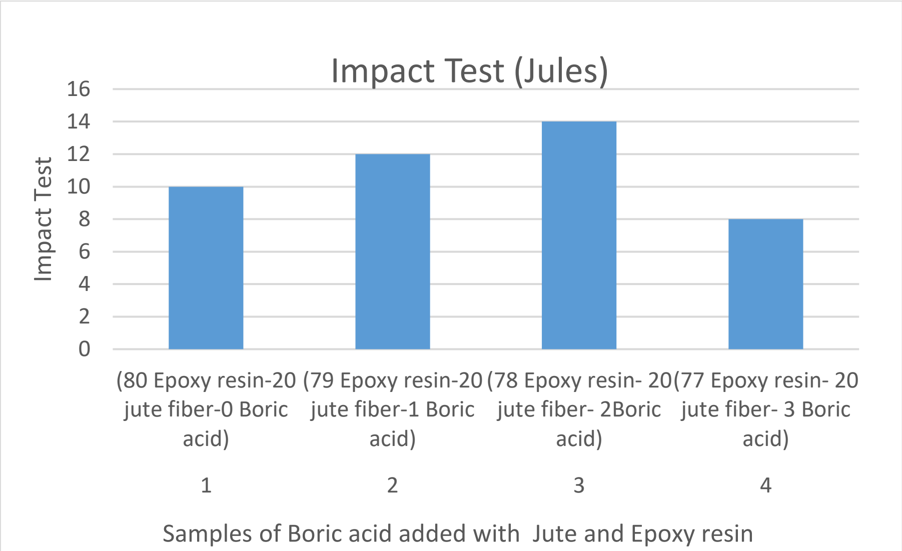


Fig. 6 Results Boric acid Izod test analysis

3. Flame retardance Test

The main purpose of oxygen index reduction tests is to ascertain a material's combustibility. This test finds the minimal amount of atmospheric oxygen required to sustain material combustion at a marginal level. To do this, the sample is loaded with a mixture of nitrogen and oxygen and placed within a room with a combustion wand attached to it. By reducing the oxygen content within the testing facility until the flaming ceases, the critical oxygen level is determined. [27] Less flammable samples are those with a greater critical oxygen proportion. In terms of biodegradable composite materials, fire retardance test requirements specified in UL-94 must be adhered to. Conducting the Burning test of composite materials it is called flammability test. We using the standard flow that is UL94, (Underwriters Laboratories test standard UL 94) there are two types of test 1.Vertical burning test and 2. Horizontal burning test in that we check the rating V-0, V-1, V-2 in which way that burns and which is characteristics.

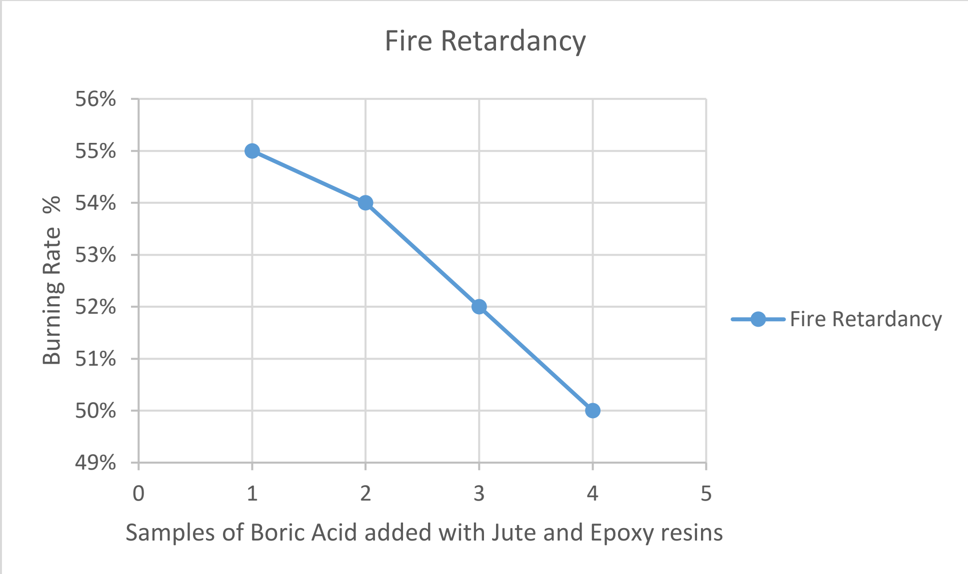
The following goes into further detail on the naming conventions used for the material classes. According to the official testing process paper, "material classified as 5VA or 5VB is subjected to a flame ignition source that is approximately five times more severe than that used in the V-0, V-1, V-2, and HB tests." VB needs to be preconditioned at 70°C for 168 hours.

Table 3: Flame retardance test

Category	Stated	Definition	Drops of particles permitted	Particle drops allowed		holes in plaques
				Flame	Non-flame	
HB	Horizontal	burning slow	rate of burning < 87 mm/min or burning stops before 100 mm for thickness <4 mm			
V-2	Vertical	burning stops	30 sec	Yes	Yes	
V-1	Vertical	burning stops	30 sec	No	Yes	
V-0	Vertical	burning stops	10 sec	No	Yes	
5VB	Vertical	burning stops	60 sec	No	No	Yes
5VA	Vertical	burning stops	60 sec	No	No	No

1. Burning test- Vertical
UL 94 V-0, V-1 & V-2
Flame High=20 mm
Flame application time=10 Sec
These Test measure self-extinguishing time of the vertical oriented polymer specimen.
2. Horizontal burning test
Specimen clamp horizontally, the flame will be given to 45 degree through burner. Marks the specimen to check the burner rating. (1inch, 3 inch, 1 inch)
UL94 HB Rating
Flame Preconditioning at 168 Hours at 70°C.
Flame High=20 mm
Flame using time=30 Sec
Whenever slightly increases the percentage of Boric acid, burning rate is decreases as up to 50 percentage.

Table 4: Boric acid fire retardant analysis results



Conclusion

This paper examines Properties of the flame retardant of jute fibers were examined. Boric acid (BA) was one of the flame-retardant substances that was assessed; it was combined with jute fibers to create experimental panels. Experimental panels were made using 20% jute fiber with resin based on oven dry fiber weight and four concentration levels of fire retardants (0, 1, 2, and 3%). Mechanical testing of Tensile test, impact test were examined. The results of the study showed that as the flame retardant was added to epoxy resins, the tensile and impact strengths decreased. The fire retardant was improved more by the highest concentration of BA than by the lowest.

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